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Green Cloud Computing: An Implementation in Block Chain A Review

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ABSTRACT

With low-cost, high-speed, on-demand, and pay-per-use capabilities, cloud computing has grown into an amazing option for tackling the difficulties of high-volume data storage and processing. Block chain technology is a new financial technology that has radically changed business interactions. A decentralised network supports and uses a diverse set of cryptographic algorithms. This secure and robust transaction is being integrated with another well-known computer paradigm, cloud computing. Despite tremendous expansion in the field of cloud computing and related services, attaining green cloud implementation is still a work in progress due to a lack of research and many hurdles in its implementation. Green clouds is committed to creating environmentally friendly, energy efficient, resource efficient, low carbon emissions, long lasting, and recyclable goods. Cloud service providers are developing cutting-edge technologies such as Green Cloud Computing in cloud architecture design to reduce massive power consumption, water consumption, the need for physical hardware peripherals, infrastructure, and harmful carbon emissions, among other things, to meet the ever-increasing enterprise data storage and processing needs. To protect our environment from the negative consequences of cloud computing, service providers must embrace green computing and change their cloud architecture. Green computing management includes, among other things, virtualization, high performance computing, load balancing, green data centres, reusability, and recycling. This study will provide a complete evaluation of the implementation of green cloud computing and its attributes.

Keywords: Green Cloud, Blockchain.

Introduction

Cloud computing has become the most popular computation platform for commercial companies over the last decade, allowing entrepreneurs to focus on their core business operations rather than investing time and money in infrastructure upkeep. As seen in Figure 1, cloud computing provides multiple services such as IaaS, PaaS, and SaaS to persuade business app owners to accept and migrate cloud services to their business app modules (Archana Patil and Rekha Patil, 2019). Cloud-based data centres, platforms, servers, and other infrastructure services are elastic enough to fulfil clients' unanticipated need for vast quantities of resources. The cloud's scattered deployment patterns, pay-per-use pricing policy, on-demand connectivity, high-speed networks, and low-cost resources, according to Heininger, are supporting in the adoption of new cloud-based firms, from multinational to small-scale. Most technologies, including smart phones, tablets, smart watches, medical equipment, and sensors, are now cloud-connected for private data storage. Cloud services are used by the majority of software programmes, including e-mail, messengers, workplace apps, social web networks, e-cart apps, music and video streaming apps, broadcasting, and entertainment services, to store, process, share, and preserve data. Google hosted all of its services, including Gmail, Google Earth, Google Drive, Google Play, and YouTube, on its own cloud infrastructure in order to deliver high-quality services to its global clientele (GCF). According to Forbes, the global public cloud revenue value is presently 175.8 billion dollars, as of September 2018. Public cloud revenue is predicted to reach 206.2 billion dollars in 2019, marking the world's fastest growth rate of cloud use, with a 17.3 percent growth rate. Some of the most significant cloud service providers in today's business include Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform, and IBM Cloud.

W While the cloud's elasticity matches the expectations of cloud service customers, service providers are suffering as a result of allowing large power consumption by data centres, which leads to high operational expenses, higher carbon emissions, and poorer revenues. Clouds solve the bulk of today's business challenges, but they have a few significant drawbacks, such as high power consumption, longer CPU idle times, the necessity to deploy resources at the upper bound, the production of carbon emissions, and the development of vast electronic trash (e-waste). There is a pressing need to make today's cloud environment as environmentally friendly as possible, such as "Green Cloud Computing."

Figure 1 Cloud Computing Service Layers Architecture

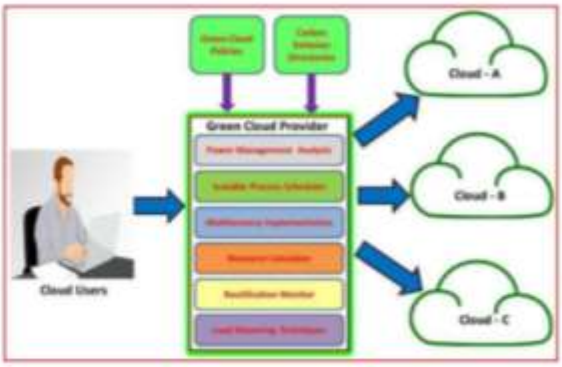

Figure 2 Cloud Computing Service Layers Architecture

Ordinary cloud computing focuses on efficiently storing and processing data, however green cloud computing is a revolutionary reform in cloud computing that was created with the primary goal of transforming the cloud environment into an environmentally friendly one. Green clouds are defined by their energy efficiency, virtualization, multi-tenancy (high-end usability), consolidation, automation, resilience, recyclability, and cloud resource sustainability. The world's green environment must not be hurt by foolish advances such as cloud computing; consequently, experts strongly advocate that "cloud computing must consider both the ecological and economic gains."

