Exploration on Cloud Computing Techniques and Its Energy Concern

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Abstract
Cloud Computing Model provideresources on demand and is massively scalable. It has a distributed infrastructure and it allow consumers to fully access the resources. It offers high performance, reliable resourcesas a utility to the client through internet. It is moving towards green computing,client accessing resources in a distributed way and eliminates the implementation and installation steps. Rather than usual computing paradigms it makes considerations on energy, excessive heat,powerconsumptionetc.whichmake it environment friendly.

Keywords: cloud, evolution, energy efficiency, service models, environment friendly, power consumption,Cloud Management System.

1. INTRODUCTION

Cloud computing become a 'buzz' which is accepted as ubiquitous concept. It provides services like compute power, storage, application over internet. It changed technology sector. Cloud computing is a style of computing in which IT related capabilities are provided as a service using networking technology to multiple externalcustomers. It is a grown up technology which have a vital role in economy through cost effective resource utilization technique.

Cloud services are offered through data centres, at various locations by the virtualization technique which is providing service benefits to the end user. By the cloud services remote alliance become easy and by the use of virtualization technique end users can access services including resources on demand in a scalable fashion. Nowadays there is a huge list of cloud service providers and are focused on various areas .The resources may be hardware or software based which are designated based on requirement.

In spite of the financial benefit it also has some dealings on power consumption. Data centres storing high amount of data and it will cause high energy consumption which cause environment harming gas emission. Now lot of studies are going on towards minimizing the energy consumption of datacentres and power consumption is a major concernin service distribution on cloud computing.

2. EVOLUTION OF CLOUD PARADIGMS

For cloud computing there was no exact date or year to mention its evolution. It was along termmovement towards resource Optimization.Origin of cloud computing isobscure. This concept was introduced by Jun McCarthy in 1960 and was exploredfirst time by Douglas an Electrical Engineer in his book in 1966. At the beginning of this era client server Architecture was popular along with mainframe architecture.

Organizations can rent access to anything from applications to storage from the cloud as a service. By this companies can save upfront cost. Other benefit is they can avoid headache of maintaining their IT infrastructure and can simply pay for what they use. Virtualization which was initially developed during mainframe era is now involved to create virtual software of a computing resource rather than the actual version of same resource. Multiple operating system and applications can run on same machine, same hardware at same time which increased utilization and flexibility collaboration of various computing platform lead to the birth of the cloud computing and are listed in the figure given below

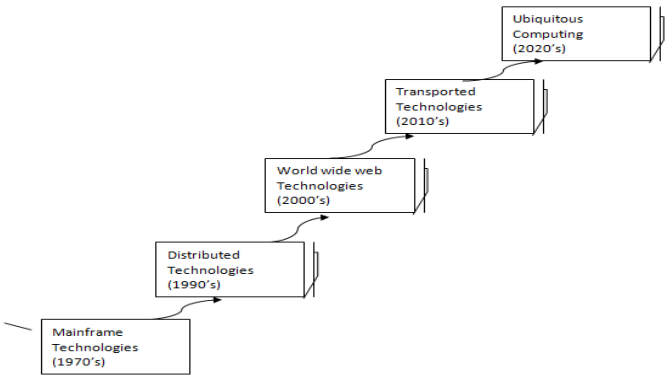

Figure 1. History of Cloud Computing

3. SERVICE AND DEPLOYMENT MODELS

Software–as - a- Service(SaaS):-Third party provider host application and allow to access application quickly without installing new infrastructure.

Platform - as – a –Service (PaaS):- It allow organizations to access platform and framework upon which developers can develop and run application.

Infrastructure – as – a –Service (IaaS):- It is the vital model to launch the organization's service to make the service available to client and application to run them smoothly.

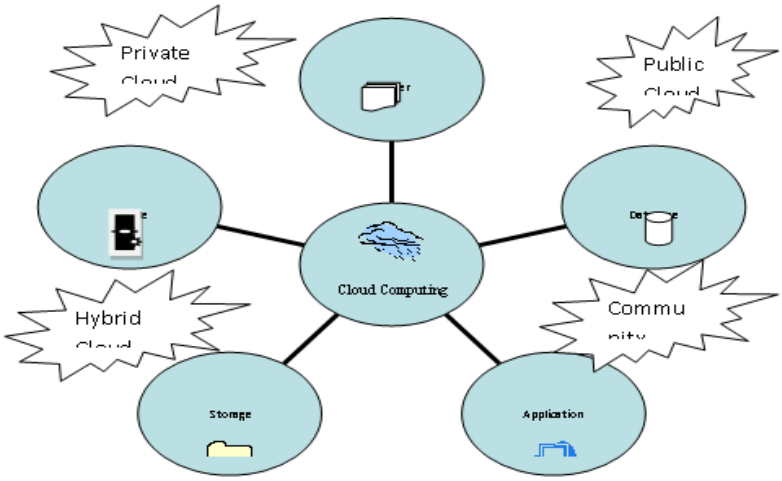

Figure 2. Types of Cloud Computing

Deployment model defines the way of providing cloud service available to the users. They are defined based on the infrastructure and it is selected based on the organizational needs. Public model hold up all users where as Private Model is true to its name, used by single organization. Hybrid model make use of interconnected public and private cloud to scale up the utilization. In community level multiple organizations sharing resources as a part of community based on the service or department.

