



## GREEN CLOUD COMPUTING: CHALLENGES AND SOLUTIONS

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### Abstract

Cloud computing and green computing are actually complimentary to each other. Both of these advance computing gradients have important role for technological advancement and transformation. Cloud computing is a kind of network grid in which network and communication technology play an important role for complete virtualization of information technological infrastructure. On the other hand, green computing is nothing but reusing of information technological product. In green computing recycling can play an important role. Cloud computing and virtualization is an important method of green computing, which make less use of computers, products and energy. In this paper green computing has been described with special reference to their need and value in today's competitive world with the main challenges and issues of these technologies in Indian scenario. Also, the solutions to clear the obstacles have been mentioned.

**Keywords:** Cloud Computing, Green computing, Green Technology, Energy Management, Resource Management, Advance Computing, Information Science, Technology, Computer Science, Virtualization, Computer, IT.

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**DOI:** 10.48047/ecb/2023.12.si5a.0616

## Introduction

The virtualization of various information technological infrastructure, such as software, hardware, applications, utilities, drivers, and so forth, is actually what cloud computing is all about. Fundamentally, cloud computing is a way for one user to benefit from a remote location almost constantly and from anywhere in the world.

While *Green Computing* is the application of environmentally friendly technology or green initiatives to successful computing systems. In addition to resource allocation, green computing includes deployment, optimisation, virtualization, and energy management. Green computing is currently a power and energy-saving initiative.

Although there are a number of difficulties and problems with both cloud computing and green computing, initiatives, awareness, and monetary issues are the most prevalent and significant difficulties.<sup>1</sup> Applications are growing in many other new fields and areas as a result of the astounding and wonderful benefits of computing.<sup>2</sup> According to the cloud computing service model, a service provider must supply massive pools of high-performance computing resources and high-capacity storage devices, which are then divided among end users as needed.<sup>3</sup>

Despite the fact that there are numerous different cloud service models, in general, customers who subscribe to the service have their data hosted by the service and have access to computing resources on demand from a pool. The service provider may offer software applications created by the end user. A fast network connection between the end user and the infrastructure of the service provider is necessary for the cloud service paradigm to function effectively. Cloud computing has many different definitions, and the IT sector is still debating potential future services.<sup>4</sup>

The term *Green Cloud Computing* (GCC) refers to the use of computers and related resources in a sustainable way. Examples of such techniques include using central processing units, servers, and peripherals that use less energy, conserving resources, and properly disposing of electronic waste. Green computing is "the science and practise of developing, industrialising, using, and disposing of computers, servers, and associated subsystems with low or no environmental impact." This includes monitors, printers, storage devices, networking and interface systems. Similar to green chemistry, green computing aims to reduce the use of dangerous chemicals, increase energy efficiency

throughout the product's lifetime, and promote the recycling or biodegradability of production waste.

## Relationship Between Cloud Computing and Green Computing

Both cloud computing and green computing are closely related; in fact, both computing concepts are regarded as being at the cutting edge of technology. In addition, cloud computing and green computing both involve the design and development of computer systems. Thirdly, green computing is actually created for environmental friendly computing and technology, which supports power management and less power consumption. Virtualization is a key component of all of these green computing solutions. Virtualization, which is included in the category of cloud computing, is thus a key method in green computing.<sup>5</sup>

## Need for Green Cloud Computing

The key tenets of green computing, such as virtualization, power management, material recycling, and teleworking, have varying degrees of importance for businesses<sup>6</sup> and it is a primary prerequisite for green computing. The others are-

- A better algorithm aids in power management by saving energy.
- Because virtualization enables remote access to IT infrastructure, it also indirectly aids in energy management by reducing component usage.
- It aids in recycling and provides solutions to the main issues with abandoned computers.
- This makes it possible for computing infrastructure to be centralised.
- It preserves a green atmosphere. It directly aids in organisational growth.
- Utilising IT infrastructure free of chromium and hexavalent metals, which is environmentally beneficial.

## Challenges with Green Cloud Computing

Green computing faces the same problems and challenges as cloud computing, including-

- Green computing requires awareness among all computing stakeholders, including users, manufacturers, and organisations.
- Each nation's government must adopt a uniform green computing policy.
- Due to a lack of user awareness, many eco-friendly or green initiative supporting organisations still do not include green computing in their plans.
- Green computing demonstrates how to reuse materials, but many materials cannot be recycled. We need to consider these utilised tools.<sup>9</sup> Green

computing necessitates the development of skilled labour, which is still an issue in India due to the outdated nature of the majority of computer science programmes offered in Indian universities.

- Funding for resource allocation, cloud architecture, and deployment optimisation remain crucial issues.
- A significant problem today is the design and development of energy-efficient algorithms.
- Various virtualization techniques could occasionally malfunction.
- Indian IT companies are still uninterested in creating user-friendly models.

Software design plays a major role in green cloud computing. Applications can assist with energy efficiency and resource management. Effective communication between software components is required. The typology must be dynamic; resources must be automatically added or removed depending on server demand. One of the unsolved issues is the dynamic allocation of energy and resources, as well as the cost and time associated with job execution as well as the reduction of energy consumption.

The obstacles include, international regulations that are concentrated on cloud security issues, and they vary from country to country. Certain of them have passed and put into effect strict environmental regulations. Others are quite lenient in this regard, either because they lack regulations or because they don't implement them properly. An additional non-technical concern is the cost of using green cloud computing. These expenses are transferred to cloud users, and as a result, cloud providers will increase the cost of their services. Utilising renewable energy is a non-technical problem. For businesses that use cloud computing, the intermittent nature of this energy presents a challenge and invalidates established methodologies for cloud operations planning. Some cloud service providers have built data centres in places where renewable energy sources are already available or will be in the future.

Due to the increasing awareness of how greenhouse gas emissions contribute to climate change and global warming, green computing has grown in popularity in recent years. Economic needs, in addition to environmental concerns, are a concern as well because energy prices and IT electrical requirements are both rising. Since efficiency will be the cornerstone of green computing rather than consumption reduction in the future, future plans for green IT should include effective energy-saving strategies and efficient services. While recent

research on green computing has addressed some issues, there are still some that require more research.<sup>7, 8</sup>

### Green computing: Potential Solutions

The potential solutions to several issues with green computing can probably be as-

- Businesses must adopt technological practises and Green Computing.
- To create a solid Green Computing infrastructure, IT companies should use Energy Star and other standards.
- To promote green initiatives, financial support from the government is essential.
- There is an urgent need for technology and computer user awareness.
- We must develop a modern IT policy for green computing.
- The creation of a specialisation in green computing for computer science programmes in universities.<sup>9</sup>

### Conclusion

Today, the terms "cloud computing" and "green computing" are used interchangeably when referring to the advancement of information technology and society. We face a number of obstacles that we must overcome with the help of awareness campaigns and financial aid. Both computing techniques have some drawbacks and issues, so we must keep them in mind for an information society to be healthy.

Data and services are now accessible to people all over the world thanks to the cloud computing initiative. To evaluate the effectiveness of the cloud computing data centre, experts identified a variety of indicators. As a result, cloud computing has been recognised as an affordable method to address environmental concerns.<sup>10,11</sup>

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