A Study of Energy Conservation Using Green Cloud Computing

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Abstract

Cloud and green computing are rising areas in the IT field, both provide services to users and respond to their needs. Cloud computing is dependent on data whereas, green cloud computing is based on cloud framework. The use of cloud computing is increasing day by day which generates large amount of carbon dioxide because processing each request needs servers which consume high power energy and produce CO_2. To reduce this some green computing techniques are required. These techniques use computer and memory devices and other devices like network communication devices for constructing a device that helps in reducing the effect of CO_2 on the environment and making it green. This paper discusses some of the green cloud computing techniques and their future use.

Keywords: Cloud computing, green cloud computing, green data centre, virtualization

I. INTRODUCTION

Cloud computing is basically defined as a model to enable convenient on-demand network access to a shared pool of configurable and reliable computing resources like networks, servers, storage, application, services etc., whereas, Green cloud computing is the term which is used to improve the efficient use of resources and reduce energy consumption in cloud computing.

Cloud Computing services like storage, servers, database, networking, and softwares are delivered by cloud computing over the internet. Cloud computing also provides virtualization of resources over the internet. It provides various kind of services like software-as-service, platform-as-service, and infrastructure-as-service to the customer.

II. CLOUD COMPUTING DEPLOYMENT MODEL

A. Public Cloud

Public cloud is the simplest way of deploying cloud computing. Cloud resources like servers and storage are owned and operated by service provider third parties. The services are delivered over the internet. Public cloud can be accessed by any type of cloud for storing data on cloud.

B. Private Cloud

Private cloud consists of computing resources used exclusively by one business and organization. Private cloud is maintained by the cloud owner.

C. Hybrid Cloud

Hybrid cloud is the combined form of public cloud and private cloud so that an organization can take the benefits of both. In this type of service, data, and application can move between private and public clouds for more deployment options.

III. GREEN COMPUTING

Green computing is the effective and environment friendly use of computer and relative resources like types of software and hardware. Green computing is introduced to reduce power consumption and

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environmental waste materials. Green computing aims to design computing technology which is environment friendly and energy efficient. Green computing efficiently manages its resources by using an environment centric approach. The main goal of green computing is to increase power efficiency and reduce CO_2 emission in the environment.

A. Life Cycle of Green Computing

The life cycle of green computing includes seven phases like analysis, specification, design, implementation, and usage, and recycling and disposal phases. Analysis and specification phase includes requirements for energy consumption of applications in the cloud. The design phase includes energy efficiency in which the most efficient and reusable IT infrastructure for power management facilities is chosen. In the fourth phase of life cycle implementation is done. In this phase, while acquiring and installing hardware and software energy efficiency should be considered. After implementation phase users can use services which include some important points like power management facility which should be used to conserve energy as much as possible. Devices and computers should be switched off when not in use. Users also ensure that there is good air flow at working place so that devices consume less energy. Last phase of lifecycle is recycling and disposal that involves several options such as reusing old computers at home to perform single tasks and finding new users for computers or other IT infrastructure, wiping data before disposal, and using a reputable disposal facility.

B. Energy Saving Strategies

Some common techniques that provide energy saving computing is turning on-off servers, putting them to sleep mode, and other techniques such as DVFS, DVS etc. The performance and consumption of energy in these techniques is based on many factors.

IV. GREEN DATA CENTRE

The technology of Green Data Center is based on green computing concepts. Its purpose is to build to minimize the environmental effect not only for energy saving technique, it also cuts down cost and power. This framework is used to deal with cooling demands and accumulating power.

Many steps are being taken by organizations to make data centers environment friendly by using green data centers. Green data centers decrease the consumption of power by filing minimum resources for cooling systems.

A. Virtualization

One of the techniques that is used in decreasing the cost, hardware, and power is virtualization which is a rapidly growing technology that changes the way of computing. Using hypervisor, several PCs and servers can work on a single operating system.

Types of virtualization:

1. Server virtualization
2. Application virtualization
3. Network virtualization
4. Storage virtualization
5. Desktop virtualization

B. Power Consumption

Two dynamic techniques that are used to reduce energy consumption in green cloud computing are Dynamic Voltage/Frequency Scaling (DVFS) and Dynamic Voltage Scaling (DVS). In DVFS, supply voltage can be decreased by adjusting the operating clock which can help in saving power. First, the amount of power consumed is calculated with the help of various components before applying power optimization techniques. Through power consumption technology, electronic waste, and resource consumption can be reduced.

