GREEN CLOUD FRAMEWORK FOR ENERGY EFFICIENCY USING ROUND ROBIN SCHEDULING AND PRIORITY SCHEDULING

Isha Chaudhry*, Pawan Luthra and Bindu Bala****

*Shaheed Bhagat Singh State Technical Campus, Ferozepur, India
****** Department of Computer Science and Engineering, Shaheed Bhagat Singh State Technical Campus, Ferozepur, India
***Department of Computer Science and Engineering, Shaheed Bhagat Singh State Technical Campus, Ferozepur, India

ABSTRACT: Lowering the energy usage of datacenters is a challenging and complex issue because computing applications and data are growing so quickly that increasingly larger servers and disks are needed to process them fast enough within the required time period. It is essential for ensuring that the future growth of Cloud computing is sustainable. Otherwise, Cloud computing with increasingly pervasive front-end client devices interacting with back-end data centers will cause an enormous escalation of energy usage. To address this problem, data centre resources need to be managed in an energy-efficient manner to drive Green Cloud Computing. The Green Cloud Computing has been proposed in this work using two scheduling algorithms i.e. Round robin scheduling and Priority based Scheduling. The results evaluation will be done on the basis of total energy consumed during running of tasks and on energy consumed by low priority jobs and high priority jobs.

KEYWORDS: Cloud Computing, Energy Consumption, Round robin Scheduling, Priority Scheduling, Green Cloud.

INTRODUCTION

Recently, the emerging cloud computing offers new computing models where resources such as online applications, computing power, storage and network infrastructure can be shared as services through the internet [5]. The popular utility computing model adopted by most cloud computing providers (e.g., Amazon EC2, Rack space) is inspiring features for customers whose demand on virtual resources vary with time. Energy consumption is the key concern in content distribution system and most distributed systems. These demands an accumulation of networked computing resources from one or multiple providers on data centers extending over the world. This consumption is censorious design parameter in modern data center and cloud computing systems. The power and energy consumed by the computer equipment and the connected cooling system is a major constituent of these energy cost and high carbon emission. The energy consumption of data centers worldwide is estimated at 26GW corresponding to about 1.4% of worldwide electrical energy consumption with a growth rate of 12% per year [6] [7]. The Barcelona medium-size Supercomputing Center (a data center) pays an annual bill of about £1 million only for its energy consumption of 1.2 MV [9], which is equivalent to the power of 1, 200 houses [10].
However, minimizing this energy consumption can result to conceal cost reduction. Moreover, apart the enormous energy cost, heat released increases with higher power consumption increases the probability of hardware system failures [11]. Therefore, minimizing the energy consumption has a momentous outcome on the total productivity, reliability and availability of the system. Subsequently, minimizing this energy utilization does not just decrease the gigantic cost and enhances framework unwavering quality, additionally helps in ensuring our regular habitat. In this way, diminishing the energy utilization of distributed computing framework and server centers is a test on the grounds that information and registering application are developing in a quick express that undeniably circles and bigger servers are obliged to process them quick inside of the obliged time of time.

