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A Brief Study on Green Cloud Computing

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ABSTRACT

Cloud computing offers computing power and properties as a ability to users across the sphere. This scheme was presented as a means to an end for customers worldwide, providing high presentation at a inexpensive cost when compared to keen high-performance computing machines. This provision requires huge data-centers to be tightly-coupled with the system, the increasing use of which yields heavy feeding of energy and huge discharge of CO2 In this survey we discuss key methods to decrease the energy ingesting and CO2 release that can cause severe health issues. A discussion on green matrices appropriate for data-centers and then throw light on green scheduling algorithms that facilitate reduction in energy consumption and CO2 emission levels in the existing systems. At the same time the various existing architectures related to green cloud also discussed in this paper with their pros and cons.

Keywords: high-performance computing machines, Green cloud computing, CO_2 emission

INTRODUCTION

According to Wikipedia [wiki], Cloud computing is a collection of a variety of computing concepts in which thousands of computers communicate in real-time to provide a seamless experience to the user, as if he/she is using a single huge resource. This system provides multiple facilities like – web data stores, huge computing resources, data processing servers etc. The concept of cloud computing is around since the early 1950s, although the term was not coined back then. Time sharing systems was how it was addressed back then. During the period of 1960 - 1990, a host of experts did hint the era of cloud computing in their books or quotes.

The term dumb terminal attached to the mainframes was more famous in this period, in-lieu of the term cloud computing. In the early 1990s, even the telecommunications companies began offering VPNs (Virtual Private Networks) instead of dedicated connections, which were decent in QoS but were comparatively cheaper. In 1999, Salesforce.com was among one of the first to provide enterprise applications via a website. This move aided the advent of cloud computing which was introduced around 2002 by Amazon, the organization which can be considered as one of the pioneers in the field with their Amazon Web Services (AWS) and Elastic Compute Cloud (EC2). Since 2009, after the introduction of web 2.0, other big shots in the web industry viz. Google, Yahoo etc. have also joined the club.

Cloud computing can be considered as a hierarchy of concepts, which comprises of several models. The first model is the Service Model [11] which further includes three models namely – software as a service, platform as a service and infrastructure as a service. Second is the Deployment model [11] which further comprises of public cloud, private cloud, community cloud and hybrid cloud. According to National Institute of Standards and Technology (NIST) – "the major objective of cloud computing is to maximize the shared resources and at the same time the disadvantage is its high infrastructure cost and unnecessary power consumption."

According to National Institute of Standards and Technology (NIST) – "the major objective of cloud computing is to maximize the shared resources and at the same time the disadvantage is its high infrastructure cost and unnecessary power consumption." Global warming has been a big concern of late, with high power consumption and CO2 emission acting as a catalyst to increase the same. The world has become highly protective about the environment with inputs from contributors such as – Greenpeace, Environmental Protection Agency (EPA) of the United States and the Climate Savers Computing Initiative to name a few. With the continuously increasing popularity and usage of cloud computing and the increasing awareness of the people across the globe towards the use of eco-friendly resources has forced the researchers to devise concepts towards an eco-friendly energy efficient flavour of cloud computing called green cloud computing.

According to the previous works green cloud computing facilitates the reduction of power consumption and CO2

emission along with the reutilization of energy in an efficient way. Cloud uses thousands of data-centers in order to process the user queries and to run these data-centers bulk amount of power is used for cooling and other processes. Every year this power consumption is gradually increasing and green cloud computing endeavours to reduce the same thus playing a helpful role to curb these issues. There are various techniques and algorithms used to minimize this expenditure [13]. Among various avenues, one area ofresearch focuses on reduction in energy consumption by computer servers [11],whereas the other lays stress on dynamic cluster server configuration [20, 21]to reduce the total power consumption by balancing load and effectivelyutilizing only a subset of the resources at hand. Similarly Dynamic CPU clock frequency scaling again incorporates some form of load balancing to save power during different load conditions. In addition to these, some more techniques are used to measure the power consumption in data-centers. The first one was developed by the Green Grid called Power Usage Effectiveness (PUE) metric to measure the effectiveness of data centers. PUE tells about the amount of extra power required for cooling IT equipment [16].

It is clear from Figure 1 that in cloud scenario power consumption is very high with high carbon emission whereas at the same time in green cloud thisis very less as compared to traditional cloud. Green clouds avoid power wastage and this is the reason for adoption of this technology by IT companies like Google, Microsoft, Yahoo!, etc. According to a survey done in the year2007 IT industries contribute to 2% of the total carbon emission every year[19]. European Union (EU) is also of the view that severe reductions of the orderof 15%-30% is required to maintain the global temperature and stop it from increasing drastically before 2020 [19].

