# An analysis on green cloud computing in reference of the energy efficiency

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***Abstract- With the help of cloud computing business customers can increase and decrease their resource based on needs. we present a system that uses virtualization technology to allocate data centre resources dynamically based on application demands and support green computing by optimizing the number of servers in use. Cloud Computing produced buzzing around the enterprise world but behind the buzz, the Cloud computing technology is on the margin of spurring an information revolution in all regions. Therefore, we need green cloud computing solutions that can not only save energy, but also reduce operational costs. High energy consumption not only translates to high operational cost, which reduces the profit margin of Cloud providers, but also leads to high carbon emissions which is not environmentally friendly. Hence, energy-efficient solutions are required to minimize the impact of Cloud computing on the environment. It offering utility-oriented IT services to users which better suited option than traditional methods. Cloud has millions of services based on web services. Cloud is very cost-effective infrastructure for this web related services. there is certainly actually something and cloud computing seems become an extremely disturbing technology, which is gaining momentum. It has hereditary the inheritance technology including unique ideas. The style of cloud computing addresses the next evolutionary steps of distributed computing. The purpose of this computing model is often in order to make an improved use of distributed resources, place them together in order to attain higher throughput and also tackle big scale computation problems.***

**Keywords- Cloud Computing, energy-efficient, distributed computing, green cloud computing, computation.**

## I. INTRODUCTION

Network and internet is an essential service in current world in all areas as business, education, banking and all government sectors. Demand of high speed network is confirmation of these different types of e-transactions. The concept of cloud is introduced to fulfill these web demands. Cloud contains massive infrastructure handling large data storage, network systems and related components. Many internet service providers such as Microsoft, Google and Yahoo are operating clouds commercially. Cloud service is utility on a pay-as-you-go basis. This can help to cut down business organizations vast investment amount for capital in achievement and maintenance of computational resources. Cloud computing provides access to scalable infrastructure and on demand services. Users can store, access, and share any amount of information in Cloud. In everyday life most of the web activity are rely on cloud like iPad which relies upon cloud to stream video, download music and books, fetch email, Google's signature products - Gmail, Google Documents and Google Earth - are delivered from the cloud and a digital library entirely hosted by servers storing most of the world's published work, all in digitized form.

The ever-increasing demand is handled through large-scale datacenters, which consolidate hundreds and thousands of servers with other infrastructure such as cooling, storage and network systems. Many internet companies such as Google, Amazon, eBay, and Yahoo are operating such huge datacenters around the world. The commercialization of these developments is defined currently as Cloud computing, where computing is delivered as utility on a pay-as-you-go basis. The emergence of Cloud computing is rapidly changing this ownership-based approach to subscription- oriented approach by providing access to scalable infrastructure and services on- demand. Users can store, access, and share any amount of information in Cloud. Cloud computing also offers enormous amount of computer power to organizations which require processing of tremendous amount of data generated almost every day.

According to IDC (International Data Corporation) report, the global IT Cloud services spending is estimated to increase from $16 billion in 2008 to $42 billion in 2012, representing a compound annual growth rate (CAGR) of 27%. Attracted by this growth prospects, Web-based companies (Amazon, eBay, Salesforce.com), hardware vendors (HP, IBM, Cisco), telecom providers (AT&T, Verizon), software firms (EMC/VMware, Oracle/Sun, Microsoft) and others are all investing huge amount of capital in establishing Cloud datacentres. Clouds are essentially virtualized datacenters and applications offered as services on a subscription basis. They require high energy usage for its

