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A REVIEW ON GREEN CLOUD COMPUTING

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Abstract— **Cloud computing is the whole new paradigm in the field of information technology and moving towards a cloud based system increases day by day because of this cloud based data centers are increasing greatly which leads to high energy consumption every day and also the emission of CO_2 by these data centers greatly affect the environment. To overcome this problem Green Computing came into existence. The main goal of green computing is to recycle and reuse. Green Computing helps to get the same computing speed at decreased energy consumption. In this paper I discussed about how green computing can be achieved by load balancing and virtualization. This can reduce the energy consumption of cloud data centers which will in turn reduce the low emission of C02.**

Keywords— Green Cloud Computing, Energy consumption, virtualization

I. INTRODUCTION

Green computing, **Green ICT** as per IFG International Federation of Green ICT and IFG Standard, **green IT**, or **ICT sustainability**, is the study and practice of environmentally sustainable computing or IT.

The goals of green computing are similar to green chemistry: reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, the recyclability or biodegradability of defunct products and factory waste. Green computing is important for all classes of systems, ranging from handheld systems to large-scale data centers.

Many corporate IT departments have green computing initiatives to reduce the environmental effect of their IT operations

The issue of energy consumption in information technology equipment has been receiving increasing attention in recent years and there is growing recognition of the need to manage energy consumption across the entire information and communications technology (ICT) sector. In the last compel of years, Cloud based data centers are increasing greatly because of the demand for computer resource. Since more data centers are came into existence the energy consumption of these data centers are also increased to a great extent. In addition to high energy consumption there is an addition impact on the environment by the form of carbon-di-oxide emissions.
By 2020 the total amount of Carbon-di-oxide emitted by these data centers will be nearly 359 megatons. In such a situation it is crucial importance that the cloud data centers should have a good energy efficiency. The Major problem in poor energy efficiency is that most of the energy are wasted when servers run at low utilization.
According to the recent research from Pike Research, the global market for green data centers will grow from $17.1 billion in 2012 to $45.4 billion by 2016. In fact on-site server with no virtualization will emit bout 46 kg of CO_2 per year.



Cloud Computing

Cloud Computing is not a very new concept in IT, in fact Cloud Computing is a more advanced version of the Data Processing Service Bureaus that we had 40 years ago. Nevertheless, the best known companies in the IT field offer or will shortly offer Cloud Computing services to a range of customers from organizations of all sizes to individuals. The cloud model is been classified into three types:

a) Public Clouds: Public cloud is the most common deployment model where the services are available to anyone on the internet. The service is available to public in a pay-as you-go manner.

b) Private Clouds: Private clouds are deployed within an organization to provide IT services to its internal user. It offers a great control over the infrastructure, improving security and service because its access is restricted within an organization.

c) Hybrid Clouds: A Hybrid cloud is emerged due to the diffusion of both public and private cloud advantages. By this model, organizations outsource non-critical information and processing to public cloud. While keeping critical service and data in their control by using private cloud.

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Cloud computing also offers different types of service to its customer and it is of three types:

a) SaaS: "Software as a Service (SaaS)", sometimes referred to as "software on demand," is software that is deployed over the internet and/or is deployed to run behind a firewall on a local area network or personal computer. With SaaS, a provider licenses an application to customers either as a service on demand, through a subscription, in a "pay-as-you-go" model. Software or an application is hosted as a service and provided to customers across the Internet. This mode eliminates the need to install and run the application on the customer's local computers. SaaS therefore alleviates the customer's burden of software maintenance, and reduces the expense of software purchases by on-demand pricing. An early example of the SaaS is the Application Service Provider (ASP) 15). The ASP approach provides subscriptions to software that is hosted or delivered over the Internet. Microsoft's "Software + Service" 30) shows another example: a combination of local software and Internet services interacting with one another. Google's Chrome browser 21) gives an interesting SaaS scenario: a new desktop could be off ered, through which applications can be delivered (either locally or remotely) in addition to the traditional Web browsing experience

b) IaaS: "Infrastructure as a Service (IaaS)", delivers computer infrastructure - typically a platform virtualization environment - as a service. Rather than purchasing servers, software, data-center space or network equipment, clients instead buy those resources as a fully outsourced service.

c) PaaS: "Platform as a Service (PaaS) is the delivery of a computing platform and solution stack as a service. PaaS offerings facilitate deployment of applications without the cost and complexity of buying and managing the underlying hardware and software and provisioning hosting capabilities, providing all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely available from the Internet.

