Green Cloud Computing: "A Boon to Technology"

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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 base data center are growing really which leads to high energy utilization every day and also the emission of CO_2 by these data centers greatly affect the environment. To conquer this trouble Green Computing came into subsistence. The main goal of green computing is to reprocess and use again. Green Computing help to obtain the similar computing speed at reduce energy utilization. In this paper I discussed about how green computing can be achieved by various algorithms which can reduce the energy consumption of cloud data centers which will in turn reduce the low emission of CO_2. That arises research challenges when such energy-saving techniques are required to minimize the impact of Cloud computing on the environment.

Keywords
Energy-efficient Computing, Efficient Data Centres, Co_2 emissions, Cloud Computing.

I. Introduction

The issue of energy consumption in information technology equipment has been getting increasing concentration in recent years and there is mounting recognition of the require to manage energy consumption across the entire information and communications technology (ICT) sector [1]. In the last induce of years, Cloud support data centers are increasing greatly because of the demand for processor resource. Since more data centers are came into survival the energy utilization of these data centers are also increased to a great extent [2]. In adding to high energy utilization there is an adding impact on the surroundings by the form of carbon dioxide emission.

According to the report of Congress on Server and data centers [4], the data center are accountable for regarding 2% of global CO_2 emission and they use virtually 80 million megawatt-hours of energy annually, it is about 1.5 era the quantity of electricity used by the complete New York City. By 2020 the total quantity 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 center should have good energy efficiency [3]. 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 [5], 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.

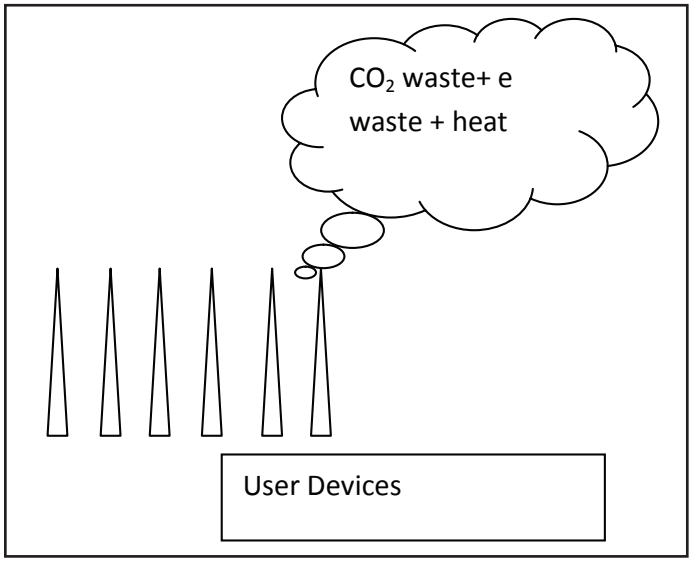

Fig. 1: Cloud Computing

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:
The concept of smart means low on energy consumption. Reliable network store large numbers of data over the cloud and for this purpose server are required to put the data over the cloud. According to the reports of 'Data Centre Energy Forecast Report' 20 percent of energy can be saved in aspect of server and network of any cloud. Moreover data centers are required to be cool on which our data is residing. According to the HP total 60-70 percent energy is required to cool our data centers [6].
Further the concept of virtualization plays a key Role in energy efficient clouds, which allows large numbers of organizations to share its infrastructure. In other words servers in the form of multiple virtual machines sharing the same physical server at higher utilization and companies can gain saving in the form of space, management and energy.

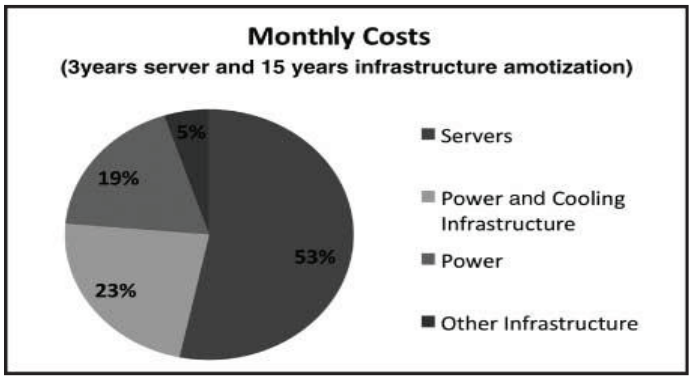

Fig. 2: Energy Distribution in the Data Center (Amazon.com)

Modern data centers, operating under the Cloud computing model are hosting a variety of applications ranging from those that run for a few seconds (e.g. serving requests of web applications such as e-commerce and social networks portals with transient workloads) to those that run for longer periods of time (e.g. simulations or large data set processing) on shared hardware platforms [7].
The need to manage multiple applications in a data center creates the challenge of on-demand resource provisioning and allocation in response to time-varying workloads [8]. Normally, data center resources are statically allocated to applications, based on peak load characteristics, in order to maintain isolation and provide performance guarantees. Until recently, high performance has been the sole concern in data center deployments and this demand has been fulfilled without paying much attention to energy consumption [9].
Data centers are not only expensive to maintain, but also unfriendly to the environment. High energy costs and huge carbon footprints are incurred due to massive amounts of electricity needed to power and cool numerous servers hosted in these data centers. Cloud service providers need to adopt measures to ensure that their profit margin is not dramatically reduced due to high energy costs. Lowering the energy usage of data centers is a challenging and complex issue because computing applications and data are growing so quickly that increasingly larger servers and disks are needed to process them fast enough within the required time period [10].

