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Cloud Computing: Types, Topologies, Virtual Machine and VM Migration for Decrease in Power Consumption

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Abstract: As the usage of internet is increasing day by day, more and more people are now getting connected with the web. In the last few years, internet has become apowerful platform that has changed the way to do a business and the way of communication. The number of users which were using the services of internet in last ten years isbecoming double in the number, in every two years. As the number of users is increasing the more storage and new technologies and new platform to develop software are on a huge demand. Then cloud computing came into the picture, which is providing huge storage capacity, on demand self-service, pay according to usage, flexible pricing, resource pooling, software for users and services on their demand which can be accessed anywhere (SaaS), platform to develop new software (PaaS), any hardware which is required for development (IaaS). Now even XaaS i.e. everything as a service (here X is considered as everything, its value can be any) is also coming into the picture. To run one or more than one services or applications together but in their separated space or partition, we need virtual machine. It is refer to the one instance of an operating system (Guest OS). Then Virtualization makes it possible to run manyoperating systems and applications on the same physical computer at the same time. It makes the physical system energy efficient, as many machines or applicationsare able to run all together, in a way it consumes less energy. To make the physical system more energy efficient,migration of virtual machine is done, so that we can reduce the energy consumption. VM Migration is used for migration ofvirtual machine from one PM (physical machine) to another physical machine or host. In this paper, we will discuss about the introduction of cloud computing-its types and topologies; and the main focus would be on energy efficiency using VM migration.

Keywords: Cloud Computing; Virtual Machine; VM Migration; Green Computing; Energy Efficiency

1. INTRODUCTION

Cloud Computing is an extension of traditional computer network with new features. It provides highly scalable platform in which the resources are offered as-a-service. It is a distributed based processing, as resources are scattered in it at different physical locations and we calculate their values from those locations.It works on sharing of resources- physical or virtual. It saves cost of deploying local or personal software or hardware. It mainly focuses on shared resources, so we can use them more effectively. These resources are not only shared by many users together but also it is dynamically reallocated per demand. Cloud computing provides huge storage capacity for its users and pay according to use model, it also provides on demand self-services, resource pooling- in which the host of services serve the multiple clients and services. Service on demand of users, which can be accessed anywhere in the world by just logging in into your account- it is also known as software as a service (SaaS); then there comes platform as a service (PaaS) - it provides platform to users where they can develop or create their own new applications; it also provides any hardware which is required for the development of applications and this service is termed as infrastructure as a service (IaaS). Now even the XaaS is also coming into the picture, which means everything as a service, here X means everything, its value can be considered any, here it acts like an variable, it includes everything as SaaS, PaaS, IaaS all are interrelated to one another, it also includes business process as a service (BPaaS), network as a service (NaaS), communication as a service (CaaS), desktop as a service (DaaS), application platform as a service (APaaS), application infrastructure as a service (AIaaS). Cloud Computing relies basically on its components, there are three major components: Client computers- clients interact with the cloud these are the end users; Data center-it is known as the collection of servers, where an application is placed and accessed; Distributed servers- even the servers are at different locations but they act as they are working together[1].

2. CLOUD IMPLEMENTATION TYPES

A. Private Cloud:

Private cloud is only for a particular single organization. The organization which owns the cloud manages it itself or any third party manages it. High degree of control privacy and security is there. It is

most secure among others. Only one organization owns it and manages it. It limits its access only to the organization and its partners, if any.

B. Public Cloud:

Public cloud is shared by two or more organizations. It is used by the public on shared basis or by a large industry group. It is managed by the service provider.Public cloud is less secure as compare to the private cloud.

For example: Amazon, Google, Microsoft, Salesforce.

C. Hybrid Cloud:

It is a combined cloud, usage of both private and public cloud. In it one part of cloud isowned by a particular organization i.e. it acts as a private cloud, and other part acts as a public cloud. It is flexible and cost efficient and less secure [2].

3. CHARACTERISTICS OF CLOUD COMPUTING

Important characteristics of cloud computing are as follows:

A. On demand self-service

On demand self-service means, whenever required the services are provided by the host of the network to the customers. Users can access the services through the online control panel.