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operation. Today, a typical datacenter with 1000 racks need 10 Megawatt of power to operate, which results in higher operational cost. Thus, for a datacentre, the applications of Green Cloud Computing in energy cost is a significant component of its operating and up-front costs. 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 .According to a report published by the European Union, a decrease in emission volume of 15%–30% is required before year 2020 to keep the global temperature increase .Thus, energy consumption and carbon emission by Cloud infrastructures has become a key environmental concern .Cloud computing can actually make traditional datacenters more energy efficient by using technologies such as resource virtualization and workload consolidation. Cloud data center on the other hand, can reduce the energy consumed through server consolidation, whereby different workloads can share the same physical host using virtualization and unused servers can be switched off. The Elasticity and the lack of upfront capital investment offered by cloud computing is appealing to many businesses. There is a lot of discussion on the benefits and costs of the cloud model and on how to move inheritance applications onto the cloud platform. Here we study a different problem: How can a cloud service provider best multiplex its virtual resources onto the physical hardware? This is important because much of the touted gains in the cloud model come from such multiplexing. Studies have found that servers in many existing data centers are often severely under- utilized due to over-provisioning for the peak demand. The cloud model is expected to make such practice unnecessary by offering automatic scale up and down in response to load variation. Besides reducing the hardware cost, it also saves on electricity which contributes to a significant portion of the operational expenses in large data centers.

Even the most efficiently built datacenter with the highest utilization rates will only mitigate, rather than eliminate, harmful CO2 emissions. The reason given is that Cloud providers are more interested in electricity cost reduction rather than carbon emission. Clearly, none of the cloud datacenter in the table can be called as green. Cloud computing, being an emerging technology also raises significant questions about its environmental sustainability. Through the use of large shared virtualized datacenters Cloud computing can offer large energy savings. However, Cloud services can also further increase the internet traffic and its growing information database which could decrease such energy savings. A Green Cloud framework for reducing its carbon footprint in wholesome manner without sacrificing the quality of service (performance, responsiveness and availability) offered by the multiple Cloud providers. Important objectives of this research are to be determine how to improve resource utility, how to schedule the resources and how to achieve effective load balance in a cloud computing environment. Dynamic resource allocation is done by using the virtualization technology.

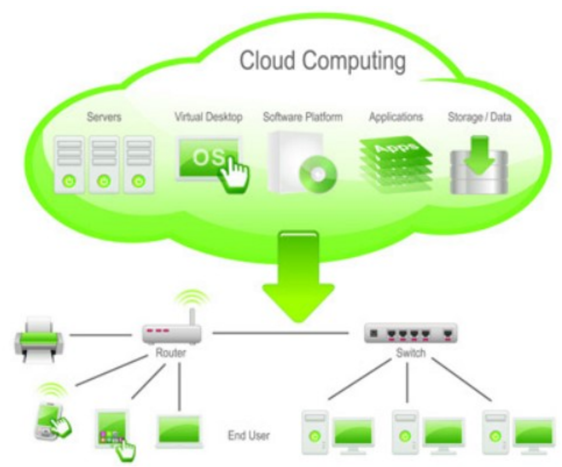

Figure 1: Green Cloud Computing [1]

## II. FEATURES OF GREEN CLOUD COMPUTING

Virtualization plays the important role in making green cloud computing energy-efficient and cost-efficient. Virtualisation is the process in which all the computer resources are grouped together. Under utilized servers can be grouped together and provide the computing resources in the form of virtualisation. There are various terms related to green cloud computing:

1. **Power Management** - This feature means conservation of power used by all electrical appliances. Many appliances now come with a power saving/management feature as well. Devices with this feature automatically turn off the power or switch the appliance to a low power state when not being used.
2. **Energy Efficient Computing** - Computers have a fan / heater-like component inside them. The energy waste of computers is increasing by the day. Unfortunately, not many people are aware of this. Energy waste is leading to a climatic change from burning coal and oil.
3. **Remediation of Environmental Pollutants** - This deals with reducing and removing pollution or contaminants from groundwater, soil, surface water, or sediments.
4. **Server Virtualization** - This is popularly known as VPS and is commonly used to split the server. The idea is to use one server which connects to many individual computers. This development has been seen in software,

technology, and other types of architecture virtualization.

