

Comparative Study on Cloud Computing in Carbon Cost & Energy Consumption

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ABSTRACT

Now a days the major problem in computing system servers and cloud computing is "Energy Consumption". In this paper we discuss about the optimization of energy use and reduction of carbon footprints. This approach is used to provide cloud computing at low cost in comparison of other high performance computing machines like. Resource utilization in virtualization technology reduces energy consumption and CO₂ emissions which may be the reason of health issues. To maximize the impact of cloud computing on environment we discuss many energy-efficient solutions.

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INTRODUCTION

In today's world the computing needs increasing rapidly which may lead to the many environmental problems due to high CO₂ emissions that's why the concept of cloud computing is drastically exploring around the world to reduce the high carbon emission by using many virtualization techniques and the proper utilization of hardware and software which may lead to less computing cost, less infrastructure cost and maintain an eco-friendly computing environment. Due to the virtualization technique high performance computing also increases with low cost. It also develops the scope in e-waste management technique. It increases the CPU utilization and RAM capacity which may cause increase in energy efficiency. Virtualization plays an important role in cloud as it uses virtual servers that uses less power and increase more efficiency than a single server. Carbon cost refers to the amount of carbon dioxide present in the atmosphere. Multi-tenancy system is that system where a organization outsources its digital operations to the cloud that the costs of servers and hardware are handled by vendors

and those vendors uses the same architecture to serve multiple clients rather than an organization built its own server and hardware architecture. In this there is complete security, data access etc, but the hardware can handle more than one organization networking demands.

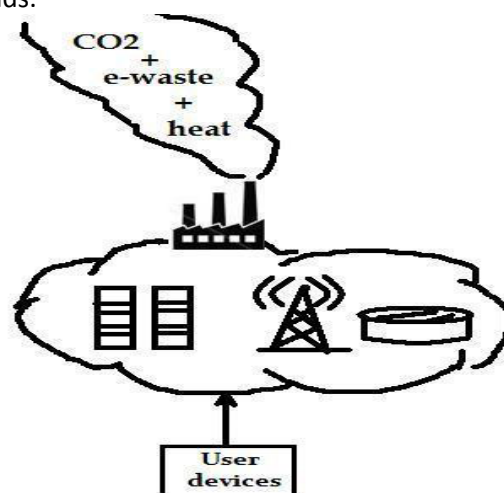


Figure 1: A non green system (Anup R Nimje, V.T Gaikwad, 2013)

I. CLOUD COMPUTING

Cloud computing refers to the web based computing in large areas which provide a virtual environment that allow sharing of resources which makes the utilization of resources efficiently. Through this technology we can access the information and data that are useful to us anywhere in the world through the internet. It allows sharing of software, hardware, databases. It increases the effectiveness of resources that we are used. Due to sharing of resources it reduces the cost of organization infrastructure. All the applications used in an organization according to time when it is needed are kept on the cloud which also reduces the cost of software, hardware and its maintenance and up gradation. As unlimited data stored in cloud backup and restoring of data is much easier than a single hardware.

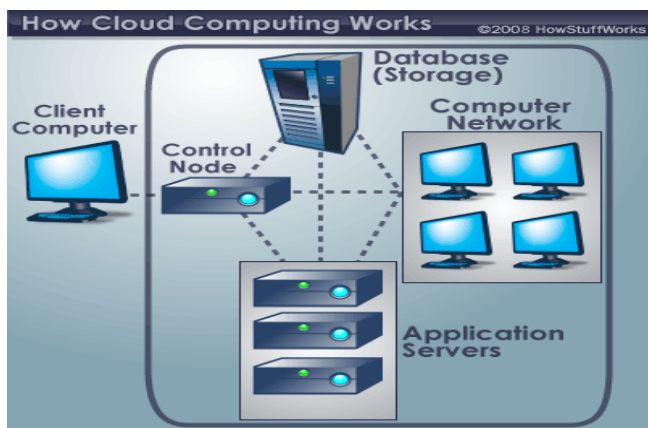


Figure 2: Cloud Computing System

Classification of cloud: There are two types of cloud

A. According to location

According to location cloud is classified in 3 parts:

- **Public cloud**- In this cloud vendor hosted the whole infrastructure of cloud and there is no intervention of end user. It has no control on computing infrastructure. It shared between many organizations with less security.
- **Private cloud**-In this, cloud is hosted internally or externally in the organization. It has dedicated infrastructure for a particular organization and not shared by another organization. In this data is highly secured but more expensive.

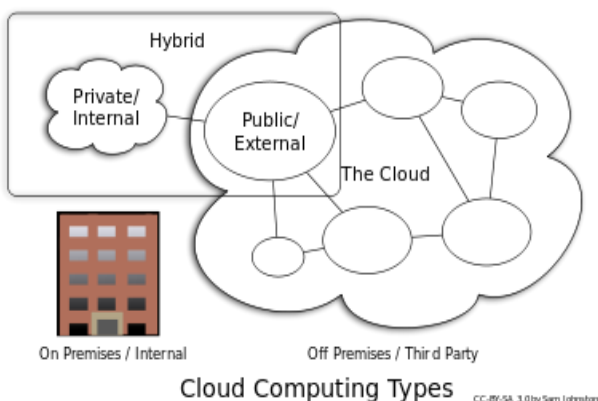


Figure 3: Cloud Types

- **Hybrid cloud**-In this cloud we use both public and private cloud. Private cloud is used to store the highly secure applications. Public cloud is used to store less secure applications used in organization. Organization can provide public cloud to their customers and private cloud to internal working.