4. ENERGY CONSUMPTION FACTS

As we discussed earlier cloud provide service to the user based on demand and cloud should be functional throughout the whole time to maintain reliability and availability. The methods to handle data storage and processing consume large amount of power and become a challenge on sustainable environment. Nowadays cloud service providers are trying to reduce the carbon foot prints of their infrastructure by minimizing the gas emission due to the service methods.

Based on the application or computation reside on the server has role on energy consumption. Server idle time, electrical and network equipment also have contribution on energy consumption.

$$PC_{tot} = PC_{idle} + PC_{proc}$$

herePC_{tot} =Total Power Consumption

PC_{idle}= Power Consumption at idle timea

PC_{pro}= Power Consumption at processing time

Demand of cloud is in its peak due to its service on demand. Many organizations are now migrating to the cloud and due to that number and size of data canters are increasing tremendously. Servers are working whole 24 hour/365 days even if it is not in use not possible to turnoff because of the demand service approach.

Energy efficient cloud infrastructure should focus on hardware and software part. In the hardware part we have to mainly focus on servers and the network section and in the software part include the cloud management system and appliances.

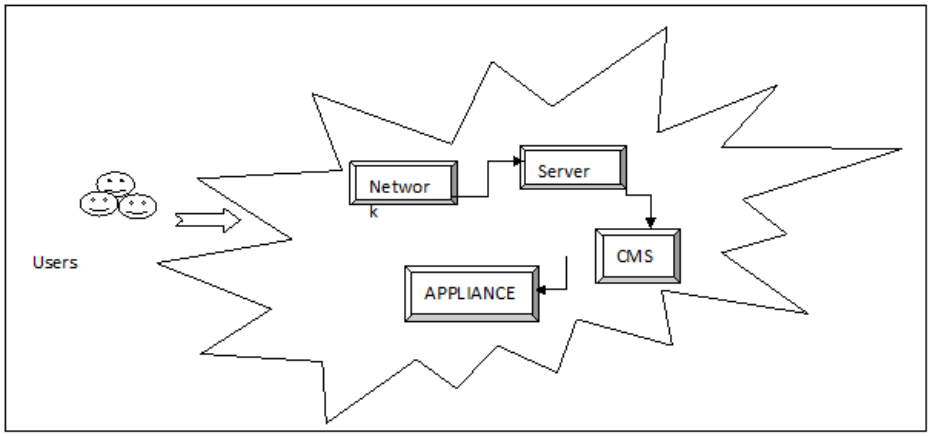

Figure 3. Cloud Computing Data Centre Domain

5. SERVER AND NETWORK DOMAIN

Server is the key part of cloud concept and it comprises system for storage as well as computation. In a data centre components of a server as we know processor, memory, and cab all are layered as racks. Communication devices or equipment which is under network domain along with server part and supporting hardware part consume energy and have contribution towards energy wastage due to poor policies of equipment usage.

Overall efficiency of a server greatly depends on energy efficiency of its components. In order to reduce the energy loss we can apply various approaches like

✓ By the use of energy efficient components including energy efficient CPU, key value storage system reduces the temperature which mitigate the energy loss through heat. Excluding the server components which are not in use also reduce the energy loss through heat.

✓ By limiting the hardware subsystems which are mostly used for power supply and cooling which leak energy due to low performance. Approaches like replacing UPS with backup batteries will lead to a great energy saving.

✓ By the use of fair size cache we can save energy. Large sized cache does not guarantee low cache miss rate.Now modern on-board cache are available.

✓ By the use of components like processor, memory and storage disk which can automatically scale their power consumption based on the load and while being in the idle state.

Network is the most important enabling part that allow communication between computing sections, storage and cloud end user. It plays role inside the data centre then communication between data centres and communication with end users. Various strategies techniques to reduce consumption are like

✓ By deducting the heat load of network equipment used inside the data centres which can reduce consumption and can also lead to reduction of energy consumed by the cooling sub system.

