

Study on Green Cloud Computing and Environmental Feasibility

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Abstract— Cloud computing is an infrastructural model that is used for enabling convenient, on-demand access to compiled pool of computing resources. Sharing of resources is its primary concept which helps in achieving coherence and economies of scale. Cloud computing is a concept in which multiple users can access the compiled or heaped resources or update their data without purchasing licences for different applications. The main advantage of cloud computing model is that the user can access services based on their requirements irrespective of where the service is being hosted. Cloud computing is an infrastructure that is vastly scalable and cost effective due to which there is an enormous growing demand for it. This has led to a critical issue of increased energy consumption at data centres which are indirectly increasing the operational cost. Due to this, the profit margin of cloud providers has decreased. Another serious issue has emerged due to increased energy consumption is high carbon emission which makes it unsafe for environment. Thus, in this chapter, we will discuss various elements of Clouds that contributes to the entire energy consumption and also explain the roles of cloud users in achieving this goal.

Key words: Cloud computing, energy efficiency, environment, performance, datacenter, infrastructure

I. INTRODUCTION

After emerge of cloud system, small or medium organizations need not have to worry about purchasing and maintaining their own computing infrastructure. Instead they can focus on improving their core.[6]Hence the ownership based approach is now transformed into subscription based approach which lets the organization to access scalable infrastructure and service on demand. The term “Cloud” also focuses on expanding the performance of shared resources. Multiple users can share these resources and can also reallocate per demand. Organizations that needs to process immense amount of data that are generated almost every day requires large amount of computational power which is offered by cloud computing system. [2]Since the growth of high speed internet over last couple of decades, the usage of internet has increased vastly which comprises of thousands of e-commerce transactions and millions of queries every day.

Large scale datacentres handles this demand by consolidating millions of servers. Examples of such datacentres are Google, amazon, yahoo etc. This on service demand helps the user to store their data on cloud, many companies to backup contents of millions of users. Hence now it has become a potential market place.[5] Cost minimization is a main purpose of cloud computing for cloud providers but they still need to focus on energy consumption or electricity demand of cloud and use renewable resources for it. Since these clouds which are also known as virtualized data centres, require high energy usage for its operation has led to a problem of environmental

sustainability. [5]Today, datacentre with 100 racks need 1Megawatt of power to operate which results in higher operational cost. In addition, in April 2007, Gartner estimated that the Information and Communication Technologies (ICT) industry generates about 2% of the total global CO2 emissions, which is equal to the aviation industry. [3]

Some researches shows that cloud computing have the ability to make datacentres by making use of technologies such as resource virtualization and workload consolidation. [3] Large corporations can save at least 30-60 per cent and ID size businesses can save 60-90 per cent in carbon emission using cloud application.

II. WHAT IS GREEN CLOUD COMPUTING?

Green cloud computing consist of two terms green means environment friendly and cloud as a traditional symbol of Internet. In short environmentally responsible and eco-friendly use of computers and their resources is nothing but green computing. Nowadays Many IT companies are taking initiative by designing energy efficient computing products which are recyclable thus reducing dangerous materials.[1] After launching Energy Star Program by EPA (Environment Protection Agency) in 1992 Green cloud computing practices came into picture. Green computing is also known as green IT or green information technology. As energy costs are increasing there is need to shift focus from optimising data centre resource management for pure performance alone to optimising for energy efficiency while maintaining high service level performance[6]. Green cloud computing model achieves efficient processing and utilization of computing infrastructure and minimise energy consumption. Green cloud computing as resource saving, cost saving, energy saving. [3]

A. Why go for Green Cloud Computing:

Today the main problem of the world is Global warming. The atmosphere is becoming hot and is causing many problems to living organisms. Computers also play a major role in polluting the world.

B. Approaches to Green cloud computing:

- Green use-by decreasing use of energy consumption of computers and other systems as well as using them in manner of environment.
- Green disposal: Reusing old computers and properly recycling unwanted computers and other electronic equipment's.
- Green design: Design energy efficient and sustainable computers, servers, cooling equipment and data centres.
- Green manufacturing: Manufacturing computers and other systems with minimal impact on the environment. [3]

C. Some Useful Strategies To Implement Green Cloud Computing:

Many IT vendors use dedicated servers for utility tasks such as file servers, emails and database servers. This led to proliferation of servers in the data centers. Don't buy the software on disk rather than download it from web. [2] This will save packaging, manufacturing, transport cost etc. Reduce purchase of papers that will help in reducing consumption of forest, as well as maintain. Display with light emitting diodes (LEDs) in place of fluorescent bulb should be used for reduction in the amount of electricity used by display.