C. Energy Efficiency Techniques for Green Cloud Computing

Various approaches are used in green cloud computing for energy saving, memory saving, and

TABLE I.
TECHNIQUE TYPE AND ADVANTAGES

S.No.	Techniques	Details	Advantage	Technique Type
1.	First Fit Algorithm	First Fit (FF) algorithm is based on greedy algorithm in which the list of all over utilized machines is made so that the machine which is over utilized can be excluded laterto reduce energy consumption.	Reduce energy consumption by finding the optimal solution.	Software Technique

2.	Ant Colony Optimization (ACO)	In ACO (Ant Colony Optimization), the performance of resources is increased to reduce the number of active servers. In this, servers are organized after receiving all virtual machines and then the solutions are constructed and the best solution is chosen.	It is based on Java-simulation toolkit.	Software Technique
3.	DVFS (Dynamic Voltage Frequency Scaling)	In this technique, to reduce energy consumption, the DVFS selects the suitable voltage and frequency of processing part.	It results in reducing energy consumption. It is implemented using CloudSim toolkit and can be provided as a simulator.	Hardware Technique
4.	Dynamic Voltage Scaling (DVS)	In DVS, the ability of each scheduled task is evaluated to save energy. For evaluating the scheduled tasks it uses two policies. First is the space-shared policy and the other is time-shared policy.	It uses the GridSim toolkit to reduce energy consumption. It also provides balance between task deadlines and power consumption.	Hardware Technique

reducing power consumption.

D. Software Techniques

Investigated Algorithm: In this section two techniques are presented that are widely used in power consumption efficiency. These two techniques are First Fit and Ant Colony Optimization.

(1) First Fit Algorithm: First Fit algorithm also evaluates as a greedy algorithm, through which *bin packing* problems are solved. Items are sorted in decreasing order and the items are placed into suitable bin. The First Fit algorithm is not guaranteed to have optimal solution, but one solution is considered as optimal solution among all the solutions which are generated by First Fit (FF) algorithm. The main objective of this algorithm is to execute Virtual Machines (VMs) migration policy with minimum migration time by creating a list of over utilized machines. In terms of bin packing problem, this problem can be formulated. In bin packing problem, the bins are considered as the physical host machine and Virtual Machines (VMs) are considered as the items in which VMs are assigned to physical host machines, and the size of bin can be categorized by several properties like size and price. CPU capacities of host machines constitute as size and power that is consumed by the host and is constituted in price. The destination host machine is determined by employing First Fit algorithm.

(2) Ant Colony Algorithm: Ant Colony is a heuristic based algorithm used for finding optimal solutions by applying probabilistic approach. Ant Colony algorithm was introduced by M. Dorigo. This algorithm is based on the behavior of real ants. In Ant Colony Optimization (ACO) algorithm, ants start searching for food and when it is found, they leave a chemical substance there called pheromone, by which other ants can get help to follow the path for food. If the pheromone evaporates, it means that the path is long and the path that has higher density of pheromone can be taken as an optimal solution. This multi-agent system can be considered as synthetic ants that lead to complex solution when used in Bin Packing Problem (BPP).

V. PERFORMANCE COMPARISON

In terms of the required number of VMs and the number of active host machines, the number of running host machines eliminates situations of having machines idle for long times as it consumes high level of energy. If the idle host machines are identified, their mode should be set to sleep. The ant colony algorithms results in lower number of active hosts as compared to the First Fit algorithm. Ant colony executes several optimization cycles that help in selecting suitable host machine to be allocated for Virtual Machines (VMs). It uses global optimization that leads to faster connection speed and minimizes the number of VMs migrations and reduces energy consumption. The rate of having machines idle is less in Ant Colony Optimization (ACO) as compared to FF that helps in reducing power consumption.

VI. CONCLUSION

Use of cloud computing can lead to large amount of energy consumption to process each data request and

large amount of storage is required. Huge carbon footprints in data centers lead to enormous energy consumption which is unfriendly to the environment. Techniques to reduce various harmful effects, which are also called Green Cloud Computing techniques are discussed here which help in decreasing power consumption and saving energy.

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