✓ By applying energy efficient network topologies and networking equipment which can reduce the power consumption

✓ By some optimization technique on user domain, software as well as on network used by the servers to reduce the consumption. Some other steps like network traffic and virtual machine assignment techniques are considered to reduce the network traffic.

6. CLOUD MANAGEMENT SYSTEM AND APPLIANCE

CMS plays an important role in managing and monitoring the cloud environment to improve efficiency utilization and to reduce the energy waste. It includes virtualization technique, monitoring and scheduling system. A number of actions can take to diminish the waste and lose.

✓ By imposing certain functions in to the cloud management system to control hardware equipment directly and by expanding its control from server to network and even the cooling system will significantly reduce the power delivered to hardware stuff.

✓ By implementing lightweight supporting subsystem for virtualization and monitoring instead of cumbersome system that provide lot of functionalities not used by CMS.

✓ By implementing subsystems in a modular fashion CMS can save energy by loading the modules when they are actually required and removes the module when they are no longer required.

Appliance the part of software domain which enacts actual work for cloud users. The appliance includes application, run time environment and finally the operating system.Energy efficiency of appliance affects both energy loss and wastage and a number of actions can be taken to reduce it.

✓ By putting a great attention to detail on optimizing the implementation, light weight programming languages and including only the required libraries. Then have a fine grained monitoring to identify the process which is responsible for more energy consumption.

✓ By implementing and using customized operating system and runtime environment based on the requirement of application can reduce the resource consumption overhead.

✓ By minimizing unnecessary use of appliance through some techniques to reduce useless energy consumption .Some of them are Batch process for serving request, limiting the threads, limiting backups and checkpoints, adjusting the cashing and monitoring frequencies without affecting the performance and security.

Suitable development of appliance, reducing appliance overhead, optimal selection of hardware components and its configuration are the major challenges. Software optimization for energy efficiency will be very valuable and green compilers could optimize code to energy efficient mode.

Cloud computing infrastructure from datacentre to the smallest component such as CPU, various domains as we discussed earlier such as appliance, network, server, cooling and power supply and their interaction are analysed as a whole. Running cloud appliance in an energy efficiency manner requires communication between appliance and other domains to make optimal solutions.

7. ENERGY EFFICIENT APPROACHES IN CLOUD COMPUTING

Green cloud computing model focusing on usage of internet computing services fromsource or provider that have considerations on measures to reduce the negative effect on environment. Improving the power usage efficiency, Usage of hardware with long lifespan
Avoidance of toxic material on hardware components, Utilization of renewable energy resources and recycling of waste heat are some measures to make a green service.

Various techniques like DVFS, virtual machine migration and virtual machine consolidation. Dynamic Voltage Frequency Scaling (DVFS) is a technique reducing dynamic power consumption by dynamically adjusting voltage and frequency of a processing unit. Virtual machine consolidation combining workload from various machines to a limited number of systems which increases the performance of a single physical machine whereas migration will transfer running virtual machine to another active physical machine. Both aim on reduction of power usage by the datacentre.

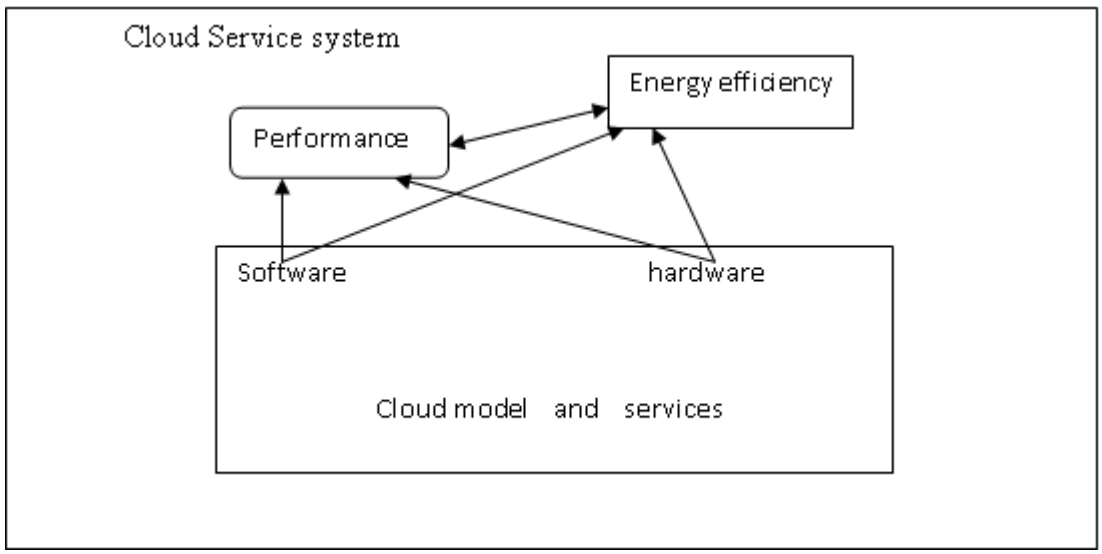

Figure 4. Cloud service systems

Software development, testing deployment and operations are also factors that affect energy efficiency. Both hardware and software in life cycle play important role in energy efficiency.
In the software section energy is not only consume by the CPU cycle it also have role on storage section and data transfer section.

