

A Review on Green Cloud Computing as a Step towards Promoting Sustainable and Eco-Friendly Computational Approach

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ABSTRACT

Green Cloud is an idea that contributes towards faster digital computational unit with low access cost by an eco-friendly means. Green revolution promotes the use of available resources in environment friendly way and Cloud technology offers storage, database, networking, software, analytics and many more services to its customers on Pay-As-You-Go basis. In today's scenario, technology is moving largely towards cloud. There is a drift of big as well as small businesses on cloud. With this alteration, there arises a need to go green, as there is lot of carbon footprints and emissions with the use of electronic devices like laptops, standalone PCs, servers etc. The focus of green technology is to minimize the computational costs along with saving the substantial energy consumption and effective utilization of such devices. Green Cloud Computing is an approach towards promoting the green concept in cloud technology. This paper highlights the need to switch to green technology and provides various ways by which it can be attained. The emphasis is on the use of Green Cloud with a mention of its architecture and usefulness, which probably would optimize the performance of cloud without harming the environment. The study is based on the work done by various scientists working in data centres concluding that there is a need of getting green with cloud technology.

Keywords: Green, Cloud Computing, Pay-As-You-Go, carbon footprints, standalone PCs.

I. INTRODUCTION

Getting Green is the need of today's technology. Green implies the use of resources in such a way that may not harm or disturb the ecological balance and environment in turn. Green Cloud Computing comprises of two different conceptual terms: 'Green' and 'Cloud Computing'. Cloud offers services to the

technology providers and consumers. Cloud Computing concept was coined in 1960 by Joseph Carl Robnett Ricklider as his work on ARPANET. The core purpose of a cloud was to interact with people around the world along with data sharing anywhere anytime. Cloud Computing works on the principle of distributing the services of servers, networking, storage, database etc. Its motive is to give quicker upheaval,

supply resources, and budget solutions. Cloud Computing gives facility of flexibility to data and services. A cloud user is not confined to boundaries as the data and services are available as per the needs and convenience. Clouds have been proved as a cost-effective service provider. Most recent cloud products include AWS elastic Compute, Google cloud Engine and many more.

Every business these days is focused on customer's data. All the devices like computers, laptops, Smartphone, smart watches keep the customer related data on clouds. These clouds offer services for storing, processing, and retrieving user's data by using available software applications meant for emails, messengers, social-media networking sites, audio and video streaming, entertainment, and many more of same kind. Cloud technology requires huge data centers with web servers to store and retrieve tremendous amount of data. According to a research done in the year 2020, the data center industry consumed around 196 to 400 terawatt hours (TWh). This is equivalent to 1% to 2% of worldwide annual data center energy consumption [6].

According to an article published in June 2022 in Economic Times, the current data center capacity of India is around 870 mw, which is expected to get doubled to 1700-1800 mw by fiscal 2025, according to a crisil report. It also mentioned that this massive growth is due to the boom of data usage because digital adoption and local data storage mandates. Due to recent trend, after the COVID-19 pandemic, the office work is largely shifted to homes. As employees are mainly doing work from homes, the use of mobile data traffic grew 31 percent which is approximately 253 exabytes (1 exabyte is 1 billion gigabytes)[3]. Increasing dependency on internet-enabled services in the country has given rise to the need of reliable data centers. This is reason behind the huge investment by Indian government on building digital infrastructure and data centers are the base of this digital infrastructure. With this rapid growth of data centers, comes the challenge to control carbon emissions as 2

percent of world's green house gas emissions are contributed by data centers alone.

II. NEED OF GREEN COMPUTATION FOR CLOUDS

Global warming has become a major threat to our environment. It has got various reasons behind it, like electronic waste or e-waste, energy consumption are main areas of concern. Green computing is solution to such problems. It helps in reducing energy consumption, or in optimal usage of energy. By opting green computing practices, organizations can reduce their energy requirements, hence can reduce carbon footprints. This approach always leads to resource sharing and utilizing the components in best possible way. It focuses on all sides of computer's life from design to disposal. It practices power off with idle virtual server to save energy. Thereby it has become silver lining in the clouds.

III. GREEN CLOUD ARCHITECTURE

GCC architecture is designed to make computational work efficient on the clouds, which enables optimal energy and resource utilization [10].

A. Cloud Consumers

Cloud consumers are the most important stakeholders of cloud technology. They are the end-users that generate requests for avoiding cloud services from any part of the world. A cloud consumer can be a company using web services or it can be a direct client working on some project or research area who wishes to avoid cloud services on pay-as-you-go terms.