Green cloud computing attempts to develop an eco-friendly cloud environment, which means that the cloud should not exploit nature's greenness in any way. A cloud environment, for example, meticulously conforms to energy efficient power management regulations and processes in order to preserve electricity, yet it is powered by coal-based thermal stations, resulting in indirect environmental damage. As a result, green cloud policies and standards must be developed with the direct and indirect negative effects of clouds on the environment in mind. Aside from rules and regulations, the green cloud architecture need a set of monitoring tools and technologies. Figure 2 depicts the primary tools and technologies required to build the green cloud computing architecture (Archana Patil and Rekha Patil, 2019).

The green cloud computing architecture indicated above was developed in partnership with Cloud Data Centers (cloud-A, cloud-B, and cloud-C), Green Cloud Providers, and Cloud Users, among others. Cloud data centres are traditional cloud infrastructures used to deliver cloud services such as IaaS, PaaS, and SaaS. The Green Cloud Provider (GCP) is an authenticated cloud service broker module that permits monitoring of cloud infrastructure and activities in order to certify linked clouds as green. As part of its responsibilities, GCP manages electricity at each cloud level by displaying module-level energy use metres. GCP analyses power consumption data collected from monitors and proposes energy-efficient power management solutions after gathering data from monitors. The scalable process scheduler deploys cloud virtual instances at runtime to handle incoming requests quickly and accurately. These virtual instances are used to increase the capabilities of hardware infrastructure by fully using it. Custom task scheduling methods are used in this process scheduling to enable parallel processing.

Aside from a few notable large corporations, the vast majority of cloud customers are small or medium-sized businesses. They are unable to build their own IT infrastructure without significant financial investment, therefore they are turning to the cloud to install their apps for data storage and processing. Public clouds must be constructed securely in this case to allow a group of cloud users to execute their apps on a shared cloud instance and share cloud resources. This is referred to as multi tenancy in cloud computing.

Another important cloud monitoring tool is the GCP module's resource calculator, which is implemented at the cloud instance level to record memory, CPU, Storage, bandwidth, and time utilisation metrics. This data will be evaluated using proper resource computation methods, among other things, to anticipate future resource demand, underutilization, and availability. A reutilization monitor is a high-level examiner that suggests potential reutilization opportunities for cloud resources in order to save time and money. Similarly, the load balancing module is responsible for balancing the load (of Memory and CPU) among several cloud instances when processing data to ensure smooth processing. Green cloud policies and carbon emission directories are examples of third-party policy preparation organisations. Their rules and restrictions help to create green clouds from conventional cloud settings. Finally, any organization's IT manager may contact GCP to discuss hosting their organization's applications on green cloud and arranging the migration process of their IT applications to green clouds based on service level agreements (SLA).

GREEN CLOUD COMPUTING

The usage of a computer system and information technology services has simplified and improved daily life. It also increases processing speed and reduces power usage. This massive amount of power use contributes to both greenhouse gas emissions and pollution. Energy consumption is also increasing as a result of technologies that are left on even when not in use. IT also wastes a lot of energy since data centres demand a lot of electricity and associated cooling capacity, which isn't always accessible, producing environmental damage. Green computing is concerned with reducing energy use, recycling, and removing hazardous materials, but it is also concerned with reducing business travel, sharing resources (cloud computing), and optimising. Energy loss may also be caused by insufficient power and cooling capacity. All of this leads to the pollution of the environment. It was also determined that most data centres were employing old technologies and lacked enough cooling capacity. Everything indicates to a polluted atmosphere. Flaws in manufacturing practises, packing, and computer and component disposal might all lead to environmental contamination. Toxic chemicals are used in the production of computers and components, and they can enter the food chain and water supply. According to one source, "Information

Technology energy usage is growing twelve times faster than overall energy demand," and data centres emit 150 metric tonnes of CO2 per year, with the volume increasing all the time [xc]. Several organisations have been formed to create standards and norms.

