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Reducing Energy Consumption in Cloud Computing Data Centres With Green Algorithms

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Abstract

Cloud Computing is the Technology which is rapidly been used nowadays. This Technology is used for Hosting and Delivering Services over Internet. Use of Cloud Computing Minimizes the Efforts of Management in many fields. Increase in Use of Cloud Computing may results in some serious issues like Energy Consumption, power shortage. As per the growth in use the need of more servers is also increasing which causes more consumption of energy. Cloud Computing technology has data centres which runs with numerous hosts results in High Energy consumption. To Redice the Energy Consumption we are using Green Algorithm. It is an Eco-friendly way to use Computers and its resources. The Main aim is to study various techniques which are energy efficient to achieve Green Cloud Computing.

Keywords: *Cloud Computing, Data Centres, Energy Consumption, Energy Efficiency Control, Green Cloud Computing.*

INTRODUCTION

Cloud Computing is recently developing pattern in distributed computing networks. The invention of cloud computing can be seen as a growth in grid computing technologies. The term Cloud computing was given by Google's CEO Eric Schmidt in 2006.The concept of cloud computing is very simple that we can connect to the computers that resides in cloud and use them as when we need. In Cloud Computing dynamically scalable and virtualized

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resources are been given as service over Internet. The concept incorporates Infrastructure as a service (IaaS), Platform as a Service (Paas) and Software as a Service(SaaS) on Internet to fulfill the needs of Users.

Cloud is made available by large distributed data centres. Data centres are eventually organized in the manner of grids and cloud is present at the top of grid. Cloud users are made available with virtual images of machines in the cloud data centers. Virtualization is the key concept of cloud computing as it builds the abstraction over the physical system. The term cloud is important to Internet, based on how the internet is described in computer networks.

Green algorithm is the eco-friendly use of computers and other resources. It include the implementation of energy-efficient CPU's, servers as well as reduced resource consumption and proper disposal of electronic waste. Green algorithm is a study of designing , manufacturing, using, and disposing of servers and computers and associated subsystems—such as monitors, printers, storage devices, and networking systems—efficiently and effectively minimizing or no adverse effect on the environment."

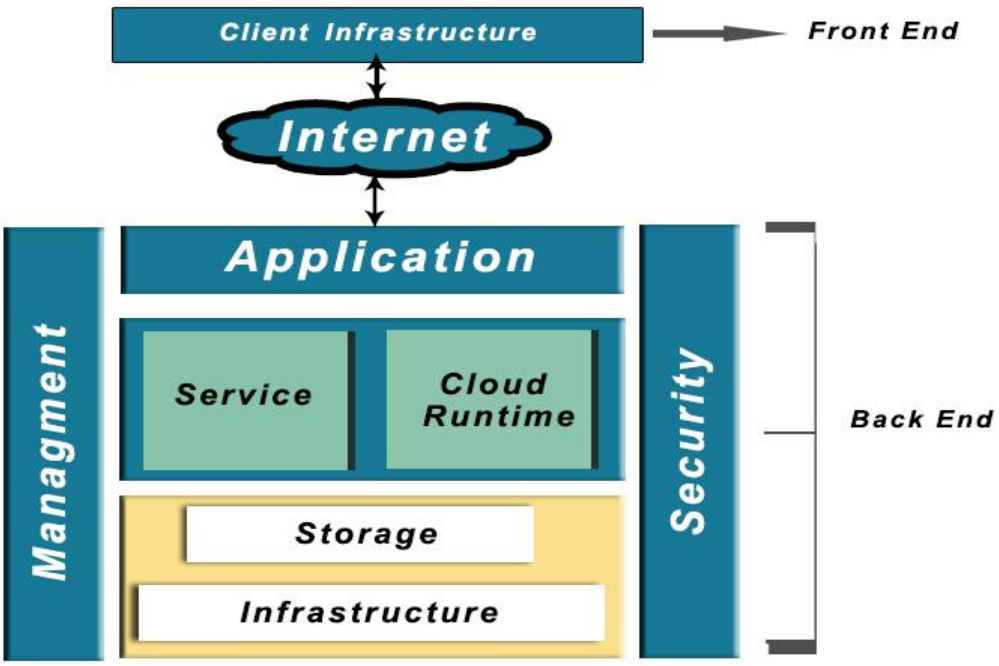


Figure 1: Cloud Computing Architecture

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The further sections of the paper are structured as — State of the Art, which puts forth the work related to Green Algorithm use in data centres; Future scope of the concept, which highlights the key aspects of development; then Conclusion, Acknowledgment and finally References.

