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Green Cloud Computing – Power Efficiency

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Abstract—Cloud Computing has a great future and moving towards it, as its own high performance usage of computing of very large data centre (DC) and increase in the use of huge cluster day by day and energy utilization by these DC and energy deplete into the environment by these DC is also rising every day. The large amount of CO2 release into the environment has generated the necessity of Green cloud computing. More usage of these resources and chips generates more energy usage which rises the heat flow, as more heat flows there is a equal option of cooling it, and which again results in heating as it generates heat in this process, so an ideal method would be balancing the both heat and cooling as a result of which it will reduce the energy consumption. This paper defines one of the methods to accomplish that.

Key Words – Cloud Computing, Data Centre, CO2 emission, energy efficiency.

I. INTRODUCTION :

One of the most emerging and popular technologies in today's world is Cloud Computing. Mainly because of its promising paradigm and which delivers computing as a utility. It provides data access, software, computation and storage services through the Internet and facilitates customers to rent resources based on the pay-as-use model. The clients will be charged only for as much as they have consumed resources. The main advantage of Cloud Computing is that users can get their data storage services and computing on demand without much investment in the computing infrastructure.

One of the major causes of energy inefficiency in data centers is the static idle power wasted when servers run at low performance and reliability. Even at a very low load, such as 10% CPU utilization, the power consumed is over 50% of the given power.[16] Similarly, if the network, disk or any given resource is the performance bottleneck, the static idle power wastage in other all resources goes high. In the cloud computing approaching many data centers applications are hosted on a common set of servers.

Workloads on small number of servers are better utilized, because different workloads may vary in the usage of resources and it will differ in temp variations. Thus consolidation allows the usage of static idle power more efficiently. However, effective combining is not as important as packing the maximum workload in the any shortest number of servers, keeping each and every resource like CPU, disk, network, others on every server at full efficiency, utilization and reliability. As a matter of fact such a approach may increase the energy utilization used per unit service provided, as it will be described later. In last few decades usage of cloud computing in the day-to-day demand and IT areas makes it compulsory to think towards the Green IT areas so that the energy an power can not only be minimized but can also be used for the purpose of recycling.

Generally, Cloud exhibits the large amount of numerous data centres and takes care to fulfil the amount of clients based on pay-per-use methodology. These resources are spanned in vast area and consume high amount of power for many devices, cooling technologies, monitors and IT etc. Due to this main reason it has been a very concerned and serious topic of investment in all the given field both by government as well by private organisation for the development of Green Cloud computing to deal with IT related environment issues Green IT offers a large amount of methodologies and practices through some Green initiatives. The organization is as follows: Section 2 covers detailed explanation about Cloud Computing. Section 3 covers information related to Green cloud computing. Section 4 provides information related work in the cloud computing field. related to the real Motivation behind this to achieve. Section 5 provides information about the motivation behind this paper. Section 6 provides Preferred Technique and Section 7 completes with conclusion.

II. CLOUD COMPUTING :

Cloud computing is a computing technology, where a large number of systems are connected in private or public networks, they provide dynamically scalable infrastructure for application, data, file storage and many other fields. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly. It is a practical approach to experience direct cost benefits and it has the potential to transform a data center from a capital-intensive set up to a variable priced environment. The idea of cloud computing is based on a very fundamental principal of re-usability of IT capabilities. The difference that cloud computing brings compared to traditional concepts of grid computing, distributed computing, utility computing, or autonomic computing is to broaden horizons across organizational boundaries.[9]

Cloud computing allows individuals or business units to obtain resources from third party providers which will be usually located at remote areas. The main reason for this to become there is no need for investing or buying all the required infrastructure, purchase hardware or buy software licences. Cloud computing provides an easy solution in which the required infrastructure or resources can be used for a pre-determined time. The main reason for using this technique is because it stands on the on-demand policy.

Cloud Computing can be broadly classifed into three categories, namely SaaS, PaaS and IaaS.

Saas – Software as a Service

PaaS – Platform as a Service

IaaS – Infrastructure as a Service

In the software as a service (SaaS) model, users gain access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis or using a subscription fee. In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. Cloud users do not manage the cloud infrastructure and platform where the application runs. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. Cloud applications differ from other applications in their scalability—which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand.[10]

PaaS [Platform as a Service] vendors offers a development environment to application developers. The provider typically develops tool-kit and standards for development and channels for distribution and payment. In the PaaS models, cloud providers deliver a computing platform, typically including operating system, programming-language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers like Microsoft Azure and Google App Engine, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually. The latter has also been proposed by an architecture aiming to facilitate real-time in cloud environments.[11] Even more specific application types can be provided via PaaS, such as media encoding as provided by services like bitcodin.com[12] or media.io.[13]

Iaas – Infrastructure as a Service, in the most basic cloud-service model - and according to the IETF (Internet Engineering Task Force) - providers of IaaS offer computers – physical or (more often) virtual machines – and other resources. IaaS refers to online services that abstract user from the detail of infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc.