The remainder of this article is organized as follows. Section II reviews previous research in the field of green cloud computing. In Section III we briefly describe the approach used to address the problem. Section IV examines the proposed work with the existing method. Finally, we summarize the study and give way for future research in Section V.

Existing Work

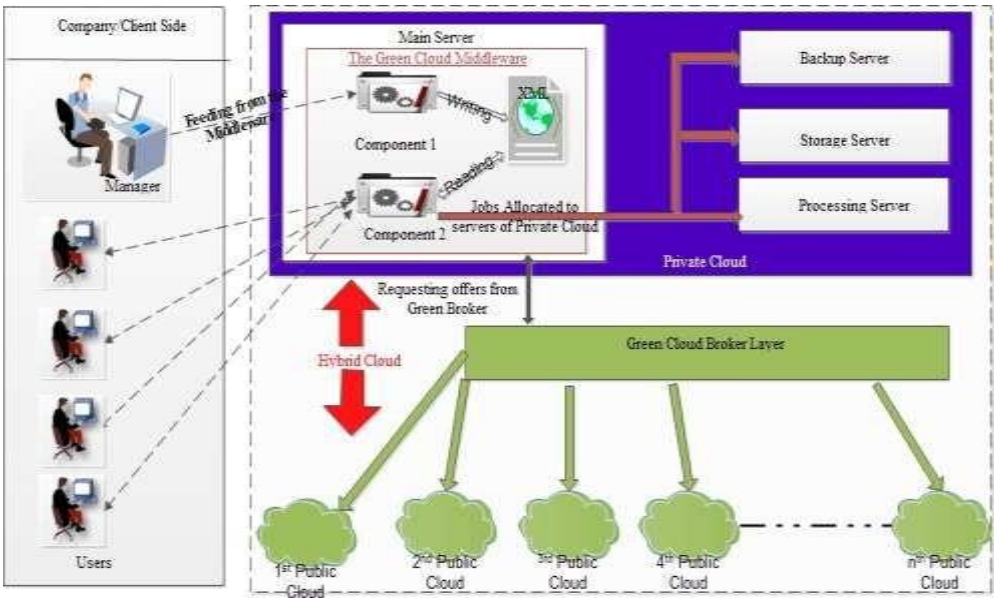
The use of Green Cloud Computing has increased substantially in the recentpast. A lot of research has been done to incorporate and enhance the applicabilityof Green Cloud in real life scenarios with these help of various parameters. Usage of energy is dramatically increasesin data centers. Cavdar et al., [1,2] introduced for improving the energy efficiency of the running data centers, the Green grid is proposing some parameters like Power Usage Effectiveness (PUE)[7] and Data centre Efficiency (DCE) metrics [10], TDP (Thermal DesignPower) [2], etc. PUE is the common parameter.

According to Wikipedia “PUE is a measure of how efficiently a computer datacenter uses its power “The range of PUE is varies from 1.0 to infinity. If the value of PUE approaching it means efficiency is 100% and full power is used by IT equipment’s. In recent years some companies achieved low PUE levels, like Google PUE with .13 [9]. If the value of PUE is 1.5 it means that energy consumed by IT equipment in 1kWh, by data centre 1.5 kWh and 0.5 WH energy has wasted as fruitless work like cooling, CPU dissipation and other work. Table I explain some parameters proposed for data centers. In many data centre the value of PUE reached to 3.0 or more but by using correct design 1.6 values should be achievable [5].

This calculation is done in Lawrence Berkley National Labs [8]which illustrate that 22 data centers 22 datacenters measured had PUE values inthe 1.3 to 3.0 range [8]. Truong Duy, Sato and Inoguchi et al., [3] implement the green scheduling algorithm combines with neural network predictor for reducing the energy consumption in cloud computing. In this algorithm, the server predicts the load from time t to the time it takes for restarting and calculates the peak load. According to the peak load the number of server state is decided. Let, No is the number of server in ON state and Nn is the number of necessary servers. Ifthe Nn > No then, choose server in OFF state, signal them to restart and if Nn < No choose server in ON state and signal them to shut down.

Fumiko Satoh et al., [4] also focus on reducing the usage of energy in data centers. But for the future energy management they develop an energy management System for cloud by the use of sensor management function with an optimized VM allocation tool. This system will help to reduce the energy consumption in multiple data centers and results shows that it will save 30% of energy. This system also used to reduce the energy in carbon emissions.