STATE OF THE ART

A. Green Cloud Computing Framework

Green Cloud Computing in a simple way describes a facet of computing that is interested in reducing number of physical machines for performing computational tasks and improving energy efficiency.

Green cloud computing is nothing; it just reduces the number of servers for performing multiple tasks than already used. The green system architecture worked for energy consumption. **Figure 3** shows the green cloud computing high level architecture with three layers- Application Layer, Resource Management Layer and Data center Layer described as follows

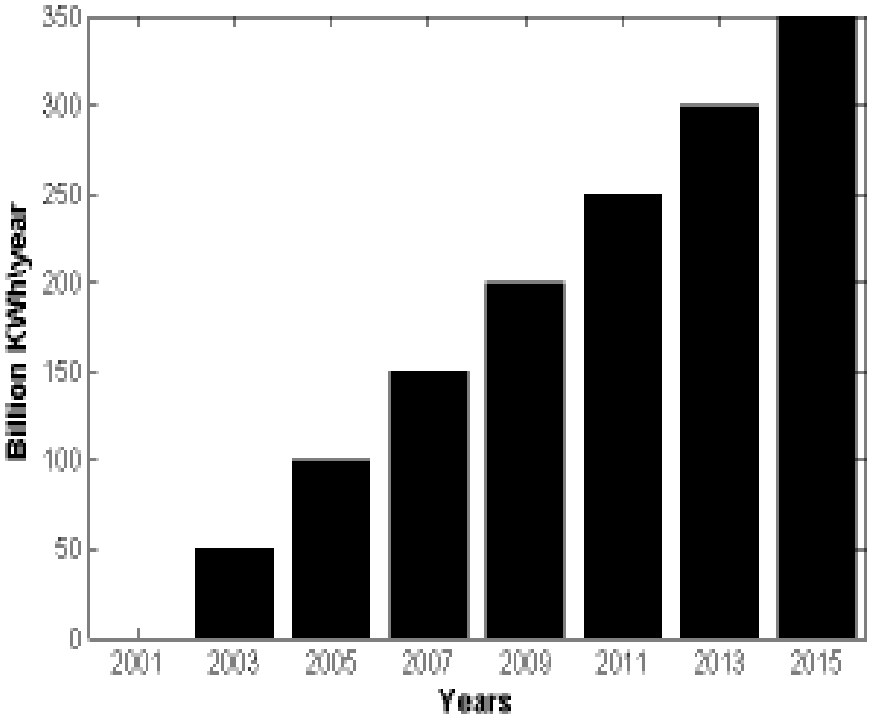


Fig. 2 Level of Energy Consumption

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1) Application Layer: This is the first layer which worked at business or customer level.

2) Resource Management Layer: It is accountable for dealing with consumer necessities. The functions worked under this layer are estimating energy con-sumption by energy estimator, Management of Virtual Machines (VMs) and Resources, check level of SLA through SLA examiner.

3) Data Center Layer: It consists of virtual and physical machines. When large amount of requests comes from user side for resources and it is complicated for completing all the requests efficiently by single machine then there is a need to create an imaginary environment for meeting accepted requests.

B. Virtualization Technology

When multiple operating systems or VMs run on a single server on node, it reduces the power of hardware in use.

As virtualization creates an imaginary environment for performing simulations or experiments that are not possible to implement in a real word due to some constraints like cost, infrastructure or time.

In data centers, performing consolidation through virtualization helps to reduce the number of physical machines i.e. a single machine can run multiple jobs at a time.

1) VM Placement: This mechanism works similar to bin packing problem that have dynamic bin sizes where bins act as the physical machines and items are represented in terms of allocated VMs.

   This section defines an algorithm named as Modified Best Fit Decreasing (MBFD) algorithm.

   It reduces the energy consumption level by selecting the most power efficient node. MBFD algorithm at the end returns a list of allocated VMs.