According to the Environmental Protection Agency, roughly 30% to 40% of computers are left on during weekends and after office hours, with approximately 90% of these PCs staying dormant. In a green computing environment, each programme produced will use the most efficient physical resources.

Every day, a large amount of computer systems and other products are thrown away since many industrialised countries have greater technical skills. These commodities are supplied to other developing countries. This method of recycling electronic items is used. Furthermore, recycling materials used in computer hardware manufacture such as tin, silicon, iron, aluminium, and so on, as well as electronic goods such as audio visual components, mobile phones, and other portable electronic devices, contribute greatly to energy efficiency. Recycling computer equipment, such as lead and mercury, allows for the replacement of otherwise manufactured equipment. Reusing such equipment enables for energy savings as well as a decrease in the environmental impact of electronic waste.

A system administrator can use virtualization to convert several physical systems on a single server into virtual ones, allowing it to run multiple operating systems and become more powerful. Energy efficiency may be achieved by connecting fewer physical devices, which reduces power consumption and consumes less electricity. Several commercial companies and open-source organisations are now offering software packages to aid in the transition to virtual computing. The fact is that virtualization alone does not optimise energy and resource efficiency. Thus, when combined with the necessary skills and operational and architectural standards, automation decreases the need for physical infrastructure, maximising server virtualization's energy and resource efficiency.

Cloud as a Green Computing

Businesses are rapidly transitioning from traditional systems to cloud-based systems due to its faster scale-up/scale-down capacity, pay-per-use, and access to cloud-based services without the need to acquire and operate on-premises equipment. The pay-per-use component of cloud infrastructure provides both energy and resource efficiency, encouraging users to consume just the resources they require. An IT corporation may satisfy energy efficiency and environmental goals by transferring the load from traditional servers to cloud servers. Unfortunately, the IT sector gets 70% of its electricity from carbon-emitting fossil fuels like coal, leaving a massive carbon footprint. To provide ecologically friendly services, cloud enterprises must invest in renewable energy sources. This may be done by using renewable energy sources such as wind and solar. When the screen is switched off, the power consumption is only 59W. According to this theory, switching from Google to Blackle would save the earth 750MW every year. This was a fantastic example of Green Computing.

IMPLEMENTATIONS OF GREEN COMPUTING

Blackle

Blackle is a search engine powered by Google Search. Blackle was developed on the idea that when your computer screen is white, displaying an empty word or the Google home, it uses 74W. When the screen is switched off, the power consumption is only 59W. According to this theory, switching from Google to Blackle would save the earth 750MW every year. This was a fantastic example of Green Computing. The Blackle principle is based on the fact that different colours use different amounts of energy on computer screens.

Fit-PC

A little PC that uses only 5 watts: Fit-PC is the size of a book and absolutely silent, but it can run Windows XP or Linux. Fit-PC is designed to be utilised in settings where a standard PC is too bulky, noisy, or power hungry. If you've ever desired a PC that's compact, quiet, and kind to the environment, the fit-, PC is the one for you. Fit-PC consumes only 5 Watts of electricity, using less power in a day than a standard PC does in an hour. Fit-PC may operate indefinitely without affecting your electricity bill.

Zonbu Computer

The Zonbu is a brand-new, ultra-efficient PC. The Zonbu consumes one-third the power of a normal light bulb. The Linux operating system is powered on a 1.2 gigahertz CPU and 512 Meg of RAM on the device. It also lacks moving parts and has a fan.

Sunray thin client

According to Subodh Bapat, vice president and chief engineer at Sun's Eco Responsibility office, rising power prices have raised customer interest in the Sun Ray, a thin desktop client. Thin clients, such as the Sun Ray, he believes, consume substantially less power than typical desktop PCs. A Sun Ray on a PC requires 4 to 8 watts of power because the majority of the expensive work is done by a server. Sunrays, according to Sun, are particularly well suited to cost-sensitive industries such as call centres, education, healthcare, service providers, and finance. PCs have faster CPUs and more storage than thin clients. As a result, traditional PCs must consume significantly more electricity. Desktop PCs must utilise 50 watts or less in idle mode to qualify for the new rigorous Energy Star certification in the United States.