Yamini et al., [18] Introducing the key approaches like virtualization, Power Management, Recycling of material and telecommuting of green Buyya et al., Contributes carbon green cloud architecture which points on the third party concept, consist of two types of directories named as green offer and carbon emission. These directories help us to provide and utilize the Green services from users and providers both.



Integrated green Cloud architecture (IGCA)

This architecture has two elements; one is the client and second is the serverside. In the client side the manager and the users are present, which deals with the execution destination of the job and in the server side includes the green cloud middleware, green broker and sub servers like processing servers , storageservers etc. The directory concept is used in the green broker layer of IGCA for organizing all the information of the public cloud and provides the best green service to the user.

The services of the providers are registered in the "Green offer Directory". The Green Broker accessed these services and organized it according to the price, time and the service that offer least CO2 emission. The Carbon Emission Directory keeps and stores the data which contains the information of energy and cooling the up to date information about services.

Whenever the user request for the services, it contacts with the Green Broker.The Green Broker uses these directories and chooses the green offer and energy efficiency information and allocates the services to the private cloud. And finally give the result to the users. This directory idea is beautifully used by the Hulkuryet al., and Garg et al., and proposesa new architecture called as integrated green Cloud architecture (IGCA) shown in Figure 2. It smartly includes client oriented in the Cloud Middleware that verifies the cloud computing is better than the local computing with QoS and budget.

The green cloud middleware has two components. The manager is the main head that deals with one component and stores all the information of the middleware. The usage of the user's PC, the servers present on the private cloudsall the information. The frequencies of each sever like high, medium and low. The energy usage, storage capacity and other information also exist in the component of middleware.

When the manager got request from the client. The request is dividing into jobs and distributed among the users meanwhile they also stores the informationabout job into the component. The carbon emission and energy used for the execution of job on the private cloud by servers, on the public cloud by using green broker or on the client's PC is calculated and show to the users. The bestgreen offer is selected by the manager by taking into consideration the securitylevel of the job also. When the decision is making out by the manager then this information is store in the XML file for future usage.

The second component is accessed by all the users for reading the XML file.This file stocks all the information of the execution of job. The locations ofthe jobs are registered in the file and according to the addresses, they will execute. If the job entry is not in the file then the job will be executed either on the PC of the client or in the private cloud. The execution of job is takes place inthree places. First if the job is executed locally (on the requester side) then this information is stored in the client side so next time when the request arrives it will not get through will middleware. If the job is executed in the private cloudthe location as well as the server name is fetched from the file. Or if it is in publiccloud, we will take help from the green broker to know the most excellent greendecision for the execution of the job. The middleware know all the information about the three places. Energy used by the workers working in the company is also calculated by the middleware for taking further decisions.

The processing speed, energy consumption, bandwidth or others factors are responsible for deciding the best location for the execution of the job. By considering all the factors the middleware will compute and judge the place fromthe three places. The IGCA provides the balance in the job execution and provide the security and quality of service to the clients. The manager divides the task and top quality green solution by considering all the places (public, private, local host).

In this architecture the manager plays the central coordinator work which allocates the job to the users and does all decision making. But at the same timethe manager is the weakest point in this architecture as it is the central point of failure, as if the manager fails everything in the architecture collapses.

Advantages and Disadvantages

As we have discussed above that all existing architectures have some constructive as well as destructive points. Buya et al., [19] gave the architecture for green cloud the major advantage of this architecture is Co2 emission directory, this directory measures the best suitable service which gives less carbon emission so straight away it indicates that energy will also decrease because Co2 emission and energy consumption both are directly proportionate to each other. Similarly the disadvantage is that only CO2 emission and energyis not the factor to be under consideration like Quality Provisioning, Security, etc.

Hulkary et al., covers these factors also under consideration by taking other components which search service first on the private cloud later on publiccloud this reduces the time consumption and provides better results as compareto Buya Architecture. The major disadvantage which we observed here is that manager of the system is the central point of communication so if manager willcrash then whole system will fall apart at the same time decision making done by manager is not intelligent and all work has been done manually.

These are the some of the advantages and disadvantages which observed here in these existing architectures and which can be further improve for the future work.

CONCLUSION

In this paper we addressed the problem of traditional cloud and the use of green cloud at the same time we enlighten the recent work which has been done in the field of green cloud computer for healthy and greener environment. Consequently we gave a comparative study in the field of green cloud computing. There are many possible directions of future work. While in the paper we address the problem of efficient way to fetch the results from the cloud so all the features covered in the paper can be achieved. Further we can implement the approach to automate the manager of the green cloud whomakes all the decisions regarding the services.

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