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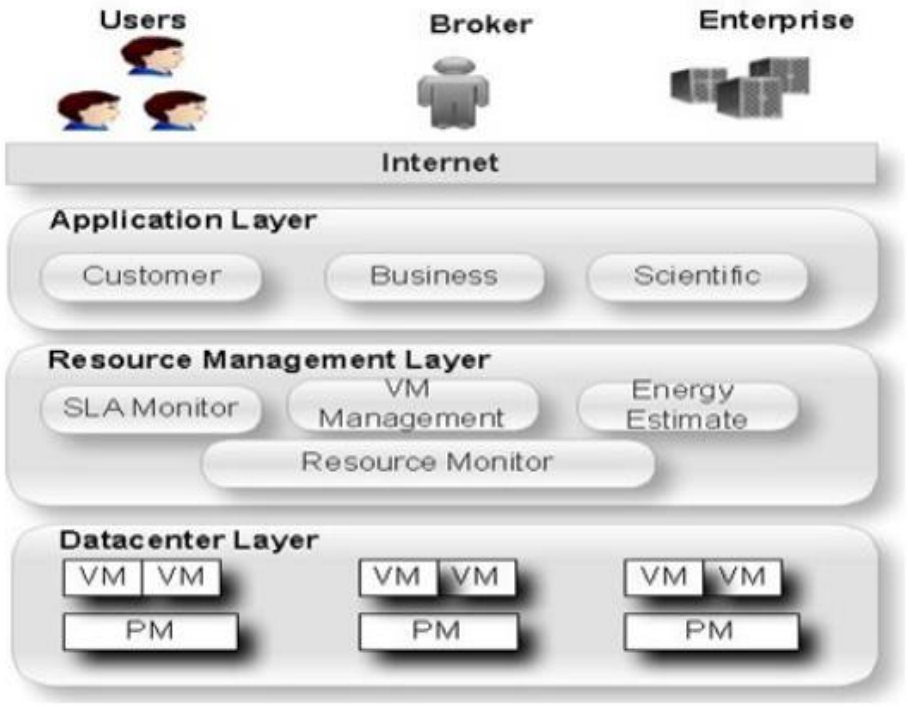


Fig.3. System Architecture

2) VM Selection: VM Selection mechanism works for selecting the virtual machines for migration on the basis of upper threshold value. Only those VMs are selected which have higher energy consumption value than the limit of upper threshold value. Minimization of Migration algorithm is used for selecting list of mi-grated VMs. MM algorithm works for green computing environment by efficient scheduling mechanism and migration of VMs. The aim of the Minimization of Migration (MM) algorithm was minimizing the number of VM migrations as much as possible.

This concept is the best capability and features for performing virtualization in the cloud environment. The use of virtual machine migration concept within the Cloud systems is a modern notion. VM migration is performed in the following conditions:

a) When resource utilization exceeds with 100 percent usage that is uncertain to SLA.

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b) When resource utility is underutilized and violations like lower threshold constraints are there.

c) When VM has immense communication with other working VM on server.

C. Power mangement using green algorithm:

Energy crisis leads to green computing and green computing requires algorithm and mechanism to be develop for energy efficiency. Different methods proposed to the green IT are virtualization, Power management, recycling and telecommunicating. The aim of cloud computing is to make the computing be assigned in great number of distributed computer or remote server. In today's world, a large number of cloud computing systems leads to wastage of tremendous amount of energy and emits high amount of carbon dioxide in air. Thus, it is necessary to eventually reduce pollution and simultaneously lower energy convention. The analysis of energy consumption in cloud computing need both public and private clouds. Cloud computing with green algorithm can ensure more energy efficient use of computing power. Based on the fact that resource utilization directly relates to energy consumption have successfully modelled their relationship and developed two energy conscious task consolidations heuristic. The output of this study should not have only a straight influence on the reduction of electricity bills of cloud service providers, but also suggest possible savings in other operational cost of course the reduction in the carbon emmisiion of clouds is another vital factor.

D. Integrated green cloud architecture

An Integrated Green Cloud Architecture (IGCA), the detail illustrated in figure, It consists of the client, a client-oriented green cloud middleware and the green broker. The green cloud middleware provide the client a medium to better handle the distribution of tasks to cloud with the minimum carbon emission (i.e. least power consumption) and by taking into consideration the other important decision criteria. The middleware is composed of a user interface application and a windows service.

