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Research paper

A comprehensive review of energy efficiency in cloud computing environment

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Abstract

High energy consumption in the cloud has become a huge problem in the data center. Energy represents direct significant cost in the operation of the data center. In Information Technology, infrastructure, Internet applications are in more demand. Cloud computing provides IT resources in the form of infrastructure, platform and application by providing services through the Internet Technology. This leads to more energy being consumed as cloud is used to provide IT services from the IT resources to the IT industry and to the Organizations. To analyze power consumed in the data center, applications are deployed in cloud and tested using different workload conditions. Virtualization depicts more energy utilization in the cloud data center. In this paper discussed about the comparison of cloud and cloud computing, cloud type providers, component performance through secured shell. Identified the various levels of energy consumptions in the cloud. the different techniques which is used to reduce the power consumption in the server and workload consolidation using various parameters are considered.

Keywords: *Energy Efficiency; KVM; Power; SSH.*

1. Introduction

Cloud is the on demand application in the current IT Infrastructure and the shared group configurable various computing resource such as storage devices, applications and provide service to the servers. Cloud is mainly deals with service models as user application to run on the cloud infrastructure Software as a Service (SaaS), platform to deploy our application Platform as a Service (PaaS) and capacity provided to the customer to run their application storage and various network resources Infrastructure as a Service (IaaS) and the network usage, service providers and inter connectivity services in Network as a Service [NaaS]all the hardware computed equipment services. Cloud data center has broadly been acclimatize by the Technology, in the current technology have many open issue be fond of Load Balancing, Virtual Machine (VM) Migration, data center Consolidation, Energy efficient Management, and security is considered. the main issue focusing on load balancing deal with the work load consistently to all the users in cloud to attain s good user satisfaction and all resource deployment. To setup private cloud VMware will place a most important role in the infrastructure. Load balancing in cloud through the virtual Machine to be done efficiently to reduce the cost . Scalability is one of another important feature in the data center.

In cloud computing the distribution of load balancing is divided into two different categories I. e., selection of the data center called as DataAppServiceBroker and we have to set the Virtual Machine Management (VMM) to each data center called as DataCenterController. Cloud infrastructure is the collection of hardware and software cloud infrastructure contains both the physical layer and abstract layer. The physical layer consisting of all hardware resources it is necessary to support the cloud services, and includes server, storage and all network components. The abstract layer consists of the software deployed across the physical layer, which manifests the essential cloud characteristics. Conceptually the abstraction layer sits above the physical layer.

2. Cloud vs cloud computing

Cloud can be called as a collection of Hardware and Software. Cloud Computing is defined as various platform and application. A cloud computing is the process happen dynamically with different configuration of the hardware and reconfiguration to use with de provisions of servers as needed. Servers are the coated with collection of hardware's and different physical machines or virtual machines. In the cloud the main issue to be considered as security. Advanced cloud computing resources compiled by SANs with other security devices.

3. Cloud types

Private Cloud: private cloud is also called as internal cloud or corporate cloud. It provides computing power as a service within a virtualized environment using physical resources.

Public Cloud: public cloud is an computing model, in which services provider makes resources through the Internet. E.g., storage, applications.

Community Cloud: community cloud is a multiple infrastructure which is shred among much organization from specific group.

Hybrid Cloud: hybrid cloud is a computing environment in which organization provides in house and others externally.

4. Cloud type provides

STaaS: Storage as a Service is mainly used as the business basis it requires the large area which large service provider with high capacity and storage infrastructure. the economy of the infrastructure main feature is to reduce the cost with high scalability[4]. Storage backup facility is one of the most important features of STaaS. it requires large amount of network bandwidth capacity to the utilization of internet based network service applications.
SECaaS: Security as a Service also a business model provides corporate infrastructure more cost effectively for the private cloud. The security includes more Authentications, antivirus and security event management and others [4].
DaaS: Data as a Service is the brothers of Software as a Service. Data is on demand application which can be assured as a user despite of geographic organizational separation to the supplier and customer.
TEaaS: Test environment as a Service referred as "on-Demand Environment" is called as environmental delivery of the model. The software which is associated centrally called as Internet or Cloud and the user can access at any instance of time normally called as a web browser or Internet .
BaaS: Backend as a Service it is also called as mobile connectivity as MBaaS where as mobile back end as a Service which is used to test the applications through the back end connectivity and storage capacity and providing social networking applications.

5. Components and performance of cloud computing

a) Data center

Data centers are distributed in all over the world through the cloud. The data center location is considered by infrastructure, cost, and other I/O devices. Data centers can expand the infrastructure depends on the demand of computing resources. In the cloud computing data centers are the fast-paced demand as a key to leverage virtualization technology. Power consumption under different workload condition becomes the critical concern for large-scale data center depends on infrastructure.
The Cloud Computing standard is an on demand computing resource categorized as CPU, RAM, Storage and Server. The Hardware level Server Configuration we are using mainly for Rack server with an Enclosure run on Hypervisor.