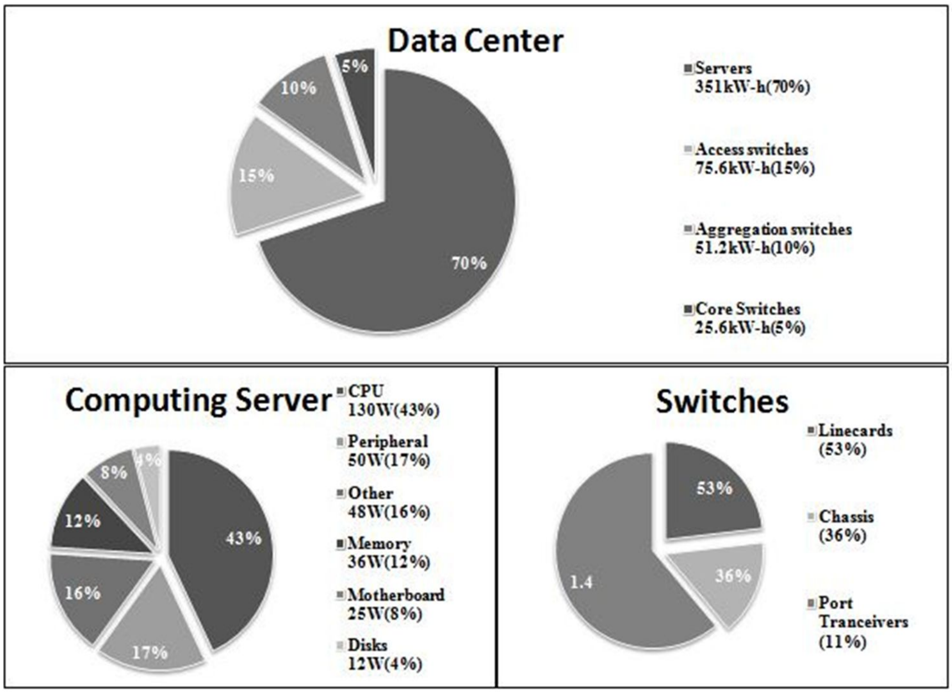

Figure.1 Distribution of Energy Consumption in a Data Center

To deal with this problem and certifying the future growth of cloud computing and data centers is maintainable in an energy-efficient manner, particularly with cloud resources to satisfy Quality of Service (QoS) requirement specified by users via Service Level Agreements (SLAs), thus reducing energy consumption is necessary. The main objective of this work is to present a new energy consumption models that gives detailed description on energy consumption in virtualized data centers so that cloud computing can be more environmental friendly and sustainable technology to drive scientific, commercial and technological advancements for the future.

ENERGY CONSUMPTION PROBLEM

The issue of energy utilization in IT sector has been accepting expanding consideration lately and there is developing acknowledgment of the need to oversee energy utilization over the whole information and communications technology (ICT) sector. In the last propel of years, Cloud based server centers are expanding incredibly due to the interest for PC asset. Since more server centers are started to be the energy utilization of these server centers are likewise expanded as it were. Notwithstanding high energy utilization there is an expansion effect on nature by the type of carbon-dioxide discharges. As indicated by the report of Congress on Server and server centers [9], the server centers are in charge of around 2% of worldwide CO2 outflow and they utilize almost 80 million megawatt-hours of energy yearly, it is around 1.5 times the measure of power utilized by the entire New York City.

By 2020 the aggregate sum of Carbon-dioxide discharged by these server centers will be about 359 megatons. In such a circumstance it is significant significance that the cloud server centers ought to have decent energy productivity. The Major issue in poor energy productivity is that a large portion of the energy is squandered when servers keep running at low usage.

As per the late research from Pike Research [10], the worldwide business for green server centers will develop from $17.1 billion in 2012 to $45.4 billion by 2016. Indeed on location server with no virtualization will emanate session 46 kg of CO2 every year.

RELATED WORK

A Solar powered Cloud Computing Data Centres [13]: The algorithm used gave a new challenge in the field of cloud computing, data centers consumes a large amount of energy and this is not necessary that the energy is all time available so solar energy is used so that the energy requirements can be fulfilled.

B Green Information Technology [20]: In this algorithm, green scheduling algorithm combines with neural network predictor for reducing the energy consumption in cloud computing. In this the server predicts the load from time t to the time taken to restart and calculate the peak load.

C Green Grid Metrics [4]: The green grid proposed The Green Grid proposed the use of Power Usage Effectiveness (PUE) and its reciprocal, Data Centre Efficiency (DCE) metrics, which enable data centre operators to quickly estimate the energy efficiency of their data centres, compare the results against other data centres, and determine if any energy efficiency improvements need to be made.

D Energy and Power Consumption Models For Greener Cloud [18]: The study gave a cloud computing metrics to make the cloud green in terms of energy efficiency, different energy models have been discussed to reduce power consumption and CO2 emission to make cloud green taking into consideration factors like- Virtualization, Work Load Distribution and Software Automation.

E Energy Efficient Allocation of Virtual Machines in Cloud Data Centers [2]: Contributes carbon green cloud architecture which points on the third party concept, consist of two types of directories named as green offer and carbon emission. These directories help to provide and utilize the Green services from users and providers both. Green brokers access the services from green offers directory and scheduled services according to least CO2 emission.
F Packet Level Simulator of Energy Aware Cloud Computing [17]: In this paper author has focused on the work load distribution among the data centres so that energy consumption can be calculated in terms of packet level. By this technique packet level communication is achieved.

G Green Cloud Computing and Environment Sustainability [8]: The demand of cloud is drastically increasing now a day and the consumption of energy and excretion of harmful gases is also extreme which is very harmful and a big issue in the field of health care and also a big reason of the increase in cost of operations in cloud. This gave a presentable and evidential description of different members of cloud which participate in the total energy consumption.

H Research on Greening Data Centres [3]: This overview the green metrics that are applicable to data centres. The technique focus on computing and networking proposals for green data centres, even though we briefly describe some other green research related to data centres such as cloud computing, cooling.

