Energy Efficiency and Green Migration in Cloud Computing Environment

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Abstract- *Cloud computing is the fundamental of technology enhancement in today's technologically advanced age, but we continue to face the problem of energy conservation and reduction. It is an evolving system that uses servers and the World Wide Web to store, retrieve and edit data. Cloud computing is the fastest evolving paradigm of the modern age of computers, thus requires more and more remote host machines such as servers. These devices needed more energy and had become a considerable cost factor in the overall functioning of clouds. As technology advances, the need for energy increases and the power includes all physical and non-physical entities present in mobile devices and for advanced computers such as servers and desktops. Another critical factor is the use of non-renewable and renewable energy resources; these resources play a vital role in our future development of technology. We will address ways we can reduce the overall energy consumption without compromising the quality of services the host provides. We further define the overall functioning of mobile cloud computing and its importance to the world and to find alternative energy solutions such as solar.*

Keywords- Cloud computing, Energy Consumption, Renewable Energy, Mobile computing

I. INTRODUCTION

Cloud computing is changing the way to store and retrieve big data; it's an evolving technique in the world of data. Cloud computing has an ever-present paradigm in our world of the technology age, it allows to periodic our day to day tasks with ease as access to our information is simple and easy to retrieve, store and edit. Cloud Computing has emerged as new energy consumed technology and virtualization model for the computing world. Cloud provides suitable, on-demand service, elasticity, broad network access, resource pooling and measured function in a highly customizable manner with minimal management effort [1]. However, there is a growing concern to optimize the output of the cloud infrastructure and to make it more mobile to ease the burden on aging computer infrastructure. The computer infrastructure is becoming outdated and is causing significant problems in the overall energy grid, non-renewable energy is currently used to the power of the world, only recently due to global warming and other issues such as economics, the need for renewable energy needed more than ever.

II. EXPLANATION OF CLOUD COMPUTING

Cloud computing has described as the methodically devised mechanism wherein the users can use the computing applications as and when they need, and they are made accessible in „cloud" through a browser or any other web-based tools [2]. Cloud Computing is a structure for enabling ubiquitous, convenient, on-demand network access to shared resources (e.g., network, servers, storage, applications, and services) that can be rapidly Provisioned and released with minimal management effort or service provider interaction. There are many definitions of cloud computing is simple and most used one is the transfer of information from one device to another. It is a pretty evident in everyday life as used on mobile devices and internet-based applications such as Google.

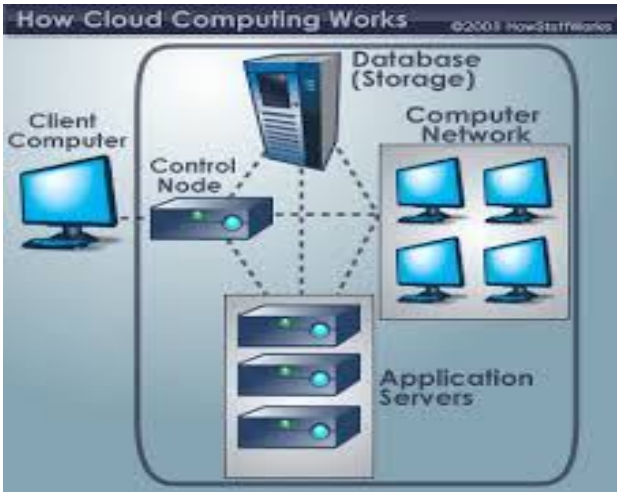

Fig.1.A simple diagram as to how cloud computing works

As seen in figure 1, there are computer infrastructures present, such as storage, a control node, and a client computer,

these electronic devices use a significant amount of energy, all of which are running and consuming a substantial amount of energy.

Computers and monitors were the first marking products. It has led to the widespread adoption of the sleep mode in electronic devices. At that time the term "green computing" was introduced to refer to energy-efficient personal computers [3].

Figure 2 explains the cloud computing services using three types such as IAAS, PAAS and SAAS [4].

1. The user runs as the lowest type is infrastructure-as-a-service (IaaS). With IaaS, users implement the software on machines configured by a third party. IaaS produces up the hardware and software that supports the whole system, from the server to storage and networks.

2. The next type is platform-as-a-service (PaaS). PaaS has required a platform that supports the complete life-cycle of building and delivering applications and services over the Web. PaaS provides services to deploy, test, host, and maintain applications within the same integrated development environment.

3. The most of the end users are used to the software-as-a-service (SaaS), rests on top of the PaaS layer. With SaaS, users access pre-baked services by merely planning to them via a Web browser, without trouble with the hardware and software details involved in the implementation.