B. According to service

According to services cloud is also classified into 3 parts:

- **SAAS**- It is defined as the on demand services to the customers that based on internet in which customer pay to that which we used. In this a central location manages all the software and user is not authorized for updation. Different pieces of software are integrated by API (application programming interface). It is only used for short term need.
- **PAAS**- In this the cloud provide the computing environment including operating system, programming language execution environment, database, web server on which a user can run its software as they need without the cost and complexity of underlying software and hardware. Team collaboration is maximally supported by PaaS solutions including project planning and communication tools.
- **IAAS**- It's another name is hardware as a service. Single piece of hardware is used by multiple users. It provides resources for a limited period of time. In this service cloud provide physical computers as virtual machines by hyper visor, firewalls, load balancers, raw data storage, networks etc. It is generally a hybrid cloud.

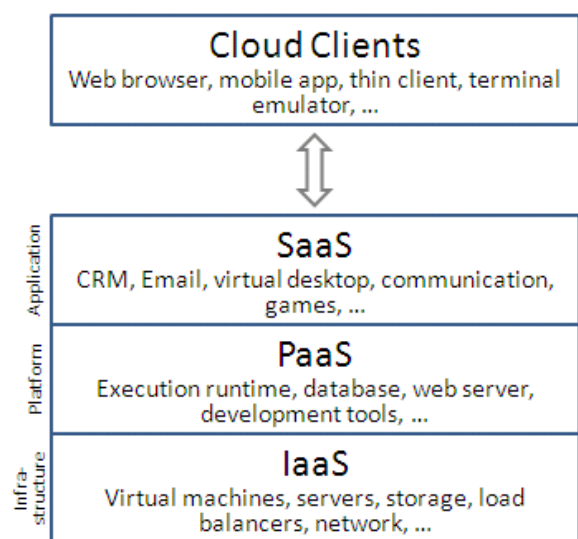


Figure 4: Cloud Services

II. VIRTUALIZATION

Virtualization is like creating the virtual environment (not actual) for any interface, application, hardware, software, memory, storage, processor and network. A physical instance of application or resource is shared by more than one organization or customer is defined as

virtualization. Its main concept is to assigning a logical name to a physical resource and providing a pointer to that resource when it is demanded. Every time when virtual machine is created on a physical device is called host machine and the virtual machine is called guest machine and this virtual machine is managed or accessed by software called hyper visor. Virtualization goal is to maintain the scalability, workloads and utility computing through the centralized administrative tasks which is done by the centralized server.

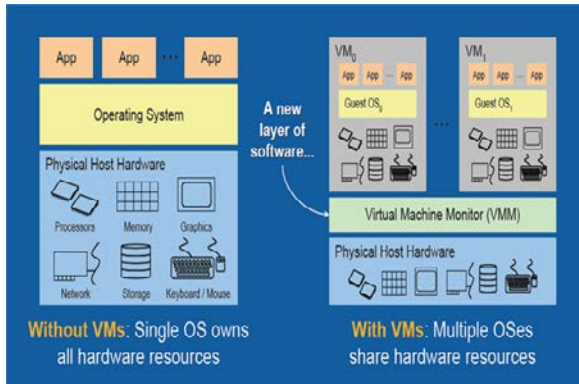


Figure 5: virtualization Technology

Broadly virtualization is divided into three categories are as follows:

- *Server Virtualization*- In this the server is divided into various virtual servers. The basic idea behind this is to protect the user from understanding and managing the complexity and crucial details of server while increasing in the number of sharing resources.
- *Network Virtualization*- In this we combine the available resources on the network by dividing the bandwidth into channels which are independent to each other and assigned to a particular server in real time. Its main concept is to reduce the complexity of network by dividing into manageable parts.
- *Storage Virtualization*- It is the combination of physical storage devices on the network into one storage device which is managed by the central remote control. Storage Area Network (SAN) mainly use storage virtualization.

III. HOW CLOUD COMPUTING HELPS TO REDUCE CARBON COSTS

As the increase in energy consumption will lead to increase in carbon emission. The type of power we used is responsible for amount of carbon emission. The cloud computing makes the IT industry to work on VMs that are run by lower power emission plants such as wind, solar, hydro electric.