I Energy-Aware Layer in Software Architecture [1]: The technique proposes an energy aware layer in software – architecture that calculates the energy consumption in data centres and provides services to the users which uses energy efficiently.

J Total Energy Management System for Cloud Computing [19]: focus on reducing the usage of energy in data centres. But for the future energy management, the system develops an energy management system for cloud by the use of sensor management function with an optimized VM allocation tool. The system will help to reduce the energy consumption in multiple data centres and results shows that it will save 30% of energy. The system also used to reduce the energy in carbon emissions.

ENERGY AWARE GREEN CLOUD ARCHITECTURE

The structure of the cloud was created such that the greener cloud computing may be achieved. The number of jobs and servers are supplied by the user. The jobs are distributed on the cornerstone of goal but the assignment of the goal isn't visible to the user whilst the priorities are given at the back-end of the process and the goal is given on the cornerstone of normal RAM consumed by the jobs. The jobs with low and high priority are performed concurrently based on the normal time quantum given to each job. The jobs implement for the full time quantum given to it and if the job isn't totally performed in the period it stands in the queue for the next occasion quantum which will be the sum up of the left time slots following one complete period of the performance of the jobs.
Set of tasks and servers are taken as input. The scheduling of tasks to the servers and the data center server energy consumption is given as output of the algorithm. The users will request for computing various types of tasks. Each task may fall under a particular task type like reading file contents, updating data, uploading files, downloading software, etc. [6, 8]. Based on the type of task selected, the processing time vary. The number of instruction in each task is obtained. Energy slope is calculated for each task of different types in each server with the help of processing time. Energy consumption is calculated by using the number of instructions and the energy slope. Task allocation is done in such a way that most-efficient-server gets the tasks first. Number of active servers among the set of available servers is reduced. The algorithm follows a priority and round robin scheduling [7, 9 and 10].

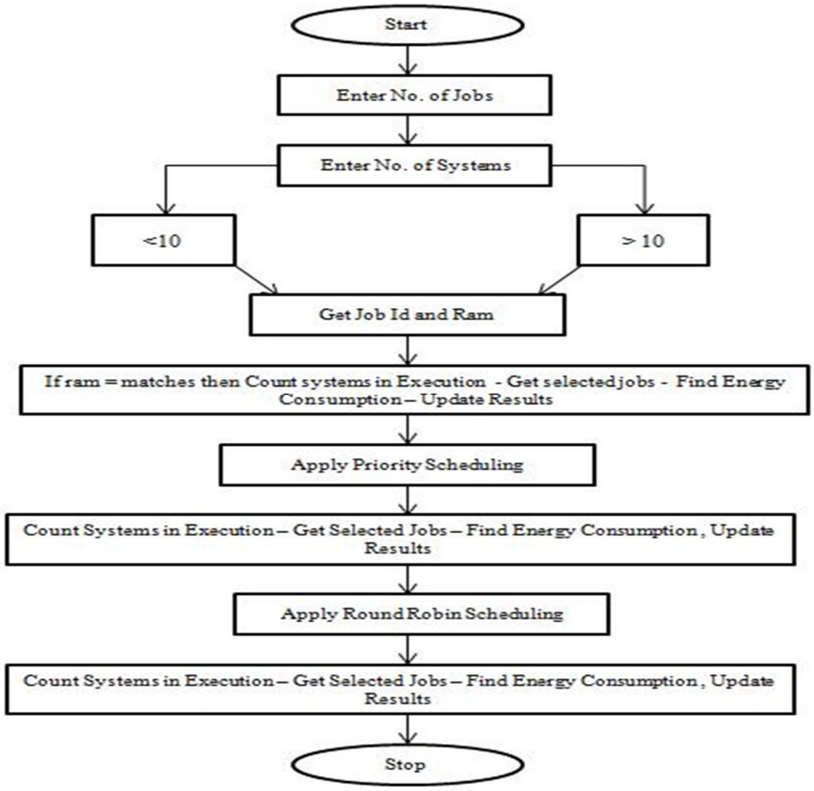

Figure.2 Proposed Flowchart

The flow diagram suggests that there could be multiple READY QUEUE which could be taken into consideration depending upon the jobs since the variation of jobs has either I/O operation taking the CPU BURST or CPU time taking the time duration of the CPU Processing. This way, if efficiency has to be maintained such that I/O Operations are given the highest priority, the multiple READY QUEUE would have (for an example) 1 READY QUEUE divided into 3 READY QUEUE, they could be:

1. Q1
2. Q2
3. Q3

Here are the Jobs which would be as per the priority of execution.