III. GREEN CLOUD ARCHITECTURE

In green cloud architecture end user submits requirements to green broker which is a middleware that manages the selection of the greenest cloud provider for user request. Registered services in the form of "Green Offers" accessed by green broker. Green broker gets current status of energy parameters from carbon emission directory. Green broker's main aim is to calculate the carbon emission of all cloud parameters who are offering the required cloud services and afterwards it should select set of services that will result into least carbon emission [6].

Green cloud framework keeps track of energy usage of user requirements and it depends on two components that is 1) Carbon emission directory and 2) green cloud which keep tracks of energy efficiency. Green broker plays important role of monitoring and selection of cloud services.

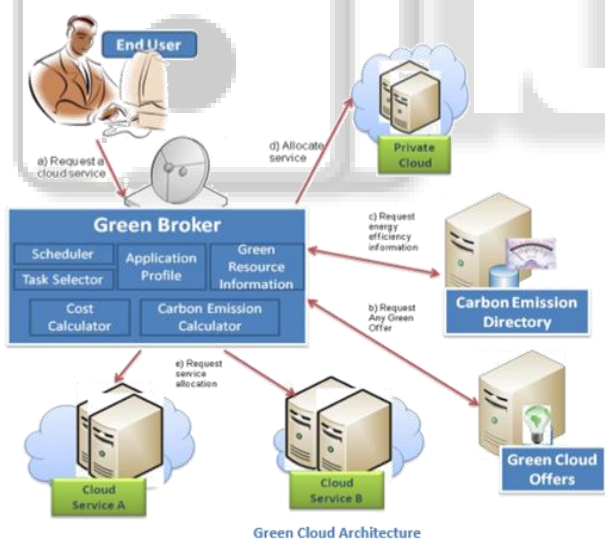


Fig. 1: Green cloud architecture.

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Below different levels are present:

- SaaS level
- PaaS level
- IaaS level

A. SaaS level:

SaaS provider's model means energy efficiency of their software design, implementation and deployment. It mainly selects datacentres which are energy efficient and also nearby users.

B. PaaS Level:

This is a software energy efficiency mark that measures the energy required to perform an external sort other than application development cloud platforms on hybrid cloud. PaaS level mainly consists of applications which are energy efficient.

C. IaaS level:

IaaS level mainly deals with independent infrastructure services as well as support other than services offered by clouds. Using virtualization, energy consumption is decreased by not using of unused servers. To calculate current energy efficiency of each IaaS providers many sensory and energy meters are used. [3]

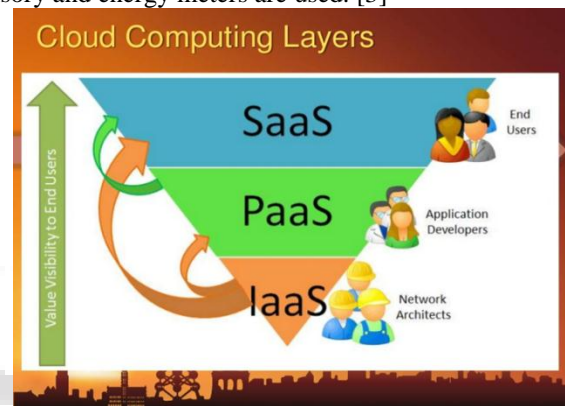


Fig. 2: Cloud computing layers.

IV. CONCLUSIONS AND FUTURE DIRECTIONS

- Firstly we analysed the benefits of cloud computing by studying fundamental definitions and benefits, the services offered to end users and deployment model. We proposed a green cloud framework having various features to make cloud computing more green [6].
- Efforts are to be made in designing software at different levels such as OS, Compiler and algorithm that
- SaaS provider's implements software which needs to be analysed runtime behaviour of applications manages energy efficiency.
- Designing of operating system and compiler done in such a way that level of performance and energy consumption can be managed.
- To use of green datacentres cloud providers need to be understand existing data centres, power consumption and cooling designing and equipment resource utilization to get higher amount of efficiency.
- For designing solution in resource provisioning of application within data centre all factors as memory, network, cooling, CPU etc. should be considered.
- Providers and consumers are having responsibility that emerging technologies does not bring any irreversible change which can affect one society.
- Before adding new technology like virtualization proper analysing should be done for energy efficiency.

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