Green Cloud computing is envisioned to achieve not only efficient processing and utilization of computing infrastructure, but also minimize energy consumption. This is essential for ensuring that the future growth of Cloud computing is sustainable. Otherwise, Cloud computing with increasingly pervasive front-end client devices interacting with back-end data centers will cause an enormous escalation of energy usage. To address this problem, data center resources need to be managed in an energy-efficient manner to drive Green Cloud computing. In particular, Cloud resources need to be allocated not only to satisfy QoS requirements specified by users via Service Level Agreements (SLA), but also to reduce energy usage.
The overall energy measuring is required at hardware levels as well at software level keeping this in discussion we organize this paper as follows. Then Section II describes the green cloud computing approaches. The most followed methods in current state of energy efficiency in Section III. We discuss the salient aspects of energy-efficient cloud computing in Section IV. In Section V, we detail the main research challenges that lie ahead, and provide the concluding remarks in Section VI.

II. Green Cloud Computing Approaches

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.

A. 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.

B. 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.

C. 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%.

D. 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.

III. Energy-Efficient Hardware

One of the best methods to increase the energy efficiency is to design and develop more energy-efficient hardware. Computer power can be saved by means of various well-known techniques. Firstly the system should be shut down by sensing lack of interaction. Secondly by slowing down the CPU clock speed known as clock gating or we can power off the chips also which is known as chip gating [11, 12].Other methods of powered down the system processor are SpeedStep [13], PowerNow [14], Cool'nQuiet [15] or Demand-Based Switching [16].
The advanced configuration and power interface (ACPI) specification [11]. Explains how the computer system can be set into four different power states ranging from G0 to G3.In which second and third state are subdivide into sub states that specify which component should be put in off state. These mentioned techniques are usually used in mobile devices but can be utilize for desktop PCs as well. Other methods includes developing energy aware scheduling or algorithm that can help in predicting jobs completions prior to its implementation on system and also predict the deadline of the job in advance before it can be executed on any cloud [17].

A. Virtualization

According to Google's earnings reports, the company has spent $US1.9 billion on datacenters in 2006, and $US2.4 billion in 2007. If we go 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 putting huge amount of capital in establishing Cloud datacenters.
So another method of energy efficiency is virtualization. In Virtualization partitions computational resources are partitions and thus allow the sharing of hardware. While many services require only small fraction of resources to run their data on servers, however power required by the server is 70 percent of their maximum power [18]. In that case, services can be virtualized and run within a virtual machine thus resulting in overall energy efficiency. Depending on their utilization, many VMs can run on a single hardware unit (server consolidation). Therefore, less hardware is needed overall, thus reducing energy wasted for cooling.

B. Other Issues in Energy Consumption

Other topics to be discussed are [3]

1. Power minimization in server clusters.
2. Power minimization in wireless and wired networks.
3. Energy savings in networks and protocols.

IV. Features of Green Cloud

With the increasing amount of energy consumption there is a great concern in the community that cloud computing can result in higher energy usage by the data center. If we go on the path of green line computing still companies are employed certain technologies and concept to achieve the goal of better utilization and efficiency then the traditional method of computing. Therefore, comparatively lower carbon emission is expected in Cloud computing. This can be achieved by adopting highly energy efficient infrastructure and reduction in the IT infrastructure itself by multi-tenancy.

According to Accenture Report, four main factors are there that can enable the cloud computing resources to lower their energy usage and carbon footprints by at least 30 percent per user by moving their applications to the Cloud [19]. These savings are driven by the high efficiency of large scale Cloud data centers.

V. Future of Green Clouding Computing

We mainly discuss those technologies, techniques and concept along with scheduling and algorithmic approaches by which we can efficiently use our cloud computing resources and facilities of different cloud. But what if we do the advance research in these fields. So that those users which are new to opt for cloud services can easily distinguish between different cloud computing companies that which companies can provide more energy-efficient, more reliable and faster services . We can lay parameters and compose the service in a way that fits to more energy efficient services. Thus next level of developing requires comparative mechanisms that can track the energy of a particular task that has been used by a particular user for their services.

VI. Conclusion

In conclusion, we can say that no technology or method is green but its user who uses it makes him green by using it effectively according to its requirement. The importance of green cloud computing is to make its usage more carbon efficient both from user and provider's perspective. Cloud Providers need to minimize the consumption of its electricity demand and take major steps in using renewable energy sources rather than just looking for cost minimization.

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