The Asus EEE PC and other ultra-portables

The "ultraportable" class of personal computers is characterised by its small size, low power CPU, compact screen, low cost, and advancements such as the use of flash memory for storage rather than hard drives with spinning platters. They can work more efficiently and waste less power than a standard form factor laptop because of these capabilities. The Asus Eee PC is one example of an ultraportable. It's the size of a paperback, weighs less than a kilogramme, has Wi-Fi built in, and saves data on flash memory rather than a hard drive. It also works with Linux.

CLOUD COMPUTING DEPLOYMENT MODELS

Cloud computing is a service delivery mechanism that delivers on-demand services to end users. Cloud installations are classified into three types: public cloud, private cloud, and hybrid cloud.

Public Cloud

A public cloud is a service that is hosted on the internet and may be accessed by anybody who has access to the internet. The most well-known public clouds are Amazon Web Services (AWS), Google Apennine, and Microsoft Azure. In this deployment, cloud services are made available to the public on a pay-as-you-go basis. A public cloud can offer one of three services: IaaS, PaaS, or SaaS. Amazon EC2 is a public cloud that offers infrastructure as a service, whereas Google AppEngine offers an application development platform as a service and Salesforce.com offers software as a service. Multitenancy, service quality, and security are key features of public clouds.

Private Cloud

A private cloud is hosted within an organisation, behind its firewall, and is designed to be utilised exclusively by that organisation. Rather of installing a large number of lower performance systems, it benefits by pooling a smaller number of centrally managed high performance computing and storage resources. Private cloud services give better control over infrastructure since access is confined to one or a few enterprises, increasing security and service reliability.

Hybrid Cloud

Hybrid Clouds are a type of deployment that evolved as a result of the spread of the benefits of both public and private clouds. Enterprises use this method to outsource non-essential information processing to the public cloud while keeping control over critical services and data. Three cloud computing services have been investigated: storage as a service, processing as a service, and software as a service. Users can use storage as a service to store data in the cloud. Consumers can use processing as a service to outsource computationally costly activities to the cloud. These two offers are combined in software as a service, which allows consumers to transfer all of their computation to the cloud while remaining at home with only a low-processing-power interface.

CLOUD SERVICE MODELS

Software as a Service

For consumer software, a licence and a copy of the application on acceptable media are purchased for a fixed upfront fee. This software licence often only permits the user to install the application on one system. When the application undergoes a substantial upgrade and a new version is released, clients must pay an extra cost to use the new version. Users can continue to use older versions of software, but once a new version is released, support for older versions is typically reduced and updates are limited. Software developers are seeking to provide Software as a Service, in which customers pay a monthly or annual fee for access to the most recent version of software. All processing is done on the cloud, where the software is housed. The computer of the client is only used to deliver commands and receive answers. Users are frequently free to use any computer that is connected to the Internet. One example of software as a service is Google Docs. On this case, data storage and processing are always performed in the cloud, allowing us to drastically reduce the functionality, and hence the power consumption, of the client's PC.

Storage as a Service

Users can use storage as a service to outsource their data storage needs to the cloud. All processing takes place on the user's PC, which may just have a solid-state drive, and all data is saved in the cloud. Cloud-stored files may be accessed at any time from any computer with an Internet connection. To make changes to a file, it must first be downloaded, changed on the user's computer, and then uploaded back to the cloud. One example of storage as a service is Amazon Simple Storage Service.

Processing as a Service

Processing as a service makes the resources of a powerful server available to customers for certain substantial computational activities that are uploaded to the cloud, processed in the cloud, and the results returned to the user. The processing service is accessible to any system with an Internet connection. One example of processing as a service is Amazon Elastic Compute Cloud.

FEATURES OF CLOUDS ENABLING GREEN COMPUTING

Cloud infrastructure has emerged as a serious environmental issue in terms of energy consumption and carbon emissions. The primary underlying technology for energy efficient Clouds is "virtualization," the practise of presenting a logical grouping or subset of computer resources so that they may be accessed in ways that give benefits over the original arrangement. The following are the four basic factors that have enabled Cloud Computing to cut energy usage and carbon emissions from ICT. By moving their programmes to the cloud, businesses may reduce their carbon footprint by at least 30% per user.