A hyper-visor, such as Xen, Oracle Virtual-box, KVM, VMware ESX/ESXi, or Hyper-V runs the virtual machines as guests. Pools of hyper-visors within the cloud operational system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements. IaaS clouds often offer additional resources such as a virtual-machine disk-image library, raw block storage, file or object storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles.[14] IaaS-cloud providers supply these resources on-demand from their large pools of equipment installed in data centers. For wide-area connectivity, customers can use either the Internet or carrier clouds.

III. GREEN CLOUD COMPUTING :

Role of cloud computing is very exceptional and is one of the developing technology in the computer field, it is used in many fields such as Education, Medical, Networking, Entertainment and so on the list continues. In all the above mentioned list power efficiency play a prominent role, as there is a need of power in every field. Power consumption should be maintained as excess usage of it will lead to carbon emission release to environment which as its huge negative impact on the environment.[1] To overcome the problem one of the possible solution might be 'Cloud Green Computing', the defined paper provides one important solution for the problem by specifying the algorithm based on cluster technique which will reduce the Power consumption by for some extent, as a result of that carbon emission into the environment will come down.

Performing merging to optimize energy usage while providing required performance raises several concerns. Firstly, consolidation methods must carefully deciding which workloads should be combined on a given common physical server. Workload resource usage, performance, and energy usages are not important. Trying to understand the nature of the composition is thus critical to decide which workloads can be together packed. And secondly, there exists an optimal performance and energy point. This happens because consolidation leads to degradation in performance which causes the execution time to increase, eating into the energy savings from reduced static idle energy. Further, the ideal point changes with acceptable degradation in performance and application mixture. Finding the best point and tracking it as workloads change, thus becomes important for energy efficient consolidation.[2]

IV. RELATED WORK :

Rajkumar Buyya and Anton Beloglazov proposed pay-as-you-go model, it enables hosting of pervasive applications from consumer, scientific, and business domains. Data centers hosting Cloud applications consume huge amounts of energy, contributing to high operational costs and carbon footprints to the environment. Therefore, we need Green Cloud computing solutions that can not only save energy for the environment but also reduce operational costs.[15]

Ghamkhari and Mohsenian-Rad have proposed a systematic approach to maximize green data's profit, i.e., revenue minus cost. The design explicitly takes into account a mathematical model for data centre's profit as a function of service rate and uses an accurate G/D/1 queuing model[3].

Quarati et al. has proposed to maximize broker's revenue and user satisfaction and reduce energy to increase profit, through the adoption of energy saving mechanisms. Dynamic Least Consuming Resource (DLCR) policy combines the behaviour of Less Consuming Resource (LCR) with a power management mechanism that turns on and off the private resources dynamically.[4]

Wu et al. has proposed to reduce energy consumption in the cloud computing environment by using DVFS (Dynamic Voltage Frequency Scaling) technique. By decreasing the supply voltage and work frequency of the processor the power consumption of the processor can be reduced. Hence the resource utilization is increased, thereby reducing the energy consumption of a server when it is in the idle mode or with light workload[5].

Pedram has proposed to provide introduction to resource provisioning and power or thermal management problems in the data. Dynamic adoption allows data to adopt and provision hardware components to meet varying workload[6].

V. MOTIVATION :

Computing technology and its component plays a prominent role in day-to-day life and subsequently the associated its high dependency of power expenditure both financially and environmentally is a main concern. Green computing is emerging as prompting solution which is arising computing technology that cut down power usage that leads significantly co2 emission reduction [7].Next generation information and communication technology designers have to consider green computing as an essential component. Energy efficient CPUs, servers and peripheral devices as well as proper disposal of electronic wastage are the key points which are advocated by green computing.

A green cloud solution is more efficient than a traditional premises-based system in three ways. The first is more efficient provisioning. Historically, IT departments deployed more server, networking and storage infrastructure than needed. Businesses wanted to avoid potential capacity problems during peak usage periods. Consequently, they designed the systems to adhere to maximum usage periods; often, systems sat idle or underutilized.