B. Green Policy Validator

This module ensures that a cloud provider should comply all the protocols defined to maintain the greenness along with computation.

C. Carbon Footprints Check

This module is designed to have a check on carbon footprints generated while using cloud services for different purposes. This task is done by providing parameters to control carbon emissions.

D. Green Service Provider

A green service provider is actually a mediator between cloud infrastructure and its users. There are many modules on which a GSP works, before providing a service to its customer.

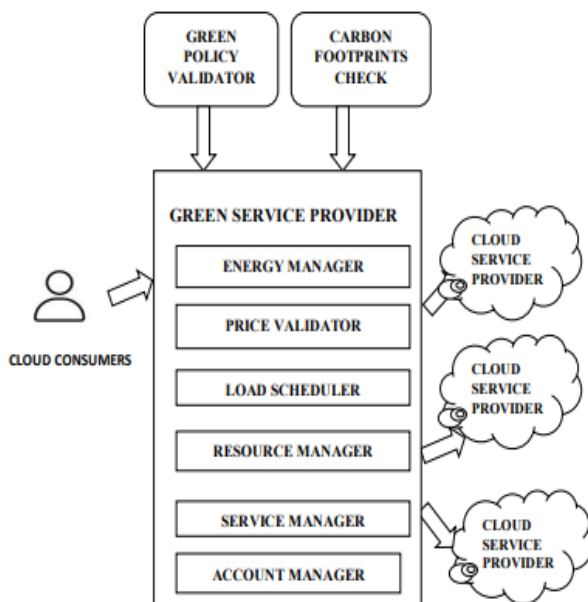


Figure 1. Architecture of Green Cloud Computing

- i. Energy Manager: This is the most important module of Green Cloud Architecture as it deals with energy and power consumption. When a consumer requests for cloud infrastructure, it calculate the energy to be consumed by the consumer after analysing the energy consumption details. It also recommends the energy efficient algorithm to be used for power management.
- ii. Price Validator: Price Validator works on pricing module and suggests the best price for the requested service for the timeline opted by consumer. This also helps in prioritizing effective resource allocations.

iii. Load Scheduler: The purpose of load scheduler is to manage the tasks handled by a cloud. Load scheduling is one of the main issues in cloud computing. The load scheduler works effectively with implementation of load balancing techniques.

A. iv. Resource Manager: The role of resource manager is to manage the available resources efficiently and effectively. The aim is to provide maximum revenue to service provider along with utilizing the available resources up to their maximum limits.

B. v. Service Manager: Service Manager Module accepts the service request and assigns them to the virtual machines. It also manages the virtual machines.

vi. Account Manager: This module deals with accounting details like the type of service requested, usage of service requested and historical usage details so that service allocation can be improved further.

The Green Policy Validator and carbon footprints check modules are the third-party policy maker modules, that ensure the proper compliance of the standards and policies specially assigned for the implementation of green clouds.

Finally, the request is forwarded to a cloud service provider (GCP) which fulfils the green criteria. The GCP is turn provides services to its consumers.

IV. CHALLENGES AND FUTURE OF GREEN CLOUD COMPUTATION

Green computing is related to the eco-friendly use of available resources for effective computation and clouds provide flexible means of computing. Green Clouds are environment friendly clouds. There are some non-technical and technical problems associated with implementation of green clouds. The main challenge that is faced in this area is unawareness of consumers towards getting green. The green ICT plays an important role in maintaining the ecological balance in nature. People should be made aware about the importance of switching to green technology. On technical grounds; the problems are related to efficient switching of virtual machines, software module

implementation and use of energy optimization algorithms and techniques. The future implementation of green clouds depends on following parameters:

Energy Utilization: There is a need of designing algorithms that can optimize the power consumption of data centres. The base of cloud technology is data centres. If data centers would be green, then clouds would be green too.

Virtualization: Virtualization in cloud computation should be effective through to deal with high-end optimization related limitations.

Automated resource allocation and sharing are among the main challenges faced in Virtualization. Optimal use of Virtual machines can make the implementation of green clouds possible.

Cost Effectiveness: The hardware as well as software cost involved in implementation of green cloud should be less. The infrastructure supporting green computing should be eco-friendly as well as affordable.

V. CONCLUSION

Green cloud computing is a perspective that integrates cloud computing concepts with Green IT. The future outcomes are manifold. It puts an emphasis on the Green ICT. This paper motivates the IT applications to be more environment friendly along with along with the optimal utilization of available resources, thereby increase in efficiency. We have proposed the probable architecture Of Green Cloud Computing keeping in view the need of getting *green*. It also covered all parameters on which future implementation of green clouds depend.

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