Dynamic Provisioning

In most cases, IT businesses end up constructing far more infrastructure than is necessary. Estimating demand at any given time, ensuring service availability, and maintaining a certain level of service quality for end clients are all exceedingly challenging tasks. Virtual machines in a Cloud architecture can be live relocated to another server if a user application requires more resources. Cloud providers monitor and predict demand before assigning resources. Applications with lesser resource requirements can be integrated on the same server. As a consequence, data centres keep active servers depending on current demand at all times, resulting in reduced energy consumption than the conservative practise of over-provisioning.

Multi-tenancy

Using cloud computing infrastructure reduces total energy usage as well as carbon emissions. Various companies are served by SaaS providers utilising the same infrastructure and software. This technique is clearly more energy efficient than putting several copies of software on different infrastructure, which can decrease the need for new equipment. The smaller the demand volatility, the better the prediction and the greater the energy savings.

Server Utilization

Using virtualization technology, many programmes may be hosted and run in isolation on the same server, resulting in utilisation levels of up to 70%. Even while greater server utilisation results in increased power consumption, higher utilisation servers may handle more workload with the same amount of power.

Data center Efficiency

Datacenter power efficiency has a considerable impact on the total energy usage of cloud computing. By adopting the most energy efficient technologies, cloud providers may significantly improve the Power Usage Effectiveness (PUE) of their datacenters. Cloud computing allows services to be transported between datacenters with reduced PUE levels. This is achieved by utilising a high-speed network, virtualized services and measurement, as well as datacenter monitoring and accounting.

BLOCKCHAIN TECHNOLOGY

This section discusses the overall model and how the Blockchain model works. As a reference architecture for cloud computing, edge computing, and fog computing, blockchain architecture is being developed. It will also be utilised in conjunction with another large-scale distributed model. It is now linked to a cloud system to provide a more secure system.

Origins of Block chain

Block chain technology is a sort of distributed architecture that uses transactions that are cryptographically signed. It operates on a block-by-block basis. Each block has cryptographic techniques. The legitimacy of the transactions should be confirmed and verified at every single point of failure. It makes extensive use of the Peer to Peer (P2P) concept. In this arrangement, the broker expenses for authorising transactions are not incurred. Blockchain technology is likely to thrive since this Blockchain technique delivers high and scalable security to its end systems. Hackers are also struggling to exploit holes in transaction systems. As a result, transactions are more straightforward and accessible. The main components of Blockchain P2P architecture are depicted in Figure 3 (Simanta Shekhar Sarmah, 2019).

Hashes

It is a vital component of the Blockchain paradigm, which offers a wide range of use cases. Its main purpose is to encrypt the data supplied in the block. It is capable of calculating data of any size. The input modifications can be used to display the output with those changes. The SHA-256 algorithm is widely used in a wide range of real-time applications.

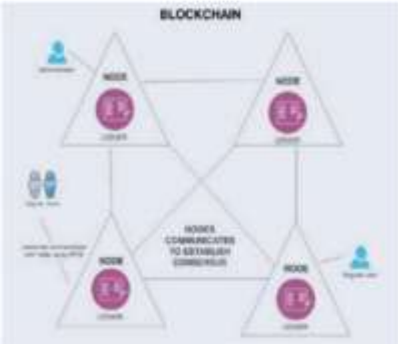

Figure 3 Blockchain technology in P2P architecture

Ledgers

It consists of a sequence of transactions. Each node has a copy of the transaction ledger. Pen and paper are often used in the traditional method of keeping ledgers. The same rationale has guided the adoption of new computing technology. As a result, a centralised ledger is used, which has several disadvantages, such as single point of failure, i.e. abrupt data loss, and centralised committed transaction verification with a third-party agent.

Blocks

Each node in a block receives a transaction id from end users. This transaction index is used for all future activities until the operation is completed. In the transactional process, mid-operations will not save time. All committed transactions are stored in a transaction pool that serves as a queue. At each level, mining nodes are in responsible of updating the transaction process. As a result, a block is comprised of the whole set of transactions. Incorrect transactions are rejected by the Blockchain system. This method demonstrates data rigidity since the resultant hash would differ greatly if a single bit of the block was modified. In addition, a copy of each block's hash is distributed to all nodes to increase security. This approach prevents any modification since every node may verify if the hash matches.