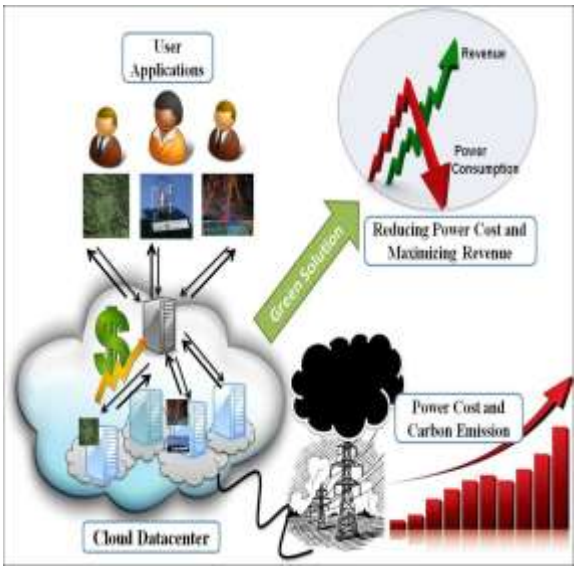
d) Data as a Service (DaaS): Data in various formats and from multiple sources could be accessed via services by users on the network. Users could, for example, manipulate the remote data just like operate on a local disk or access the data in a semantic way in the Internet. Amazon Simple Storage Service (S3) 14) provides a simple Web services interface that can be used to store and retrieve, declared by Amazon, any amount of data, at any time, from anywhere on the Web. The DaaS could also be found at some popular IT services, e.g., Google Docs 22) and Adobe Buzzword 12). Elastic Drive 16) is a distributed remote storage application which allows users to mount a remote storage resource such as Amazon S3 as a local storage

II. GREEN COMPUTING

Green computing is the environmentally responsible and eco-friendly use of computer and its resources. It is also defined as the process of designing, manufacturing, and disposing computer devices which will not affect environment. Most of the IT companies now started to realize that moving green computing not only terms of public relation but also it will reduce the cost. Currently the IT industries are responsible for 3% of the world's energy consumption with an increase of 20% every year. By 2030 the power consumption will be double.

The five core green computing technologies are: Green Data Center, Virtualization, Green Cloud Computing, Power Optimization and Grid Computing. This technology is beneficial as it:

- Reduce energy consumption of computing resources during peak operation.
- Save energy during idle operation.
- Use eco-friendly sources of energy.
- Reduce harmful effects of computing resources.
- Reduce computing wastes.



III. VIRTUALIZATION

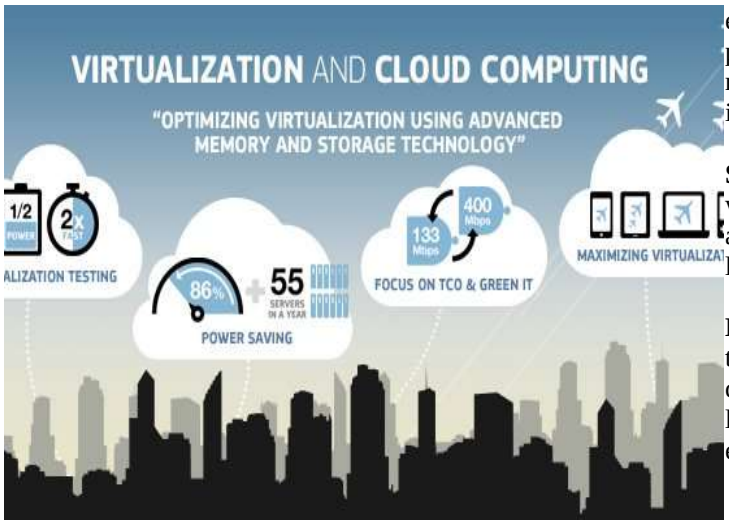
Virtualization is the main key factor for Cloud Computing to attain sustainability from the cost and energy efficient point of view. Even though there are different types of virtualization, two types are widely distributed. They are: Sever and storage virtualization

A) Server Virtualization: virtual server allows several machines to share the same physical server to run instead of having their own server that leads to less cost in terms of hardware, management for their infrastructure facilities and space.