1. Q1 – Handles the I/O Bound Jobs which require more I/O CPU BURST time duration.
2. Q2 – Handles the moderate CPU Requirement time duration.
3. Q3 – Handles the CPU Bound Jobs which require more CPU time duration.

Now the executions of such jobs are in the format as below:

1. Q1**-** any jobs which are here must be executed at first preference.
2. Q2 – only after Q1 is empty, the jobs in Q2 are taken. That is all I/O Bound jobs have to be completed first.
3. Q3 – only after both Q1 and Q2 are empty, the jobs pending on Low priority that is CPU Bound jobs are taken.

PSEUDO CODE

Start
Initialize Login Page {Either Admin, User}
Match Password and Id Found out
{If id= TRUE, Proceed
Otherwise stop}

Go for Signup
If id = admin (do changes)
If id= user (do changes< then admin)
{Apply Round Robin Scheduling on tasks;
{Int count = 0, taskram=0, taskprocesor=0, systemram=0, systemprocessor=0, timeexe=0;
Count systems in execution
Fill checkbox list with task name that is primary key in data base
Get systems count
Fill check box list
Get selected jobs
For sorting all the values of time
In timetoexe = Convert.ToInt32 (TextBox1.Text);
If (timemng <= timetoexe)
Task independent
Rest jobs in execution suppose system 3 jobs 5.
Find, Energy Consumed During Execution (Cross Breed)
Update results set energy consumption}
Apply Priority Scheduling on Tasks
{Int count = 0, taskram = 0, taskprocesor = 0, systemram = 0, systemprocessor = 0, timeexe = 0;
Count systems in execution
Fill checkbox list with task name that is primary key in data base
Get systems count
Fill check box list
Get selected jobs
For sorting all the values of time
Energy Consumed During Execution

RESULTS AND CONCLUSION

If above criteria has been achieved then only mapping will be done.

Total Completed Jobs: 85.13
Completion Percentage: 77.39
Low Priority Jobs Energy Consumed: 305.47
High Priority Jobs Energy Consumed: 302.59
Total Energy Consumed: 608.07

Energy consumption does not only reduce the huge cost and improves system reliability, but also helps in protecting our natural environment. Thus, reducing the energy consumption of cloud computing system and data centre is a challenge. Above figure shows the energy consumption by priority algorithm.

Similarly for second time the achieved values have been shown below:

Total Completed Jobs: 85.19
Completion Percentage: 70.99
Low Priority Jobs Energy Consumed: 316.59
High Priority Jobs Energy Consumed: 342.89
Total Energy Consumed: 659.49

Table.1 Comparison of Various Jobs

No. Of Jobs	Total Simulation Time	Total Jobs Completed	Low Priority Job Energy	High Priority Job Energy	Total Energy
100	1000	72.97	262.73	283.41	546.19
110	1000	103.91	335.67	382.51	718.32
120	1000	113.99	415.22	351	766
130	1000	124	412	413	825

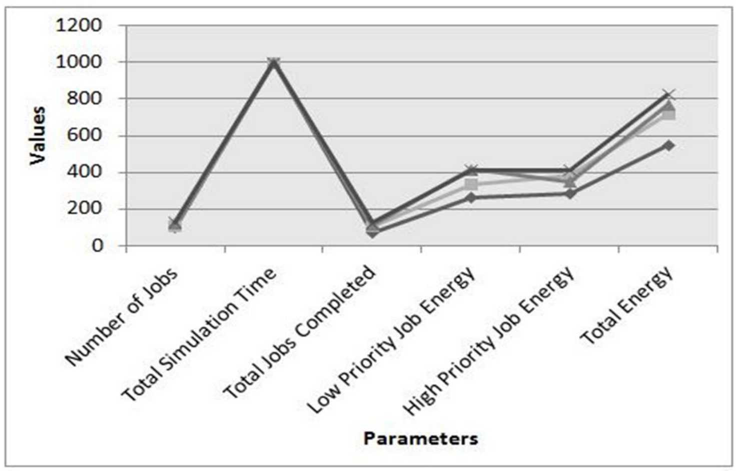

Figure. 3. Comparison Graph

Above figure shows the comparison graph between various jobs ranging from 110 to 130 having different values for each parameters i.e. no. of jobs, Total simulation time, low priority energy, high priority energy values and total energy.

