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A Study to Examines the Concept of Green Cloud Computing

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Abstract: *Cloud computing is a service that gives users around the world the power and resources they need to run their businesses. It's a great way to get the most out of your computing resources, but it requires huge data centers to be connected to the system, which means a lot of energy use and a lot of CO2 emissions. That's why green cloud computing is so important - it provides methods and algorithms to help reduce energy use and CO2 emissions, which can be really bad for your health. We'll start off by talking about green matrices that are suitable for data centers, and then we'll look at how green scheduling algorithms can help reduce energy and CO2 emissions in existing systems. Finally, we'll look at the different types of green cloud architectures and their advantages and disadvantages.*

With the expansion of cloud computing administrations and the heightening requests for information capacity and preparing, the natural affect of information centers has ended up a basic concern. This term paper presents a comprehensive consider on Green Cloud Computing, pointing to address the challenges related with the vitality utilization and carbon impression of advanced information centers.

The consider starts by analyzing the current state of information centers and their commitment to carbon emanations. It dives into the natural suggestions of resource-intensive computing, emphasizing the criticalness for economical arrangements. As information centers proceed to develop in scale and complexity, the ought to decrease their biological impression gets to be paramount.

The paper investigates different methodologies and advances outlined to upgrade the vitality productivity of cloud computing framework. From the selection of renewable vitality sources and optimized cooling frameworks to the execution of virtualization and energy-aware planning calculations, the investigate assesses the viability of these approaches in moderating the natural affect of information centers.

Furthermore, the ponder examines the financial and operational suggestions of green computing hones inside the cloud environment. By analyzing case ponders and real-world usage, the paper surveys the achievability and cost-effectiveness of transitioning towards greener information center operations.

Keywords: Green cloud computing, energy efficiency, CO_2 emission

I. INTRODUCTION

Cloud computing is a combination of a bunch of different computing ideas where thousands of computers talk to each other in real time to give you a smooth experience like you're using one huge resource. It can provide you with a bunch of different things like a web data store, a lot of computing resources, and data processing servers. The idea of cloud computing has been around since the 1950s, but the term wasn't coined until the 1980s. Back then, it was called time sharing systems. During the 1960s-1990s, a lot of experts referred to the era as the "Cloud Computing" era in their books and quotes. VPNs were becoming more popular in the early 90s, and they were cheaper than dedicated connections, but they weren't as good in terms of quality of service. One of the first companies to use VPNs was Salesforce in 1999. This contributed to the emergence of cloud computing, which was first introduced in the year 2002 by Amazon, one of the world's leading providers of cloud computing services, with its AWS (Amazon Web Services) and EC2 (Continuous Compute Cloud). Since 2009, following the emergence of the web 2.0 era, other major players in the web industry, such as Google and Yahoo, have also joined the cloud computing bandwagon.

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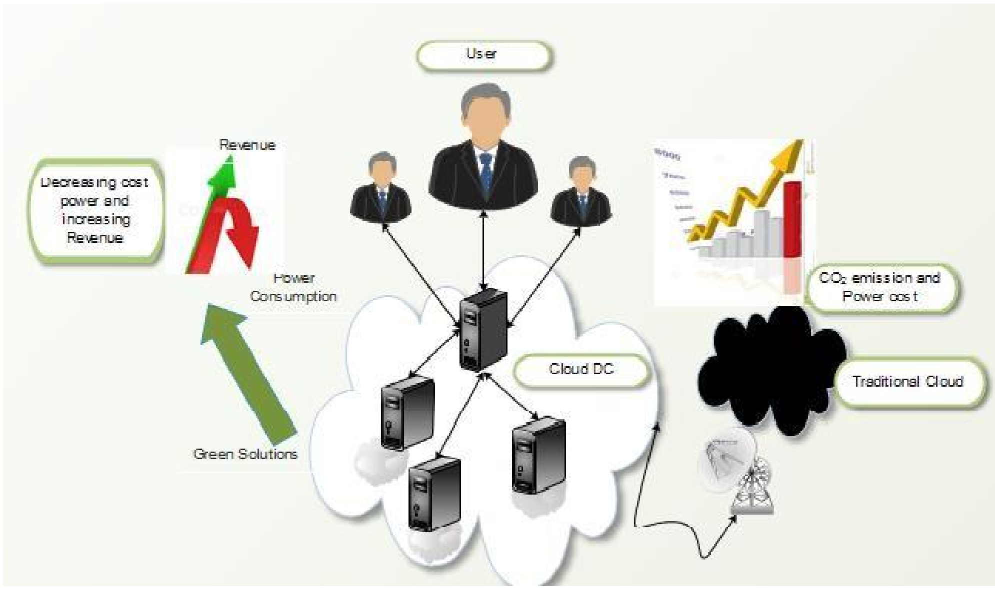