These three types are fundamental to the overall functionality to cloud computing, without them, cloud computing will be useless against other more involved internet storage methods. Cloud computing needs development of more efficient cloud infrastructure and to reduce the overall stress of the energy consumed. It can do by implementing energy saving techniques, improving the functionality of computer infrastructure and finding alternative energy means such as renewable energy. Cloud service providers such as Amazon, Sales, force, Microsoft, Google, IBM and Sun-Microsystems has established many new data centers for hosting cloud applications, business application, the gaming portal, media content delivery and accurate processing. For running these data centers, a tremendous amount of energy is required [5].

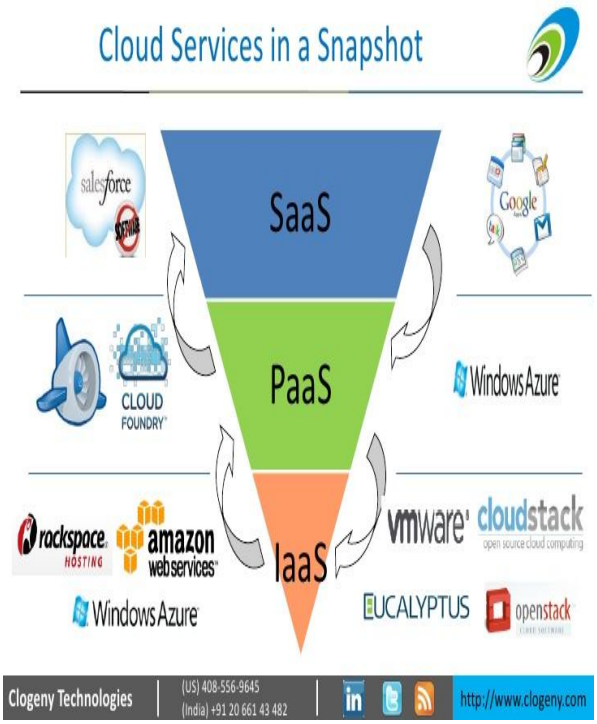

Fig.2. Cloud services and its uses

III. ENERGY CONSUMPTION ANALYSIS

The current overall energy consumption of computer infrastructure remains unknown, but we can estimate the usage. The analysis is that more than 10% of the world's energy consumption consumed by the IT world, which excludes machines that run computer code. We need much analyzing the overall functioning of the computer infrastructure to reduce the carbon footprint it leaves behind and to improve the performance of the outcome. On average, most of our power consumed it made by non-renewable energy substances such as coal and oil. We need to reduce this to avoid a severe problem such as global warming, which its effects are slowly hurting the earth and its surrounding areas. Several efforts have been made to promote energy consciousness in ICT data centers. Earlier, the power distribution in the data centers improved by distributing the power reliably and efficiently among the data center equipment, which consumes power from Power Distribution Units (PDUs) and Power Management Modules (PMMs). Improvements in power distribution could help to reduce power consumption [6].

It is one of the significant ways to improve overall power efficiency in the data centers in the global IT world.

The amount of energy is defined as equal to a power of 1 kilowatt (1000 watts) running for 1 hour. Formally, power

has defined in the references [7] and [8]. Mass computer infrastructure eats a massive load of current. The power equation is as follows;

Power = Work / time

Where the work is the number of processes a computer does and time is how long it takes to process the code/functioning. It is an estimate of the amount of power needed to power a computer peripheral. The amount of power is dependent on the amount of work the computer system does and in the case of cloud computing, it uses a significant amount of energy to keep the work in a stable condition and improve the output of the different services the mobile cloud computing initiatives use.

Technologies provide necessary energy management for servers in Cloud environments, i.e., on and off servers, putting them to sleep. Energy saving includes the use of Dynamic Voltage/Frequency Scaling (DVFS) [9] and use of virtualization techniques for proper resource utilization. Various research works have put many efforts to save the energy consumption in clouds and data centers.