CONCLUSION AND FUTURE SCOPE

An effective and efficient use of computing resources in cloud can help in achieving Green Cloud Computing. The related research proposals are mostly focused on energy-saving approaches for data centers. However, due to increasing demand on bandwidth and network connectivity of data centre, energy consumption of data centre network and data centre servers and network will rapidly grow in the future. This paper presents Round Robin Scheduling and Priority Scheduling Algorithm used for energy saving in data centers.

Future work will entail a lot of data and software on a cloud environment. As a central server, resource allocation to its clients will be one of the major things resource providers need to think about. We believe using our algorithm on a large scale optimizes resource allocation to an extent not many general algorithms can provide without suffering huge calculation costs. Additionally, certain performance checking criteria can be added to the original set up to demonstrate an algorithm which can easily outperform the FCFS algorithm in all respects.

REFERENCES

[1] Bei.R.; 2012; *Green Cloud Computing: An Energy-Aware Layer in Software Architecture;* IEEE, pp.1-4, 2012.
[2] Beloglazov A. and Buyya, R. (Eds.); 2010; *Energy Efficient Allocation of Virtual Machines in Cloud Data Centers;* Proceedings of the 10th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid).
[3] Cavdar D. and Alagoz F., (Eds.); 2012; *A Survey of Research on Greening Data Centers*; Proceedings of the IEEE Global Communications Conference (GLOBECOM).
[4] Christian et.al; 2007; *Green Grid Metrics—Describing Data Centers Power Efficiency*; Technical Committee White Paper by the Green Grid Industry Consortium.
[5] Epstein M. and Roy M; 2001; *Sustainability in Action: Identifying and measuring the key performance drivers*; Long Range Planning Journal, **34**; 585-604.

[6] Erek K.; 2011; *From Green IT to Sustainable Information Systems Management: Managing and Measuring Sustainability in IT Organisations*; Proc. European, Mediterranean & Middle Eastern Conference on Information Systems; pp. 766-781.

[7] Govindasami A. and Joseph S.; 2012; *Optimization of Operating Systems towards Green Computing;* International Journal of Combinatorial Optimization Problems and Informatics; **2**; **3**; 39-51.

[8] Garg S. K. and Buyya R.; 2012; *Green Cloud computing and Environmental Sustainability;* Wiley-IEEE Press Ebook ; Edition 1; no. 3; pp. 76-87.

[9] Hageluken C. and Art S.; 2006; *Recycling of e-scrap in a global environment: opportunities and challenges*; chap. *Tackling E-waste towards efficient management techniques*, TERI Press, pp. 87-104.

[10] Hanne F.; 2011; *GREEN IT- Why Developing Countries Should Care? ;* International Journal of Computer Science Issues; **8**; Issue-4; 424-427.

[11] Harmon R. and Auseklis N.; 2009; *Sustainable IT Services: Assessing the Impact of Green Computing Practices;* Proc. PICMET Conference; pp. 1707-1717.

[12] Hedman J. and Henningsson S.; 2011; *Three Strategies for Green IT*, IEEE’s IT Pro. ; pp. 54-57.

[13] Hodge P.; 2011; *Virtualization 101: Understand how to do more with less*; INTECH; Vol-58(4); pp. 28-30.

[14] Hosman L. and Baikie B.; 2013; *Solar-Powered Cloud computing data center*; International Journal of Computer Science Issues; **2**; **15**.

[15] Jadhwani D. et al.; 2012; *Study of Efficient Utilization of Power using green Computing*; International Journal of Advanced Computer Research; **2**; **4**; Issue-6; 108-113.

[16] Jain R. and Agrawal K.; 2012; *A Study Of Green Computing Awareness Among Bank Employees*; Asian Journal of Research Marketing; **1**; Issue-1; 11-18.

[17] Kliazovich, D. and Bouvry, P.; 2010; *Green Cloud: A Packet-level Simulator of Energy-aware Cloud Computing Data Centers*”, Proceeding of the IEEE Global Telecommunications Conference (GLOBECOM).

[18] Priya B., Pilli E. S. and Joshi R. C.; 2013; *A Survey on Energy and Power Consumption Models for Greener Cloud;* Proceeding of the IEEE 3rd International Advance Computing Conference (IACC).

[19] Satoh F., Yanagisawa H., Takahashi H.; and Kushida T.; 2013; *Total Energy Management system for Cloud Computing;* Proceedings of the IEEE International Conference of the Cloud Engineering (IC2E).

[20] Sinha M.; 2011; *Green Information Technology: A Strategy To Become Socially Responsible Software Organisation;* International Journal of Enterprise Computing & Business Systems; 1; 2.