Fig. 1: Rack Server.

Rack server hypervisor or (VMM) Virtual Machine Monitor is a part of computer software, firmware or hardware. Hypervisor creates and runs the virtual machines. Hypervisor defined as one or more Virtual machines can create and run on the same applications. This is also called as host machine. Each Virtual Machine called as Guest Machine. Rack Server used for two purposes as Storage and service provider perspective.

b) Blade Servers

Blade servers will not contained all the components of the computer which include only power supplier and the networking hardware components. Blade servers require a single power supply and cable with cooling system.

Fig. 2: Blade Server.

The main usage of this blade server is office usage. Security can be provided to the server with different login to the different users. Blade server can be secured through any remote login protocols ex., rlogin, telnet and SSH. The SSH Configuration is also called as Open SSH which is used as FOSS in Linux. Open SSH residential by the open group and released by Simplified BSD license. It is having multi platform capability with good features. The latest version is OpenSSH 6.4 released on November 2013.SSH is mainly used the cloud to be kept for private usage. Secured Shell is acting as interpreter between client and server.

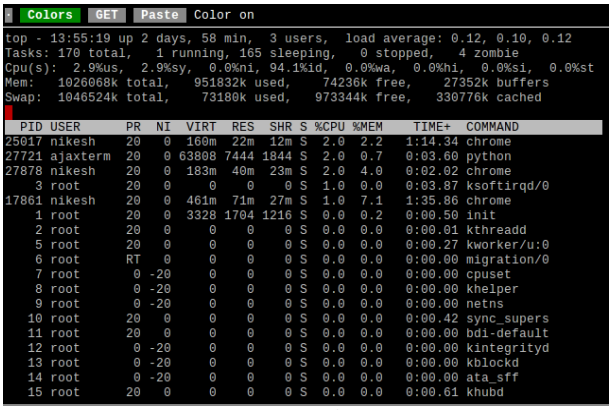

Fig. 3: SSH Performance.

c) Features of Open SSH:

- Secured Communication.
- Single login Agent Forwarding.
- Compression of Data.
- Authentication is very strong.

d) Virtualization in Cloud

Virtualization layer is acting a mediator between cloud and the hardware. IaaS Service model is supported in cloud. It is used for VM performance measurement area in cloud computing.
The hardware resources as CPU, Memory, Disk etc.VM refers to the arrangement through ready to use according to the user need. Cloud is the area it contain the collection of software and hardware resources

e) Virtual Machine Performance in Cloud

VM performance can be analysis through CPU-processing speed of the processor based on the VM created. Memory- processing speed of the memory based on the VM created. Disk-Input performance to disk based on the VM created. Response Time-Total response time to get from the server is based on the number of user's request to be made.

f) Applications of Virtual Machine

VM provides everything that u could you imagine. Hardware, Network utilization, Memory usage, Operating System, Applications, Software can be used by the help of Hardware and it can be remote with Operating System.

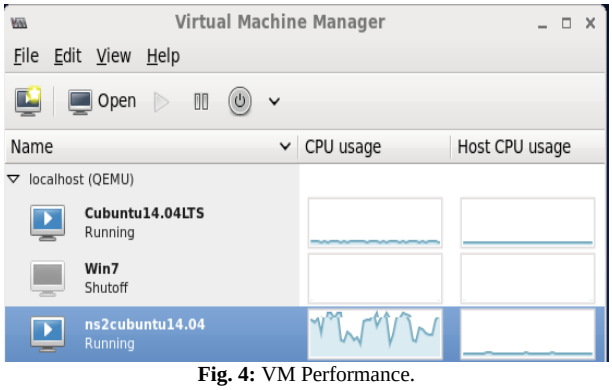

Fig. 4: VM Performance.

In the above fig 4 shows the performance of VM in cloud environment during private cloud setup. Through the VM we can distribute different tools to the different users at a time. The energy utilization in the cloud server is tends to increasing in every year is double the previous year from 2010 resulting is approximately 7.2 billion dollars annually.

Power is consuming with only with hardware physical infrastructures it also consumes by the various applications runs on the server. The end user and the business applications are the direct impact of the energy usage using various resources is shown the fig 5: Energy Consumption in different Levels.

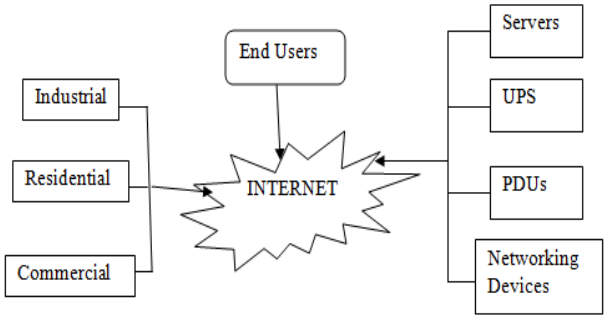

Fig. 5: Energy Consumption in Different Levels.