Figure 1. Cloud and Environment [19]

Cloud computing can be considered as a progression of concepts, which comprises of a few models. The primary show is the Benefit Show [11] which advance incorporates three models specifically – computer program as a benefit, stage as a benefit and framework as a benefit. Moment is the Arrangement show [11] which advance comprises of open cloud, private cloud, community cloud and cross breed cloud.

According to National Organized of Guidelines and Innovation (NIST) – "the major objective of cloud computing is to maximize the shared assets and at the same time the impediment is its tall foundation fetched and superfluous control consumption."

According to National Founded of Guidelines and Innovation (NIST) – "the major objective of cloud computing is to maximize the shared assets and at the same time the impediment is its tall foundation taken a toll and superfluous control consumption."

Global warming has been a huge concern of late, with tall control utilization and CO2 outflow acting as a catalyst to extend the same. The world has ended up exceedingly defensive approximately the environment with inputs from supporters such as – Greenpeace, Natural Assurance Office (EPA) of the Joined together States and the Climate Savers Computing Activity to title a number of. With the persistently expanding ubiquity and utilization of cloud computing and the expanding mindfulness of the people across the globe towards the utilize of eco-friendly assets has constrained the analysts to plan concepts towards an eco-friendly vitality proficient enhance of cloud computing called green cloud computing. Concurring to the past works green cloud computing encourages the diminishment of control utilization and CO2 outflow together with the reutilization of vitality in an effective way.

Cloud employments thousands of data-centers in arrange to handle the client inquiries and to run these data-centres bulk sum of control is utilized for cooling and other forms. Each year this control utilization is continuously expanding and green cloud computing tries to diminish the same hence playing a accommodating part to curb these issues. There are different methods and calculations utilized to play down this consumption [13].

Among different roads, one area of inquire about centres on diminishment in vitality utilization by computer servers [11], whereas the other lays stretch on energetic cluster server arrangement [20, 21] to decrease the entire power consumption by adjusting stack and viably utilizing as it were a subset of the assets at hand. Essentially Energetic CPU clock recurrence scaling [22, 23] once more joins a few shapes of stack adjusting to spare control amid distinctive stack conditions. In expansion to these, some more procedures are utilized to degree the control utilization in data-canters. The primary one was created by the Green Network called Control Utilization Adequacy (PUE) metric to degree the adequacy of information centres.

PUE tells around the sum of additional control required for cooling IT equipment [16]. It is obvious from Figure 1 that in cloud situation control utilization is exceptionally tall with tall carbon emission whereas at the same time in green cloud usually exceptionally less as compared to conventional cloud. Green clouds maintain a strategic distance from control wastage and typically the reason for adoption of this innovation by IT companies like Google, Microsoft, Yahoo!, etc.

Concurring to a survey exhausted the year 2007 IT businesses contribute to 2% of the entire carbon outflow each year [19]. European Union (EU) is additionally of the view that extreme decreases of the order of 15%-30% is required to preserve the worldwide temperature and halt it from expanding radically some time recently 2020 [19].

The leftover portion of this article is organized as takes after. Segment II audits past inquire about within the field of green cloud computing. In Segment III we briefly depict the approach utilized to address the issue. Segment IV examines the proposed work with the existing strategy. At long last, we summarize the study and donate way for future inquire about in Segment V.