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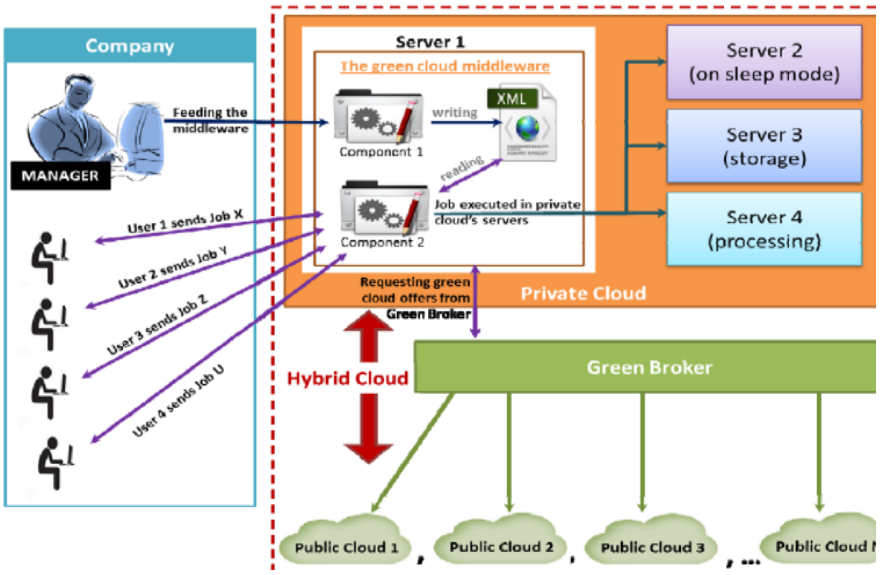


Fig 4 Integrated Green Cloud Architecture

E. Proposed Algorithm: Hybrid Energy Aware Algorithm

Based on virtual machine selection and placement mechanisms that are discussed in upper section, a new hybrid energy aware algorithm is proposed i.e. Hybrid Energy Aware (HEA).

Algorithm 1 Hybrid Energy Aware (HEA)
Require: List of virtual machines and List Hosts.
Ensure: Migration List and Total number of SLA violations

1) Begin
2) VMs are sorted in the increasing order of CPU utilization
3) Migrate VMs according to Min-Max threshold
4) Initialize SLA Parameters
5) for each allocated VM do
6) for each Host in Host List do
7) Initialize Genetic Algorithm
8) Use Fitness Fuction (fn)

fn = f1; Fs > Ft && Rs > Rp && Cs > Cp 0; otherwise

9) if fn == 1 (fitness function value feasible) then
10) return VM allocation is true
11) else
12) Drop VM and check performance metric of next VM

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13) increment SLAVoilation
14) end if
15) end for
16) end for
17) return Migration List, SLA Voilation

The proposed technique adds SLA parameters as fitness values using genetic algorithm, where Fs is the current VM, Ft is the total population, Rs is the resource time required by users and Rp is the providers response time, Cs relates the execution time of each request and Cp is the durability provided by provider. The migration of VMs in proposed scheme is based on lower and upper threshold valued with two SLA parameters, response time and throughput. The motive of the proposed algorithm is to reduce the level of energy consumption, response time and maximize the throughput rate with less SLA violations. Hybrid energy aware energy-efficient algorithm is proposed with the concept of less number of SLA violations with high performance.

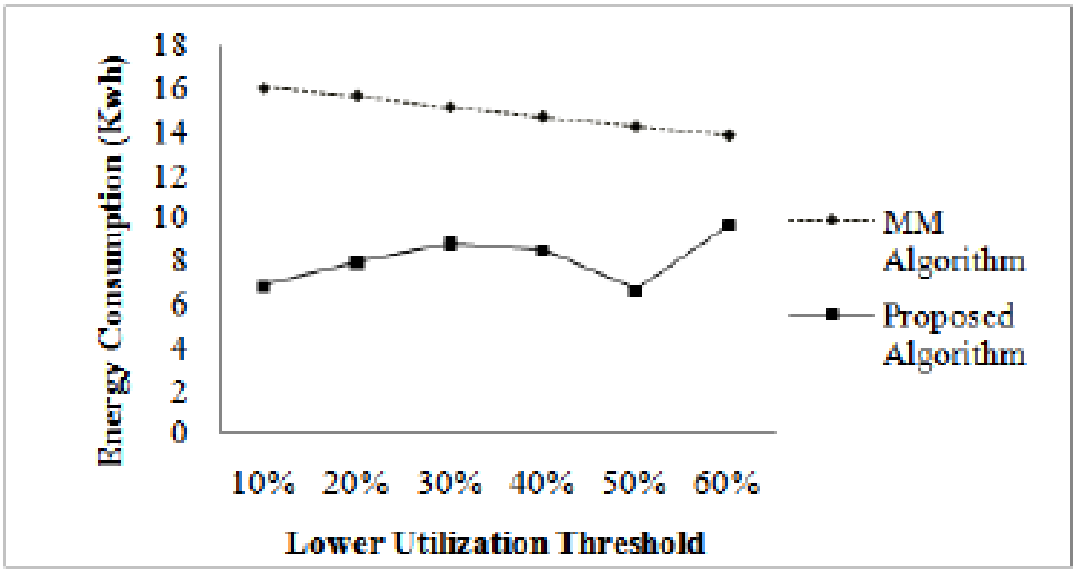


Fig 5 Energy Consumption for MM and HEA algorithm

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F. Designing Cloud Computing to be Green