B. Flexible pricing

Prices are flexible; payments are done according to the use of services.

C. Rapid elasticity

It is scalability; elasticity is defined as the ability to scale the resources i.e. upwards and downwards. Whenever any amount of resources is required, that amount of resources is provided by the host to the customer.

D. Ubiquitous Network access

Services of cloud can be used or accessed anywhere and with any electronic gadgets like computer, desktops, mobile, tablets and workstations, etc.

E. Resource pooling

Service providers serve multiple clients at a time. Multiple customers are able to access the resources.

4. CLOUD COMPUTING ARCHITECTURE

Cloud computing architecture is also known as system architecture, which provides the cloud computing services. Multiple components of cloud communicate with each other in the form of messaging queue.

The services which are provided to the costumers are based on the following service models:

A. Software as a Service (SaaS):

Software as a Service is an on demand service for end users. This service can be accessed anywhere in the world with just an internet connection and any electronic gadget that supports the features of cloud, just by logging in into the account one can access the services anywhere. This service can be accessed without any additional requirement of the hardware and the software. Gmail, yahoo, Hotmail are the few examples which fall under this category.

B. Platform as a Service (PaaS):

It provides platform for developers over the internet to create their own applications. The cost for development and deployment and the complexity of applications is very less by using this service. Applications can be created at very low cost as there is no need to buy and maintain the software, as one can directly use it.

C. Infrastructure as a Service (IaaS):

IaaS is also known as a hardware as a service. It acts as a delivery model. It provides the computing power, which is rented to the cloud customers by the service provider for a limited period of time.

For example: Google compute engine, Amazon Web Services (AWS), Microsoft Azure

5. GREEN COMPUTING

Green Computing is the eco-friendly technique of using the computers, another name given to it is green IT. It is the way to use the computing resources in an efficient way. The major goals of green computing are: to lessen the use of hazardous materials; to promote recyclability or biodegradability; energy efficiency should be maximized during the lifespan of a product. It is a practice of reducing environmental footprints of technology by efficiently using the resources. Green computing could be costly, and rapid change in the technology will also affect it[3]. Following are the approaches that are used to promote the concept of green computing:

Green design: Designing computers and other subsystems, which are energy efficient.

Green use: Using computers and other devices in an eco-friendly manner, so that consumption of electricity can be reduced.

Green disposal: Recycling of existing computers and proper disposal should be done.

Green manufacturing: Waste should be minimised while manufacturing computers and other subsystems.

6. ADVANTAGES OF GREEN COMPUTING

- Cost saving: as saving energy and resources will save money.
- Conserving resources: as less energy is required inmanufacture, usage and disposal of products.
- Lower carbon dioxide emission.
- Use the concept of three R's- Reduce, Reuse, Recycle.

By using the concept of green computing the virtualization in cloud computing came into existence. It reduces the number of physical machines by virtualizing them, so that we can consume fewer resources and save the power, by doing that we can reduce the carbon footprints [4].

7. VIRTUAL MACHINE AND VIRTUALIZATION

Virtual machine is an instance of an operating system, it is use to run one or more than one applications together within the computer in their own separate space or partition. Mainly there are three types of virtual machines: Full virtual machine, it is also known as system virtual machine, it can provide a substitute for a real machine i.e. we can use this VM completely in place of an actual or real machine. Second is- Hypervisor- for sharing and managing hardware it uses native execution, it allows multiple environments which are separated from one another to run together on same physical machine. Third is- Process Virtual machine, it

provides an environment which is platform independent to design and execute the computer programs [5].

Virtualization is a way of creating the virtual of something, not the actual or physical one. It is a software technology; which is used for running many applications, OSand softwareat a same time and on a same server [6]. Virtual machine monitor (VMM) is the technology which works behind the concept of virtualization. It makes storage, workstations, servers and other systems, independent of physical hardware layer. Virtualization can increase flexibility, IT productivity, agility, scalability, performance, availability, it is cost efficient mechanism, and itsimplifies the management of data center [7].

Two or more Virtual machines can run on a single node. And we can also migrate or shift the VMs from one node to another, so that they can act as more energy efficient and load of two nodes can be balanced.