II. EXISTING WORK

In recent years, there has been a significant increase in the utilization of Green Cloud Computing. A great deal of research has been conducted to refine and improve the practicality of Green Cloud with the aid of various parameters. Data centers are increasingly utilizing energy, and Cavdar et al. [1] proposed some parameters to improve the energy efficiency of running data centers, such as Power Usage Effectiveness [7], Data Centre Efficiency [10], Thermal Design Power [2], and more. The most commonly used parameter is Power Usage Efficiency (PUE).

The Permissible Unit Error (PUE) is a metric used to measure the efficient use of power by computer datacenters. Its range of values is estimated to be between 1.0 and infinity. If PUE is close to 1.0, it indicates that full power is being utilized by IT equipment. In the past, some companies have achieved a low PUE level, such as Google with a PUE of 1.13[9]. If PUE is set at 1.5, it implies that energy consumed in a 1kWh by data centres is being wasted as unnecessary work, such as cooling and CPU dissipation. Table I outlines some proposed parameters for data centres. Many data centres have reached a value of 3.0 PUE or more, however, with the correct design, 1.6 should be achievable. This calculation is conducted by Lawrence Berkley national laboratories [8], which shows that 22 data center 22 dataacenters had a PUE between 1.3 and 3.0 [8].

In order to reduce energy consumption in the cloud computing sector, Truong Duy et al. [3] have implemented a green scheduling algorithm that combines with a neural network predictor. This algorithm predicts the time it will take for a server to reach its peak load, and then determines the number of servers it should have. The number of servers is determined by the number of servers in the ON state. If the number of servers is less than or equal to the ON state, the server should be marked as OFF and the server should be restarted.

Satoh et al. [4] have also focused on reducing energy consumption in data centers, and have developed an energy management system for the cloud that uses a sensor management function to optimize VM allocation. The results demonstrate that this system will reduce energy consumption by 30%.

The cooling process in data centers is a major source of energy consumption. In the past, mechanical refrigerators were used to provide chilled water for IT equipment. However, today, a day's pre cooling, also referred to as free cooling, is used to reduce the need for mechanical cooling. Companies such as FaceBook and Microsoft have deployed their data centres in cold and dry climates, with Microsoft leaving servers in the open air to facilitate cooling. Google has also adopted river water as a cooling method. To reduce energy consumption, various hardware technologies, such as virtualization, and software technologies, such as software efficient algorithms, have been employed.

In order to make the cloud more energy efficient, RASOUL BEIK et al. [6] proposed an energy conscious layer in software architecture that quantifies the energy consumption of data centers and provides services to users in an energy-efficient manner. This paper discusses three main factors that can be used to make a cloud more green: virtualization, work load distribution, and software automation. Additionally, some other factors such as P2S (pay-per-use) and self-service have been demonstrated to reduce energy consumption and CO_2 emissions.

The cost of maintaining and operating data centers in the cloud is projected to increase over time. This paper focuses on the distribution of work load among data centers, in order to calculate energy consumption at packet level. To achieve this, a packet level simulation of data centers has been conducted through the use of a simulator, such as Green Cloud

NS2 Simulator and Cloudsim. The simulation is performed on three levels: Two-Tier, Three-Tier, and Three-Tier High-Speed Data Center Architecture. To address the various challenges in the area of cloud computing, author proposes a model to calculate energy wasted by the generation of various gases in the environment. The model includes data, analysis, record, restrain, and virtualization concept to make the cloud more energy efficient and environmentally friendly.

In a recent paper, Bosman et al. [14] presented a novel challenge in the realm of cloud computing: datacenters consume a large amount of energy and are not always available. In the paper, the author discusses the role of solar energy in cloud computing and how it can be used to reduce energy consumption in data centers. The author proposes a small-scale cloud center that combines three technologies: energy-efficient cloud computing, energy-efficient energy platforms, and energy-efficient DC power distribution. The author also highlights the energy efficiency as an area of controversy in the cloud computing world.