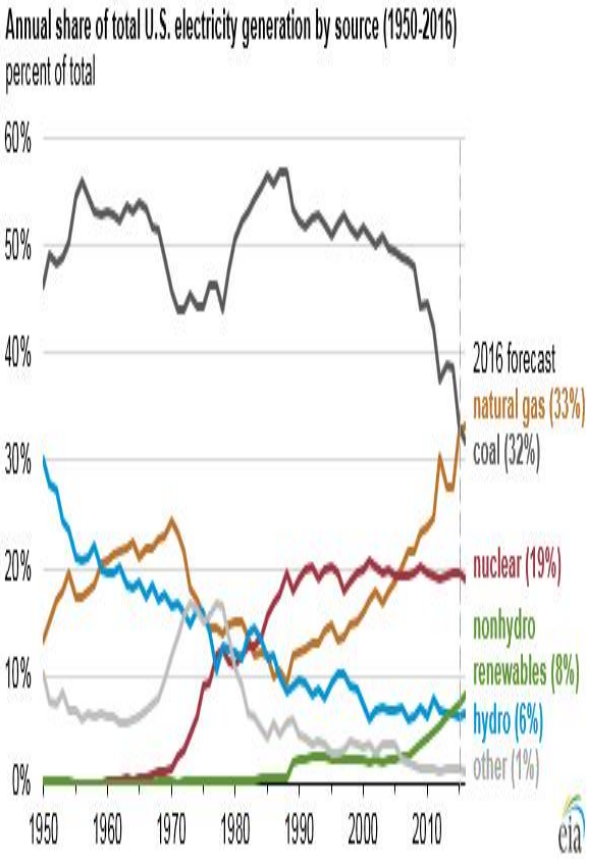

Fig. 3. Annual share of electricity in the US and shows a steady increase in renewable energy

IV. CURRENT ENERGY TRENDS

The current trend is for ISP companies, companies such as Google with substantial computer resources such as servers, etc to provide a cleaner way to generate power and to reduce the overall functioning of the non-renewable energy. Renewable energy is an excellent alternative as this is clean energy. Power required for monitors, console, network peripherals, cooling fans of the processor and cooling system. As in 2012, the power consumption of data centers was around 38 Giga Watt(GW) which is about 63% more than energy consumption of 2011 [10].

Figure 3 explains the solar power, hydro, wind and wave technology to produce energy in US and steady increase of total power generation.

Figure 4 shows the overall usage of power consumed.

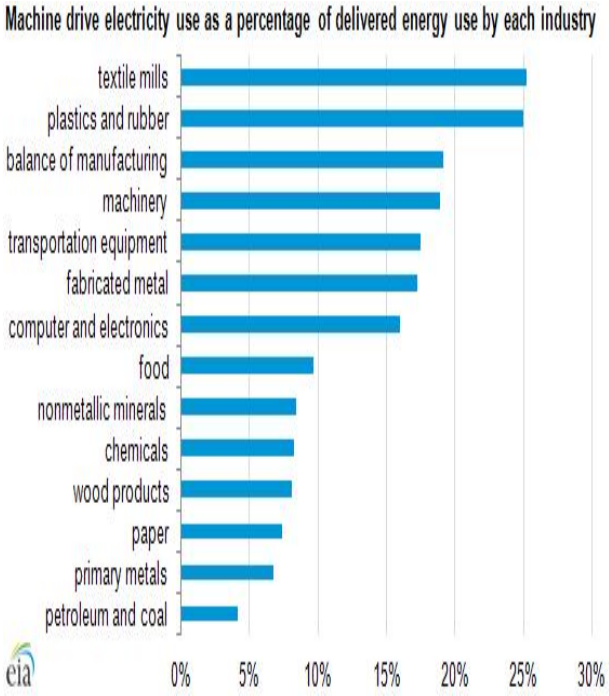

Fig. 4. Computer and electronics consume more than 15% of overall power grid consumption

Big data centers require large amounts of energy, from the cooling systems functioning 24/7 to the data servers. These are just some of the ways energy consumed in a data center. Chen et al. [11] reported in a paper that an idle server for keeping memory, disks, and I/O resources in running mode may use about 2/3 of the peak load. It concluded that an idle server in a data center consumes a considerable amount of energy and wastes more energy compared with other parts of data centers.

Since we see this fact, we need to try and reduce the amount of energy used and improve so that we can use maximum output.

V. METHODOLOGY

The methodology is simple. We can improve the overall output of cloud computing peripherals by enhancing the global power grid and converting the existing network into renewable energy. It reduces the carbon footprint left by burning fossil fuels.

The method here is to optimize the output of the computing related to cloud and to optimize the energy used by improving the way the power used. The power can be generated using renewable energy resources; non-renewable energy resources are ineffective and are causing significant problems related to the environment. Large computer rooms also need cooler temperatures compared to the surrounding environment as this is vital for the processing speed and the output generated.

The below table 1 help answer a few methodological questions:

Table 1. Motivation of this study

Questions	Motivation
Why is energy efficiency important?	Energy efficiency is important to improve overall understanding of the way energy is consumed and to preserve the way energy is used.
Renewable or non-renewable energy?	Renewable energy is more viable and reliable even though it is costly. Non-renewable energy resources release harmful gases into the environment which is not good.
How is cloud computing beneficial in energy efficiency?	It is beneficial as Computing with clouds has surfaced as a useful paradigm for handling the energy problem and in dealing with the growing need of energy. There are many different techniques implemented in cloud computing to help curb the rising energy consumption in the overall cloud computing sector.
Methods to use?	Implement renewable energy schemes around the big data centres to help curb the need for the energy needed by the overall power grid.
IT industry roles?	The IT industries roll is simple, they can create more evolved techniques to help reduce the overall energy consumed by their big data equipment and to improve on their energy efficiency techniques.
Role of cloud computing?	Cloud computing helps play a major role in our world of technology, we can implement larger drives to improve he way energy is harnessed and consumed.