8. MIGRATION OF VM

Virtual Machine Migration, it is a very useful technique. It migrates or transfers the VM from one node to another. We perform VM migration to balance the loads, to decrease the usage of energy and to manage the faults. When a host gets overloaded thenby performing the migration of virtual machines we can transfer some amount of load to another machine.The complete process of transferring VM from one physical host to another physical host is called as virtual machine migration.The process of moving one virtual machine (VM) from physical host to another physical host is termed as migration. It is used for energy efficiency, so that we can reduce the power consumption by virtual machine migration. In earlier times it was necessary to shut down the virtual machine first before its migration but now the load of virtual machines can be migrated without even shutting it down, by using the live migration for transferring the load [8].

There are two types of migrations one is live and another is non-live.

A. Live migration is also known as the hot migration. In it the user does not get interrupted while the migration of virtual machine, the machine keeps on running at the time of migration and it does not lose its status. In the live migration, two parameters are considered. One is downtime and other is migration time. The prior one is refer to the time during which the services of the virtual machine are not available. And the later, is the total time required for migration of VM, it does not affect its availability.

B. Non-Live migration is also known as cold migration, during VM migration the status of virtual machine loses and user faces the interruption. In non-live migration firstly we suspend the virtual machine and then the state of virtual machine is transferred and in the last step the VM is restored at destination host [9].

   Live Migration can be done in two steps, in first step the control is switched to the destination, in it the connection is made on prior bases. Then in the second step data is transferred to the destination

   There are two techniques for performing the live migration:

(i) Pre copy:

In this technique, firstly we transfer the memory and then the execution is transferred to the destination node. In pre copy the memory is shifted from source with number of iteration. Its phases are:

- *Warm-up phase:*
  When the VM is running on source, it copies all the memory pages to destination node. While copying if the memory pages are changed then they are known as dirty pages, and these pages are copied again until the recopy page rate is not less than the rate of dirty pages.
- *Stop and copy phase:*
  In it we stop the virtual machine in the source and then we will copy the leftover dirty pages and shift those to destination node and the virtual machine on the destination node will be restarted.

(ii) Post copy:

In this technique, firstly the execution is transferred and after that the memory is transferred from source node to the destination node.

To measure the performance of live migration, following metrics are used [10]:

- *Preparation:* In this, the resources which are used to perform various operations are reserved at the destination node.
- *Downtime:*Downtime is referred to that time during which the VM is suspended from source.
- *Resume:* Installation of virtual machineis done on the destination node, in it same state of virtual machine is installed which is suspended on the source node.
- *Total Time:* It is total migration time, the total time taken to complete all the migration steps.

9. USES OF VM MIGRATION

There are various uses and advantages of virtual machine migration.

A. Reduce energy consumption:

The load of a virtual machine is migrated to other lightly loaded virtual machine; we can switch off a VM, which is helpful in reducing the power consumption by the machine [11].

B. Fault Management:

Migration of virtual machines can also be used to manage the faults. If any fault occurs in a VM then it istransferred or migrated to some another VM to manage the faults.

C. Low level system maintenance:

While performing the system maintenance task the migration is a useful step to shed the load of a virtual machine to perform system maintenance.

D. Load Balancing:

When one virtual machine gets overloaded then migration is used to transfer its load from one node to another. It diminishes the variation of resource usage. It transfers the load of an overloaded machine to the lightly loaded machine with enough spare capacity to handle the load.

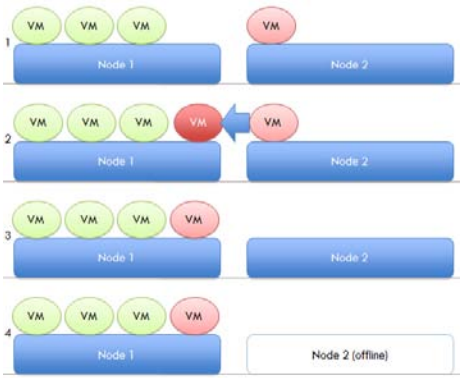

Fig.1.*Migration of VM*

By performing the VM migration, we can reduce the energy consumption- as it acts as an energy efficient technique.
There are 2 nodes of same capacity and consumes same power. And there are three virtual machines running on node 1 and only one virtual machine is running on node 2, but node 1 has capacity of four VMs, then in next step we will check the availability of node 1, if it is available then migration of VM is done from node 2 to node 1. Now all four VMs are running on node 1 and the node 2 is empty therefore now we can put the node 2 on offline mode. Now we are using only one node and other one is on offline mode, by doing that we can save the power consumption by 50%.