This paper presents a comprehensive overview of the key approaches to green cloud computing, such as virtualization, power management, material recycling, and telecommuting. The primary focus of the paper is on consolidating or scheduling tasks and resources in green cloud computing in order to reduce the high energy consumption of cloud data centers. The results presented in the paper are not based on direct drastic energy reduction, but rather on the potential energy savings of large-scale cloud data centers. Buyya provided a qualitative and empirical literature survey of the different members of cloud that contribute to total energy consumption. The structure of cloud is discussed in this paper, which focuses on green cloud computing. The demand for cloud is increasing rapidly, and the consumption of harmful gases and energy is also increasing, which is a major concern in the health care sector and a major contributor to the cost of operations in the cloud.

Buyya et al. [24] developed a carbon-neutral cloud architecture that focuses on the third-party concept, which consists of two distinct directories, referred to as green offer directories and carbon emission directories. These directories enable users and providers to provide and use Green services. Green brokers access these services from green offers directories and scheduled services based on the lowest CO2 emissions.

Additionally, Beloglazov et al. [25] focused on virtualization to reduce power consumption, as it reduces the workload from the data centres. Finally, Nimije et al. [28] incorporated a hypervisor environment into the cloud data centre to provide virtualization, which serves as a security tool for achieving a high level of safety in green cloud computing..

III. EXISTING APPROACHES

Buyya et al., [24] contributed to the green carbon cloud architecture, referring to the third concept, two types of directory: green provision and carbon emission. This directory helps users and providers to provide and use green services. The provider's services are listed in the "Green Project List".

Green Broker joins these services and guarantees that the one that offers the lowest price, time and CO2 emission. The Carbon Efficiency Directory is a repository and database containing energy and heating information for cloud services and data centers.

Green Broker has used the latest information for its services. Each time the user requests a service, they contact Green Broker. Green marketers use these lists to select green offers and information about energy efficiency and distribute services to private clouds. Finally, the results are sent to the user.

This directory idea was successfully used by Hulkury et al., [26] and Garg et al., [27], who proposed a new architecture called Integrated Green Cloud Architecture (IGCA), shown in Figure 2. It is easy to integrate the client's program into our cloud middleware, which ensures that cloud computing is better than local computing in terms of QoS and budget.

This architecture is composed of two distinct components: the client and the server side. The client side is composed of the manager and users, who are responsible for the execution of the job, and the server side, which includes green cloud intermediaries, green brokers, and sub servers such as processing servers, storage servers, etc.

Additionally, the directory concept is employed in the Green Broker layer of IGCA to organize all the data in the public cloud and provide the best possible green service to users. The green cloud intermediaries are composed of two components: the manager, who is responsible for managing one component and storing all the information in the middleware, and the servers present on private clouds, which contain all the information, such as usage of the user's PC, frequencies of each sever, storage capacity, and other information.

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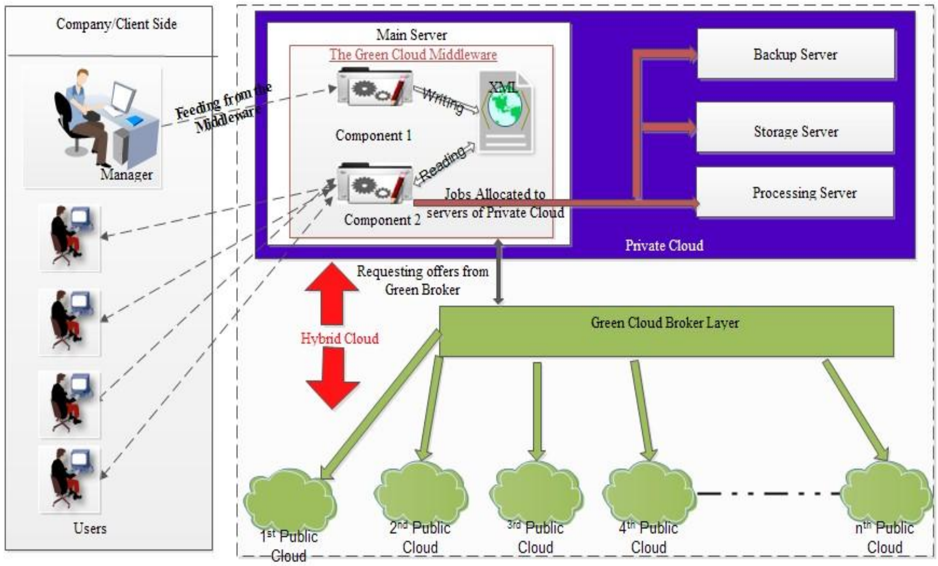