To estimate energy consumption of program statements and structure we have to consider certain things which includes

- Complex operations and data structure consume more energy than their simple one.

➢ Task which increase CPU utilization and decrease CPU idle time reduce energy consumption

➢ Task which prefer to use high performance storage has less energy consumption

At present all data centre providers are focusing on an architecture with carbon footprint and looking towards a renewable resource with minimal emission of green gas.

8. ENERGY USAGE

Green cloud computing is focusing to include environment friendly production system, energy efficient technology and efficient recycling management.

➢ Green at design

Have to concentrate on design part itself for reduced energy consumption. Designing of server, infrastructure, digital devices, software applications have role to reduce energy consumption

➢ Green at production

Recycling the equipment and optimized software application development can contribute positive effect on sustainable environment.

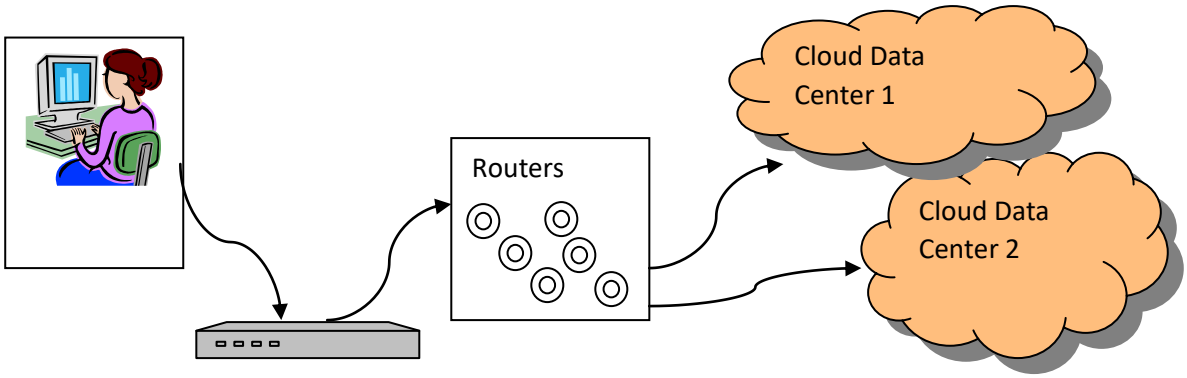

Figure 5. Energy consumption using cloud computing

User

First factor is user, how the software applications are designed and implemented.In cloud architecture we can run applications of individual user or the applications of cloud service provider. Both are utilizing SaaS and in both case energy consumption depends on the application. The inefficiencies of application like suboptimal algorithm improper usage of shared resources lead to increased CPU usage which leads to high energy consumption.

Network Devices

Another area which has contribution on total power consumption is network devices. Before the datacentre process, data traveling through many devices like Ethernet switches, broadband gateways, routers etc. Energy efficiency of network devices mostly depends on topology, system and protocol design.

Data Centres

Due to large number of equipment datacentres consume large amount of energy and emit mass amount of carbon. In the cloud infrastructure not only server and storage system consume energy but also the cooling devices consume equivalent amount of energy as the IT systems.

9. TOWARDS ENERGY EFFICIENCY

Application/Software

It is very much important to focus energy efficiency at application level. To achieve efficiency in this level SaaS should provide attention on infrastructure to deploy and execute efficiently. In addition to that use various energy efficient techniques to reduce consumption at compiler level and code level.

Virtualization and Provisioning

The consolidation of virtual machine,scheduling, demand projection, migration, temperature aware allocation and load balancing are various techniques for minimizing power consumption. Automatic reconfiguration of thermal load management system also focusing on power saving.

Power Measurement

To improve performancewe need to measure or monitor the consumption. Power consumed in the management, processing, storage, routing of data with in data centre, server are measured and various metrics are designated to compare efficiency.

10. CONCLUSION

In this paper we reviewed the energy efficiency including hardware and software that steer the cloud computing. Cloud infrastructure embrace of systems and components like computation, power supply cooling etc. These are from various areas such as hardware, network and software and optimizing these systems separately does improve energy efficiency of the whole system. Green computing is a need of current time that provides an environment sustainable computing power through energy efficient computing.

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