10. CONCEPT OF ENERGY CONSUMPTION

Energy consumption is the amount of energy or power used, here energy basically referred as the electric power. Energy consumption in cloud computing means that the electricity which is consumed by the datacentres for its working and by the coolants, coolants are used to cool down the datacentres. It is the amount of electricity which is required for the implementation and working of the cloud [12].

11. ENERGY EFFICIENCY IN CLOUD COMPUTING

Cloud computing is anessentialand more effective way to operate computer infrastructure. About 70%- 80% of resources are getting waste, and this number is increasing day by day as we are not properly utilizing the resources so the resources are getting waste. There is a need to make cloud services more cost-effective by reducingthe usage of energy and at the same time keeping the service level high for the customer. There are many ways to achieve this goal. The easiest way is to run fewer machines to save more energy. Machines have different power states, a machine may need less energy if we run it in low power state but it will not provide its full capacity. But the change from its one power state to its next power state is much faster as compare to, fromits full capacity to turnit off; therefore the increase can be served in an easier way. [13] Earlier, the datacentres are used to run in a traditional way, therefore consumption of electricity was more, but now the scenario is different, to reduce the power consumption the size of datacentres is reduced now and more load is given to the datacentres. The aim of energy efficiency can also be achieved by running more than one VMs on one host, and when a virtual machine is not required, we can switch it off and can run another required machine on its place. Its basic idea is to run the machines whenever required else we can switch off them to save the power. Migration of virtual machines is also done to save the power; if we shift the VMs of one node to another, (which is capable to handle that load)then we can completely offline that node, as currently no VMs are running on it [14].

12. RESULTS

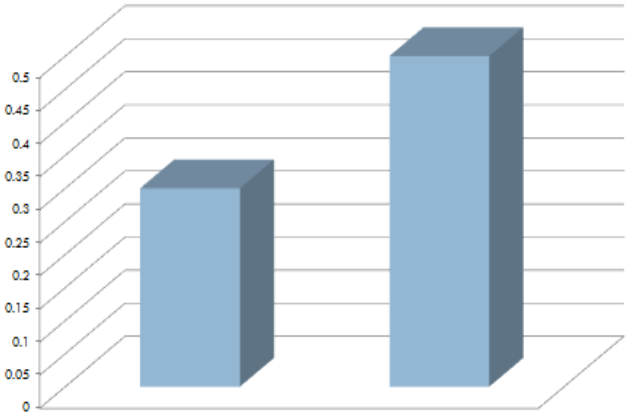

Fig.2.*Energy Consumption Comparison*

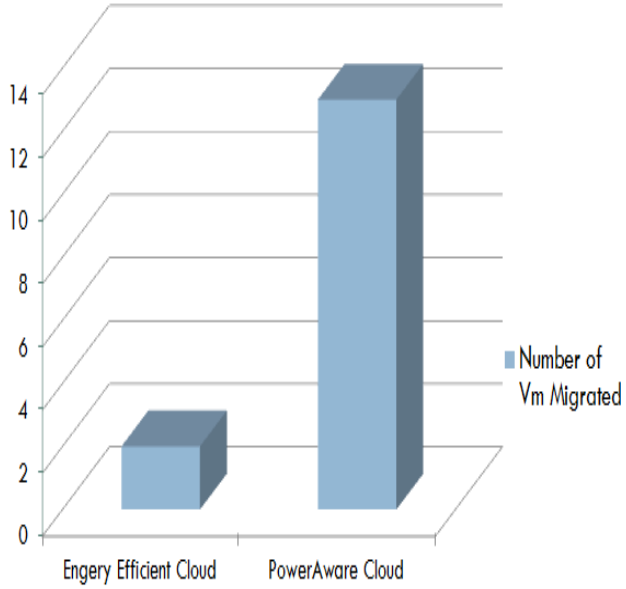

Fig.3.*VM Migration Comparison*

In the results we have shown the energy consumption comparison between an energy efficient cloud and a power aware cloud. The consumption of energy by energy efficient cloud is much lesser than the power aware cloud.
In energy efficient cloud the number of virtual machines migrated is much less in the number than the VMs migrated in the power aware cloud.