The change of energy is vital for the saving of energy, here are a few energy saving techniques used:

1. Improve the surrounding areas, by developing more evolved data centers. This means improving the output and energy consumed.
2. Implementing greener energy solutions such as solar and wind technology to generate the electricity needed to keep large computer systems operational.
3. To maximize the output and improve the computers processing production. Implementing regulations on IT companies to achieved greener energy efficiency to help reduce the energy burden on the already overloaded electricity grid.

VI. IMPLEMENTATIONS

Implementation occur using existing energy saving protocols and improving on it by using a greener approach to enhance the overall functionality of the networks.

Cluster-Based Energy Conservation Protocol:

One of the disadvantages with protocols is that it needs global information (overall network information) which may not be available every time, due to the lengthy procedures to get comprehensive information. It makes it very conservative because it guesses its connectivity instead of directly measuring it which leads to fewer energy savings.

A need to determine network redundancy

Creating nodes to determine the network redundancy can improve the overall energy consumed. An operating the nodes can do this, we can organize it into clusters that are overlapping. A group can view as a circle around the node, this head is the cluster, this cluster will provide radio

transmission and its range defines the radius of the circularly shaped cluster. A cluster head described in such a way that it reaches each node, this will provide a quicker response time and improve the overall functionality and to reduce network redundancy.

Creating network nodes can reduce the overall energy consumed by massive networking protocols. Nodes can act as an interface between the sender and receiver. It is the proper analyzing of the data such as the cloud computing interface. These nodes can help reduce the energy load on the networking hardware.

VII. RESULTS AND DISCUSSIONS

The below table 2 shows renewable energy vs non-renewable energy used in the IT world.

Table 2. IT world used for renewable and non-renewable energy

	laptops	desktops	mobiles	Servers (big computers)
Sun	✓	✓	✓	✓
hydro	x	✓	x	✓
wind	✓	✓	x	✓
Coal	✓	✓	✓	✓
Gas	✓	✓	✓	✓
petroleum	✓	✓	✓	✓
Other	x	x	x	✓

The viable options are shown table 2, however some renewable energies are not viable in terms of functionality. To safe levels of global greenhouse gases, renewable energy sources are becoming a prioritized choice for IT companies to power their rapidly expanding data center infrastructures. The international environmental organization Greenpeace states that "Green IT = Energy Efficiency + Renewable Energy" [12].

Figure 5 represents the power consumption for all computers. It includes the mobile cloud computing concept.

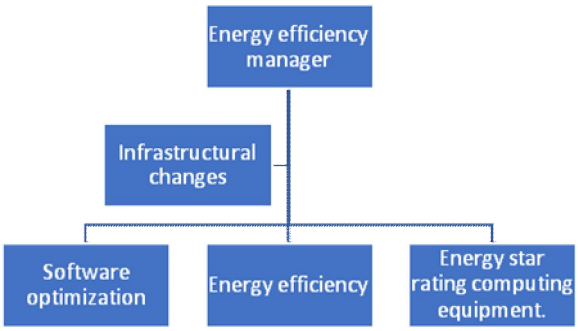

Fig. 5. Energy consumed in mobile computer

The above figure 5 shows how we can improve the energy consumed in mobile cloud computing.

With software optimization, we can save the load used on the hardware part of computing, especially in cloud computing where large servers are used that cause mass energy consumed. Energy should be conserved to create a positive response. It aids in finding more energy efficient protocols and scheduling in the overall network architecture used to run cloud computing. The node implementation can improve the overall functionality of the cloud computing operations and reduce the total energy consumption. To study the use of renewable energy in data centers, a renewable energy powered platform "Parasol" was constructed [13]. Two load-scheduling systems Green Slot [14] and Green Hadoop [15] designed. Both assume that the data center powered by solar energy and grid with no batteries for energy storage.

VIII. CONCLUSIONS AND FUTURE RESEARCH WORK

We can find a solution to control the overall energy consumed, reduce the total energy consumption, promote a greener renewable energy initiative using energy saving techniques and improving the cloud computing output by thrice fold. It can be achieved by implementing technologies such as energy saving algorithms, improving current technological computing advancements and the use of artificial intelligence go a long way in improving the energy and improving cloud computing.

Future research work should occur at finding energy efficient scheduling algorithms in software optimization and improving the overall hardware energy consumed by enhancing the software and how it is optimized. By creating energy efficient algorithms, such as network schedules, improve the overall architecture of cloud computing and its

related networks. It also surrounds the possibility of renewable energy resources to generate the required energy needed to run the networking architecture. It is an improvement of the overall functionality of the software and provides a much greener environment to work within the IT world.

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