B) Storage Virtualization: Many applications produce lots of data that cannot be stored in a single server due to storage capacity. Another problem is that multiple user can access the same data at the same time which could cause

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traffic over the network. For this reason data should be virtualized to avoid access problem and improve the data management along with reducing cost.



Load Balancing in Cloud

Load balancing in clouds is a mechanism that distributes the excess load evenly across many servers. This technique is used to achieve high user satisfaction and resource utilization this helps in high performance improvement. Proper load balancing can help in utilizing the available resources optimally, thereby minimizing the resource consumption.

Load balancing also required to achieve green computing in clouds. Which can be done two types:

1. **Reducing Energy Consumption:** Load balancing helps in avoiding overheating by balancing the workload across many servers. By which we can reduce the amount of energy consumed.
2. **Reducing Carbon Emission:** Energy consumption and carbon emission are hand in hand. The more the energy is consumed, higher the carbon emission. As the energy consumption is reduced by load balancing. So we can reduce the carbon emission by which we can achieve green computing.

IV. CLOUD ENABLING GREEN COMPUTING

The important technology for energy efficient in clouds is the "Virtualization" Which helps in significant improvement in energy efficient by sharing the same infrastructure. By using virtualization companies can gain high savings in the form of space, management, and energy.

Dynamic Provision: In traditional computing, datacenters and private infrastructure used to be maintained to fulfill worst case demand. Thus most of the IT companies deploy more infrastructure than needed. The reasons for this situation are: a) it is very difficult to predict the demand before itself. b) To guarantee availability of services and to maintain certain level of service quality to end users.

Multi-tenancy: Using this approach, we can reduce the energy usage and associated carbon emissions. The SaaS providers serve on the same infrastructure and software. This method is more useful than having multiple copies of software installed on different servers.

Server Utilization: Sometimes on-premise infrastructure runs with very low utilization. Using virtualization same application can be hosted and used on the same server thus lead to utilization up to 70%.

Datacenter Efficiency: By using the most energy efficient technologies, cloud providers can improve the PUE of their datacenters. Today most of the datacenters can achieve PUE levels low as 1.1 to 1.2, which is nearly about 40% more energy efficient than traditional datacenters.

V. FUTURE SCOPE

In this paper, we study the comprehensive energy consumption analysis of cloud computing. By using techniques like load balancing and virtualization we can reduce the excess power emission. We have much more advantages of green cloud computing. The pollution created by the data Centre is ignored but it is one of the major issues nowadays. Virtualization is one of the major ways of reducing global pollution to a lot. This is one of the major ways of increasing the efficiency of datacenters. Cloud computing business potential and contribution to already aggravating carbon emission from ICT, has lead to a series of discussion whether Cloud computing is really green. It is forecasted that the environmental footprint from data centers will triple between 2002 and 2020, which is currently 7.8 billion tons of CO2 per year. There are reports on Green IT analysis of Clouds and datacenters that show that Cloud computing is "Green", while others show that it will lead to alarming increase in Carbon emission. Thus, in this chapter, we first analyzed the benefits offered by Cloud computing by studying its fundamental definitions and benefits, the services it offers to end users, and its deployment model. Then, we discussed the components of Clouds that contribute to carbon emission and the features of Clouds that make it "Green". We also discussed several research efforts and technologies that increase the energy efficiency of various aspects of Clouds. For this study, we identified several unexplored areas that can help in maximizing the energy efficiency of Clouds from a holistic perspective. After analyzing the shortcoming of previous solutions, we proposed a Green Cloud Framework and presented some results for its validation. Even though our Green Cloud framework embeds various features to make Cloud computing much more Green, there are still many technological solutions are required to make it a reality:



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