13. CONCLUSION

Cloud computing is the emerging technology, which is spreading its roots very rapidly. It is reaching to its users and providing many services to its customers to attract them

towards itself. It is also used to save the money, as there isno need to buy the resources. In this paper cloud computing, types, topology, its characteristics, and computing services provided by cloud, architecture of cloud are discussed. It also includes the concept of virtual machine, virtualization and migration of virtual machine- its techniques, phases and uses. From the above results, it is proved that the energy consumed by the energy efficient cloud is much less than the energy consumed by the power aware cloud. Because of energy efficiency, the concepts like Green Computing are coming into existence due to that our environment will get less affected, andwill efficiently utilize the resources of computing by making them more energy efficient and environment friendly.

REFERENCES

[1] Jeba Leelipushpam, P. Getzi, and J. Sharmila. "Live migration techniques in clous environment-A survey." IEEE conference on information and communication technologies, 2013.

[2] B. Kezia Rani, Dr. B. Padmaja Rani, and Dr. A. Vinaya Babu. "Cloud Computing and Inter-Clouds-Types,Topologies and Research Issues." ISSBCC'15, 2015: 24-29.

[3] Qilin Li, and Mingtian Zhou. "The Survey and Future Evolution of Green Computing." IEEE/ ACM International Conference on Green Computing and Communications, 2011: 230-233.

[4] Gursharan Singh, and Pooja Gupta. "A review on migration techniques and challenges in live virtual machine migration." 2016.

[5] Narander Kumar, and Swati Saxena. "Migration Performance of Cloud applications- A Quantitative Analysis." International Conference on Advanced Computing Technologies and Applications, 2015: 823-831.

[6] Raja Wasim Ahmad, Abdullah Gani, Siti Hafizah Ab. Hamid, Muhammad Shiraz, Abdullah Youdafzai, and Feng Xia. "A survey on virtual machine migration and server consolidation frameworks for Cloud data centers." Journal of Network and Computer Applications, 2015: 11-25.

[7] S. Mohan, "Survey on live VM migration techniques." IJARCET

[8] M. Chawda, and O. Kale. "Virtual machine migration techniques in cloud environment, A survey." IJSRD

[9] Pankajdeep Kaur, and Anita Rani. "Virtual machine migration in cloud computing." IJGDC, 2015: 337-342.

[10] Shah, Sayed Asif Raza, Amol Hindurao Jaikar, and Seo-Young Noh. "A performance analysis ofprecopy, postcopy and hybrid live VM migration algorithms in scientific cloud computing environment." High performnace computing and simulation, 2015.

[11] Toni Mastelic, Ariel Oleksiak, Holger Claussen, Ivona Brandic, Jean-Marc Pierson, and Athanasios V. Vasilakos. "Cloud Computing: Survey on Energy Efficiency ." ACM Computing Surveys, Vol. 47, 2014: 33.1-33.36.

[12] Brain Dougherty, Jules White, and Douglas C. Schmidt. "Model-driven auto-scaling of green cloud computing infrastructure." Future Generation Computer Systems, 2012: 371-378.

[13] Anton Beloglazov and Rajkumar Buyya. "Energy Efficient Allocation of Virtual Machines in Cloud Data Centers." 10th IEEE/ ACM International Conference on Cluster, Cloud and Grid Compting, 2010: 577-578.

[14] Younn Choon Lee, and Albert Y. Zomaya. "Energy Efficient Utilization of Resources in Cloud Computing Systems." Journal of Supercomuting, 2012: 268-280.