Figure 2. Integrated green Cloud architecture (IGCA) [26]

Upon receipt of a request from a client, the manager divides the request into jobs and distributes them to users. Additionally, the information regarding the job is stored in the component, which calculates the carbon and energy emissions associated with the execution of the job on the server, public cloud, green broker, or client's computer. The manager then selects the most suitable green offer, taking into account the security of the job. After making the decision, the information is stored in XML for future use.

The second component allows all users to access the XML file, which contains all the details of the job execution. The job locations are recorded in the file, and the jobs will be executed based on the addresses. The job execution is typically done in three locations: on the client's PC, in a private cloud, or in a public cloud. The job is executed locally (on the client's side) and the information is stored on the client's side, so that when the request is received, the middleware will not be able to execute it. Additionally, the middleware is able to calculate the energy used by the employees in the company for making further decisions.

The IGCA is responsible for determining the optimal location for the job execution, taking into account factors such as processing speed, power consumption, bandwidth, and more. The middleware will then calculate and evaluate the location from these three factors. The manager is responsible for assigning the task to the users and making all decisions, ensuring the job execution is secure and of the highest quality. However, the manager is also the weakest point in the architecture, as it is the point of failure, meaning that if the manager fails, the entire architecture collapses.

IV. ADVANTAGES AND DISADVANTAGES

As previously discussed, existing architectures have both beneficial and detrimental aspects. The primary benefit of green cloud architecture is its CO2 emission directory, which quantifies the most suitable service that produces the least amount of carbon emissions. This indicates that the system will also reduce energy consumption, as CO2 emissions and energy consumption are inversely proportional.

The disadvantage of this architecture is that it does not take into account other factors such as Quality Provisioning and Security, as well as other components that search on the private cloud first and then on the public cloud, thus reducing the time consumption and providing better results than Architecture. The main disadvantage of this architecture, however, is that the manager is the primary point of communication, and if the manager fails, the entire system will collapse. Additionally, the decision making done by the manager is not intelligent, as all work is done manually.

This paper outlines some of the benefits and drawbacks of existing architectures that can be improved upon for future work.

V. CONCLUSION

This paper examined the issues associated with traditional cloud and the utilization of green cloud technology. It also provided an overview of the recent research in the area of green cloud computing, with the aim of promoting a healthier and more environmentally friendly environment. As a result, a comparative study of green cloud computing was conducted. There are numerous potential avenues of future development. Additionally, the paper addresses the issue of an efficient way to retrieve data from the cloud, in order to achieve the features outlined in the paper. Furthermore, the approach of automating the management of the green cloud, which makes all decisions regarding the services, can be implemented.

By bringing together case studies and real-world implementations, this research shows how companies and organizations can invest in environmental responsibility and economic prudence, dispelling the myths that arise about sustainability at the expense of money. More importantly, our study highlights the importance of collaborative efforts and policy interventions to promote the adoption of green cloud computing. Government regulations, industry standards and incentives have been identified as key catalysts in driving the industry's transition to environmentally conscious computing.

As we conclude from this research, it is clear that the journey towards green cloud computing is a revolutionary process. Despite great advances, there is still a need for innovation, research and industry collaboration. Developing better technologies, exploring new energy solutions and improving policy frameworks are essential components of a sustainable cloud computing project. The environmental challenges we face in the coming years show the urgency of adopting green computing.

The call for responsible technological innovation is not only wise, but necessary. This study is not exhaustive, it aims to encourage deeper exploration and action and encourage stakeholders in the cloud computing ecosystem to start walking together in a green and sustainable environment. In conclusion, the vision of green cloud computing was achieved based on the concepts of innovation, economic sustainability and environmental management. As researchers, practitioners, and policy makers continue to work together, implementing a planet-friendly and ecologically balanced cloud computing environment is not only common but important in the digital age.

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