BENEFITS OF BLOCKCHAIN IN CLOUD COMPUTING

Decentralization

The reliance on a centralised server for data management and decision making puts the entire system at danger if it fails, and large amounts of critical data kept on the central server may be lost. A hacker attack also puts the central server at danger. The Blockchain in CoT can help by offering a decentralised system in which several copies of the same data are stored on different computer nodes. Data loss cannot occur since several copies of the data are already available on numerous nodes.

Improved Data Security

Point-to-point encryption protects data during transport and storage. IoT data frequently contains personal information, and its publication may jeopardise personal security. These situations that happen in cloud infrastructure pose a danger. The solution to this problem is to use Blockchain in cloud computing, which may boost the security of the overall architecture while also keeping data exchanges sequential. After being fragmented into encrypted fragments, data files are stored on various nodes.

Permanent Audit Trial

Long-term audit trails are one of the key benefits of Blockchain in cloud computing. Blockchain maintains a permanent Proof of History (PoH) of all prior transactions and alterations, which enables a verified delay function. It not only permits PoH but also aids in the arrangement of transaction information in the correct sequence and the preservation of a period.

Fast Disaster Recovery

The record of transactions is widely dispersed when Blockchain technology is used. Because the Blockchain is accessible to a large number of authorised users, any failure in one Blockchain node has no effect on the other Blockchain copies. Even if one node fails, the system keeps running and the Blockchain gets updated. Based on the record of the transactions and modifications history of the Blockchain experiments, any failed node of the network may access the current state of the Blockchain database as soon as it comes back online.

Fault Tolerance

Blockchain data may be replicated across a highly networked network of computer servers using collaborative Clouds. The interruption of any cloud node reduces the risk of a single failure and enables uninterrupted services.

Scalability

Because the amount of Blockchain transactions for large-scale Blockchain applications may be massive, having strong data processing services for high transaction execution is crucial for enabling scalable Blockchain services. Blockchain operations may be supported by on-demand computing resources due of the cloud's scalability in this business. As a result, combining cloud computing and Blockchain might result in a highly scalable integrated solution.

SCOPE OF BLOCKCHAIN IN CLOUD COMPUTING

Blockchain applications may give huge reach in cloud computing and enhance its breadth.

- When Blockchain was linked to cloud computing, it solved the primary concern of data loss/leaking by encrypting data for security and offering database protection and privacy.
- Another major threat to cloud security is data accessibility or openness. To address this issue, blockchain develops a decentralised and distributed trustworthy method. A public Blockchain makes all operations visible and prevents data manipulation. Nobody can change data that has been saved once.
- Third-party vendors are included in cloud computing, which might result in enormous data loss for enterprises if they fail. The integrated system can avoid data loss since blockchain is governed by codes.
- Because erasing data from one's computer on a Blockchain network has no influence on data kept on other devices, a Blockchain network protects the authenticity of data and avoids data loss.
- Data stored on a Blockchain is permanent and can be easily traced. This logs all transactions and modifications and can subsequently be used for authentication or auditing.

Result

As seen that the Green cloud computing is better for cloud computing whereas when used Blockchain in Green cloud it gives better result as compared to Green Cloud in terms of better security, low power consumption of server and low CO_2 emission.

CONCLUSION

IT services leverage cloud computing technology to provide their clients with the services they demand. Except that widespread cloud adoption necessitates significant expansion of cloud data centre infrastructure. Unfortunately, in this instance, a considerable quantity of electrical energy is wasted, and a significant amount of carbon dioxide is discharged into the atmosphere.

Round Robin, Green, DENS, and Algorand Blockchain are highlighted in the generation for a three-tier data centre design. The Algorand Blockchain's operational information, as well as its ability to maintain an adequate level of QoS for the end user despite a little increase in energy consumption. As a consequence, energy usage in cloud data centres is being reduced while ensuring optimal resource management, such as. This criterion is connected to the green cloud concept, which may be utilised to aid with environmental protection.

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