## III. MODELS OF ENERGY CONSUMPTION

In this section, we describe the functionality and energy consumption of the transport and computing equipment on which current cloud computing services typically operate. We consider energy consumption models of the transport network, the data center, plus a range of customer-owned terminals and computers. The models described are based on power consumption measurements and published specifications of representative equipment [1], [2], [3], [4]. Those models include descriptions of the common energy-saving techniques employed by cloud computing service providers. The models are used to calculate the energy consumption per bit for transport and processing, and the power consumption per bit for storage. The energy per bit and power per bit are fundamental measures of energy consumption, and the energy efficiency of cloud computing is the energy consumed per bit of data processed through cloud computing. Performing calculations in terms of energy per bit also allows the results to be easily scaled to any usage level.

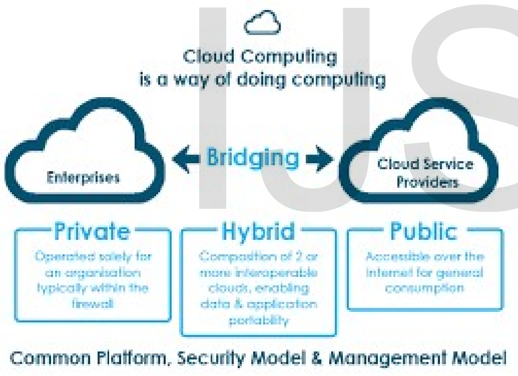




Fig.1: Schematic of networks connecting users to a cloud and the data center infrastructure used to host those clouds.

We consider both public and private clouds. Fig. 1 shows schematics of a public cloud computing network. For the public cloud, the schematic includes the data center as well as access, metro and edge, and core networks. The private cloud schematic includes the data center as well as a corporate network. These schematics form the basis for the analysis in the following sections of this paper. From a hardware perspective, the key difference between public cloud computing and private cloud computing is the network connecting the users to the respective data center. As described earlier, a data center for a public cloud is hosted on the Internet and designed to be used by anyone with an Internet connection. Public cloud users are typically residential users and connect to the public Internet through an Internet service provider's (ISP) network. Looking forward, it is expected that the access portion of such networks will increasingly use passive optical network (PON) technologies, which are particularly energy efficient [5]. Within the ISP's network, Ethernet switches aggregate user traffic, broadband network gateways (BNGs) regulate access and usage, and provider edge routers form the gateway to the global Internet, which comprises many large core routers and high-capacity transport networks. Data centers in turn connect to the core network through their own gateway router. A typical data center comprises a gateway router, a local area network, servers, and storage [1], [4]. As shown in Fig. 1, the routers, provider edge routers, and the data center gateway routers typically dual-home to more than one core router, in order to achieve higher service availability through network redundancy. Although only a single data center is shown, a cloud service provider would normally maintain several centers with dedicated transport between these centers for redundancy and efficient load balancing. Private clouds, as described earlier, are intended only to be used by the enterprise that owns the private cloud.

## IV. THE FUTURE OF CLOUD COMPUTING

The analysis in previous sections was based on state-of the-art technology in 2010. In recent years, there have been continuous improvements in the energy efficiency of equipment as new generations of technology come on line. This has led to exponential improvements over time in the energy efficiency of servers [6], storage equipment [7] as well as routers and switches [3], [8], [9]. It is reasonable to expect that future generations of transport and computing equipment will continue to achieve improvements in terms of energy efficiency, largely due to improvements in complementary Metal–oxide–semiconductor (CMOS) integrated circuit technology. In this section, we utilize estimates of efficiency gains in technology over time to forecast energy consumption of cloud computing in the future. We also discuss future directions for cloud computing and provide guidelines for how cloud computing can be made as energy efficient as possible.

## V. CONCLUSION

In this paper, we presented a comprehensive energy consumption analysis of cloud computing. The analysis considered both public and private clouds and included energy consumption in switching and transmission as well as data processing and data storage. We have evaluated the energy consumption associated with three cloud computing services, namely storage as a service, software as a service, and processing as a service. Any future service is likely to include some combination of each of these service models. Power consumption in transport represents a significant proportion of total power consumption for cloud storage services at medium and high usage rates. For typical networks used to deliver cloud services today, public cloud storage can consume of the order of three to four times more power than private cloud storage due to the increased energy consumption in transport.

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