Low server utilization makes the energy efficiency low. Since, at low work load of about 10% may lead to energy consumption 50% which is inefficient. Through cloud computing this consumption decrease because the server utilization is always about 60 to 70%. Through the virtualization technique which increases proper utilization of resources and memory, fault

tolerance power also increases through this technique. Usage of virtual servers makes the less power consumption and high level of energy efficiency. Though it uses multi-tenant system so it is very effectively decrease the carbon emission through the use of shared servers and hardware for multiple organization but separate data access, storage on the cloud instead of maintaining separate servers and hardware for separate organization or company. The most important reason for cloud computing is speed and reliability because it gives the on demand premises services and rapid elasticity. It's resources can be employed and deployed as the increment and decrement of demands. So that the organization easily adopt new changes and update itself.

IV. EFFECT OF VIRTUALIZATION ON CARBON COSTS

As all the workload is on the cloud and remotely access through the virtualization and we can access anything from anywhere which may lead to reduction of office size and infrastructure costs which may cause less carbon emission which reduce the carbon costs on earth. In today's scenario many blue chip companies may switch to the cloud computing to serve the less carbon emissions. Facebook is the organization may switch to cloud computing effectively and may lead to their effective sharing on reducing carbon emission. Alike Facebook, Twitter, Google, Microsoft, etc.... also focuses on the concept of virtualization and cloud computing to make the environment green and work on eco friendly computing environment.

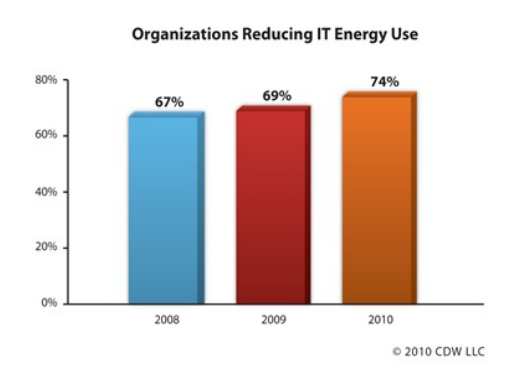


Figure 6: Reducing Energy Use

Let's figure out some of dignitary of virtualization that directly effect on environment:

- Migration of virtual machine from one server to another can eradicate the planned downtime.
- It procures automated failover for applications that are virtualized and vigorously balance workload on server.
- Managed and supervised resource allotment.
- Server's group ability to share resources is exponentially increased by virtualization.

(PalakMakhija,ShrutiAgarwal, 2013)

V. SOLUTIONS FOR REDUCING CARBON EMISSIONS

The first solution to make the less carbon emission or to save our environment is to make all the paper work digitally which may lead to less tree cutting for wood pulp for producing paper. Through cloud computing the need of paper decreases as it stores bulk of information digitally.

Organization should use renewable sources to produce the electricity for their use such as solar, wind, geothermal and can perform many recycling programs that can save our environment.

Need to decrease the cooling for a server which may lead to the decrease in energy consumption means try not to overheat the server due to which we does not need to cool it because as the heat increases the more cooling power is needed which also cause the higher emission of CO₂.

The major steps an organization needs to take in term of environmental stability are as follows:

- Use energy efficient devices which may consume less energy like energy saver bulbs, electronic devices etc.
- The devices need to be switched off when they are not in use or not in demand.
- Need to allow the employees to work at home on occasional basis to reduce the power consumption or CO₂emission.
- Use virtualization technology to reduce hardware and software cost which may lead to less carbon emission.

VI. FUTURE WORK

For cloud many future work are designed but its mainly related approach of cloud to make the data centers as green data centers. As the remote access for employees will reduce the power used by their vehicles by not driving to their offices and energy consumption shifted from offices to home. The main aim of data centers is profitability on the expenses of the environment. Also data centers still results in green house emission so we need to make the data centers as green data centers.

Data Center Greenhouse Gas Emissions by Scenario, World Markets: 2009-2020

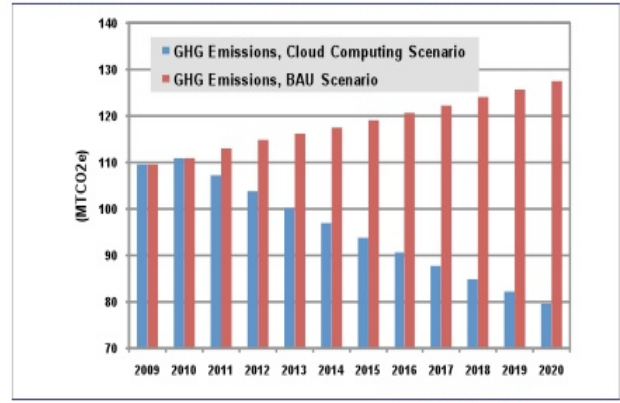


Figure 7: Comparison Between Cloud and Non Cloud Scenario

According to the study in the above graph there is an assumption we are able to decrease the green house emission through data centers by using cloud computing and reduce carbon cost and make the environment green.

VII. CONCLUSION

There is always a debate as cloud computing is either energy efficient or not and its impact on energy consumption and emissions. Cloud is ever increasing amount of energy as it grows but still it is very energy efficient for organization. As the primary concern for the organization is profitability which may increases through cloud computing. That’s why we have many reasons to say that cloud computing and data centers may lead to reduce carbon footprint. It allow the compatibility to cloud-driven efficiency, usage, performance, and importantly renewable energy.

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