The end users are directly interacting with the cloud through internet. Internet can be used every ware industrial, residential and commercial purpose. Then the infrastructure components like Servers, Ups, PDUs and Networking Devices are main energy consumption devices in the data center.

Table 1: Power Consumption in Server

Server Class	2010	2011	2012	2013	2014	2015	2016	2017
Volumes	300	320	342	375	418	450	492	560
Range Min	900	1000	1572	1854	2051	2450	2832	3030
Range Max	10100	10900	12000	13500	15620	17725	18632	20256

The table 1 depicts the power consumption in a server is describes as volumes as the cloud storage blocks and the range of power consumption with minimum to maximum from 2010 to 2017 has identified.

6. Power-energy model

The terminology used to calculate the power and energy is discussed below
Amperes: measurable for electric charge flow
W: power measured in terms of watts
Kwh: Kilowatts workload measurable per hour
1000W: 1KW is equivalent to 1000W of power consumption

$$P = P_{minimum} + (P_{maximum} - P_{minimum}) * Utilization \quad (1)$$

Whereas P is Power usage in Eq. (1)
P minimum is minimum power usage during idle state
P maximum is the maximum power usage at peak workload condition and the utilization can be measured between 0 and 1.

$$E = (Nodes + Switches + Storage + NIC) * T \quad (2)$$

The energy can be calculated in Eq. (2) by measuring the usage of Number of Nodes considered, usage of switches, storage capacity and other networking devices usage during Time period considering as decreasing the performance of CPU.
In Table 2 explains the authors work carried out in various parameters considered and the work or technique implemented in their research.

Table 2: Consolidation of Work Done So Far

Sl. No	Author	Parameters used	Background work done
1	Usha, J., Jayasimha, S. R[1]	Utilization of CPU and Server	Automata Approach
2	Beloglazov, A[2]	Power usage in server	Servers are in Idle Condition
3	Jalali, F.,[3]	Utilization of CPU	DVFS Algorithm
4	Midha, S.,[4]	Networking Components Power usage	VM and Domain Consideration
5	Singh, S., Swaroop[5]	Storage devices	Single Host and Clusters
6	You, X., Li, Y[6]	Usage of power	Allocation of Resources
7	Aswal, M. S[7]	VM energy consumption, SLA violations	Eco System in the data center
8	Dayarathna, M[8]	Energy consumption of data center,	Applications runs on server
9	Kachris, C.,[9]	Storage devices	SLA Agreements
10	Kaur, S.,[10]	Green energy coefficient	CO2 emissions
11	Erol-kantarci, M[11]	Usage of server	Active VM Participations
12	Sharma, S. K[12]	SLA violations Energy consumption of data center	Considered all possible supporting devices

Table 3: Energy Efficient Survey on Parameters

Sl. No	Author	Components	Work Load	Cost	Emission	Power	QoS	Networking Components
1	Mastelic, T[13]	Wireless WAN	Yes	Yes	No	No	Yes	No
2	Yin, S., Xiao, Z.,[14]	Server	Yes	Yes	No	No	No	No
3	Eichhorn, F.,[15]	Data Center	Yes	Yes	No	No	Yes	No
4	Quintiliani, A[16]	Data Center	Yes	Yes	No	No	Yes	No
5	Al-qawasmeh, A. M[17]	Server	Yes	Yes	No	Yes	Yes	No
6	Yin, S., Li, X[18]	Data Center	Yes	No	Yes	No	Yes	No
7	Chisca, D. S.,[19]	Server	Yes	Yes	No	Yes	Yes	Yes
8	Arroba, P.,[20]	Data Center	Yes	No	Yes	No	Yes	No
9	Deguchi, T.,[21]	Networking Devices	Yes	No	No	No	No	No
10	Taniguchi, Y[21]	Data Center	Yes	No	No	Yes	No	No

The table 3 describes the energy efficient parameters to be considered to achieve the efficiency.

7. Conclusion

Considering the features of large applications in cloud computing the current trend in the environment is Cloud usage and the performance. Cloud provides Infrastructures, Platform, Software, Data, Storage, Test Environment and Security provides the services. The Cloud computing begins with the virtualization using as a resource to the whole set of computers the prime fear about the cloud computing is security and privacy. User can access their data and applications from any ware and any time with the network. In this paper discussed with the differences of cloud and cloud computing. The setup features of cloud and giving security to the cloud with the performance of cloud. The energy and power measuring factors been considered. The paper contains detailed survey of various parameters considered to achieve energy efficiency and the technique implemented in energy efficiency is discussed.

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