Business dynamics also played a role. Corporations sometimes had difficulty understanding and predicting demand growth and peak loads, so they purchased enough capacity to be safe rather than sorry. And since corporate budget policies often encourage departments using all of their available funds in a given year and threaten a smaller allocation the following fiscal year, finances are also partly at fault for underutilization.

VI. PROPOSED TECHNIQUE :

The possible solution might be using clustering technique. There are many possible technical algorithms that can be used of this purpose mainly but one algorithm that is most effective is Agglomerative Hierarchical Clustering algorithm. This is a 'bottom up' approach in which each observation starts in its own cluster, and pairs of clusters are merged as it moves up the hierarchy.

When a user submits his job, it will be placed in job queue and later it will be assigned to Virtual Machines. Prior to that each Virtual Machine(VM) acts as a separate cluster and a separate mechanics is used to calculate the energy efficiency of each VM and machines with same energy is combined together to form a single group. Based of the job in the queue it will be submitted into the respective VM. Once VM of same energy efficiency is combined together to form a cluster. So mainly clusters are divided into three main groups namely minor-level cluster, medium-level cluster and major-level cluster. Based on the amount of energy required to full fill each job, particular cluster will be enabled. Until job is assigned for one of the cluster it will be in idle sate thus reducing the energy efficiency of the VM.

Power Consumption :

The major problem faced is due to power usage. If all the requested service is provided to the client, then there is a possibility that it might not be used for the full extent. Due to which excess of carbon is being emitted into the environment, which turns out to be hazardous. So care should be taken to check that the resources are not under utilized. The major cause for the energy inefficiency in data centers is due to the servers run at low utilization. Because there is a situation where even though resources usage is less, the power consumed is more than the power spent on usage.

In most of the distributed systems Energy consumption is the key concern in content distribution system and these demand an accumulation of networked computing resources from one or multiple providers on datacenters across the world. This consumption is censorious design parameter in modern datacenter and cloud computing systems. The power and energy consumed by the compute equipment and the connected cooling system is a major constituent of these energy cost and high carbon emission.[8]

Grouping Clustering Method :

Based on the energy consumed by each Virtual Machines(VM), the VM's are clustered into three main cluster group namely small size cluster, medium size cluster and large size cluster. The energy values will be less when the power load is low. But when the load increases in the VM's then it will be shifted to Medium size cluster. So the VM's in each cluster will be activated only if the load requirement increases. Until then the VM's in respective cluster group group will be in static mode.

SLA Agreement :

One of the problem might be the violation of Service Level Agreement, because when resource is requested by the user, then there is a possibility of allocating all the resources to the client. Even though it might not be used 100% at the given time. But since the resources are allocated when needed while balancing the load would not create any problems.

Process :

The whole process can be defined in simple steps, Step to carry out :

Step 1 : All the virtual machines are considered as single cluster.

Step 2 : When job request is made for a resource, job will be moved into a job queue.

Step 3 : Each job will be taken from queue and will be assigned to respective Virtual machines.

Step 4 : Before assigning each job, energy consumed by each VM has to be determined.

Step 5 : Once energy consumed by each VM is known, VM will be clustered into three regions, namely small cluster, medium cluster and large cluster.

Step 6 : Based on energy consumed it will be assigned to small cluster.

Step 7 : Once the demand for the resource increases, it will be shifted to medium cluster.

Step 8 : Once it is full, it will be sent to large cluster group.

Using this algorithm there is a chance of reducing the CO2 emission into the environment. This technique prevents the problem related to carbon emission into the environment. Instead of keeping all the systems in run mode even though they are not effectively used, using the above techniques power and energy efficiency can be utilized for full extent. If the resources are not required or used at the particular point of time, then it will be in idle state. Thus having power utilization in the ideal method.

VII. CONCULISION :

This paper presents new idea for improving power performance of cloud application, data centers etc. It is mainly defined for for analysing power performance of cloud computing and data center then the proposed possible techniques to minimize the power requirement. Using this technique we should be very careful as the resources might be used from any place at any point. But the main moto should be to secure the environment by reducing the co2 emission into the nature thus keeping our nature secure from carbon emission. Thus by this we will obtain more user friendly environment. As we are moving towards cloud and using its application in every field such as disaster management, service provisioning, online data storage, data retrieval from any place at any time etc we must ensure it to be environment friendly otherwise the day will not be far when pros of cloud becomes cons for environment.

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