Mainly three methods have been approached to make cloud computing data centres more eco-friendly. These methods have been tried out in the data centres under experimental conditions. The practical application of these methods are still under study. The methods are:

- Algorithmic approaches:- An ideal server consumes about 70% of the power from a fully utilised server, it has been measured practically.

- Dynamic Voltage frequency scaling technique(DVFS):- Every electronic circutory is associated with an operating clock within it. The supply voltage is regulated by adjusting the operating frequency of this clock. This method is heavily dependent on the hardware and cannot be controlled according to the varying needs. The power savings are also low in this compared to other methods. The power savings to cost incurred ratio is also low in this method.

- Resource allocation or virtual machine migration techniques:- In a cloud computing centre, every physical machine hosts numerous virtual machines upon which the applications are running simultaneously. According to the varying needs and avaialble resources these virtual machines are transferred across the hosts. The VM migration method mainly aim on transferring VMs in such a way that the power increase is least. The most power efficient nodes are choosed and the VMs are transfered across to them.

With the help of neural network predictor, the green scheduling algorithms first estimates the required dynamic workload on the servers. Then unnecessary servers are turned off in order to reduce the number of running servers, thus showing the reduction in the energy use at the points of consumption to provide benefits to all other levels. Also, several servers are added to help assure SLA. The bottom line is to protect the environment and to reduce the total cost of ownership while ensuring QoS.

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CONCLUSION

This paper is survey or a brief explanation and study of green computing in a cloud environment .This study will also tells the methods of green computing. How the green computing works and operates and how the power consumption is minimized by using different methods and vital challenges facing to achieve the goal. The concept of green computing is popularized and brought in practice in the past few years. Apart from environmental issues, this also deals in economic needs. This paper is focused to provide a brief survey on the current state of the art in green computing. In the future we can save more energy through several methods and mechanisms which are shown in the paper like virtualization, data centre and many other energy efficient techniques. i.e. cooling of server, we can analyze the energy conservation and optimize it.

Applying green algorithm is highly important for the gradually development of cloud computing. Out of the various green methodologies known, the DVFS technology is a highly hardware oriented approached and hence less flexible.

FUTURE SCOPE

Green technology is rapidly developing and green computing is becoming crucial part of life, and we know that information technology is not just an idle observer but it is contributing actively in the concepts of green technology or green computing for better development. From its beginning IT field is always involved in efforts to minimize the energy consumption and wastage and is currently also at a reasonable level along with the development made by other fields. Therefore being involved in IT, it becomes the duty of all, to learn and gradually follow the principles of green computing to be enable to be survived in the future. IT industry can adopt different methods like going for virtualization of servers, moving to cloud, using laptops in place of computers, even network virtualization.

ACKNOWLEDGMENTS

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REFERENCES

1) Shaden M. AlIsmail Heba A. Kurdi “Green Algorithm to Reduce the Energy Consumption in Cloud Computing Data

Page 29-39 © MANTECH PUBLICATIONS 2017. All Rights Reserved

Centres" SAI Computing Conference 2016 July 13-15, 2016 | London, UK 978-1-4673-8460-5/16/$31.00 ©2016 IEEE

2) Mohammad Naiim Hulkury, Mohammad Razvi Doomun "Integrated Green Cloud Computing Architecture"

3) R. Bianchini and R.Rajamony, "power and energy management for server systems," IEEE Computer, voI.37, no. ll, pp.68-74, 2004.

4) Mujtaba Talebi and Thomas Way "Methods, Metrics and Motivation for a Green Computer Science Program".

5) Baljinder Kaur and Arvinder Kaur "An Efficient Approach for Green Cloud Computing using Genetic Algorithm"

6) Gaganjot Kaur and Sugandhi Midha "A preemptive priority based Job Scheduling Algoritm in Green Cloud Computing"

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