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STUDY ON VIRTUALIZATION TECHNOLOGY AND ITS IMPORTANCE IN CLOUD COMPUTING ENVIRONMENT

[1]Virendra Tiwari, [2]Dr.Akhilesh A. Waoo, [3]Balendra Garg
[1]Assistant Professor, [2]Associate Professor [3,] Assistant Professor
Dept. of Computer Science & Application, AKS University, Satna, Madhya Pradesh, India

Abstract: Virtualization which is a technology, where cloud is an environment are two most popular research directions in recent times because both the technologies revolve around creating useful environments from abstract resources. Virtualization is a technology that is being used by a growing number of organizations it allows you to create multiple virtual environments or dedicated resources from a single, physical instance of resources like hardware system, and clouds are IT environments that abstract, pool, and share scalable resources (Storage, Servers, Databases, Networking, Analytics, Software, and Intelligence) across a network. It improved System Reliability, offer faster innovation, flexible resources, and economies of scale and Security and reduces power consumption, and also provides high availability for critical applications, and run your infrastructure more efficiently. In simple words cloud computing is the delivery of computing services over the Internet. Virtualization is one of the useful technologies of cloud computing which rapidly integrating the fundamental way of computing. In this paper, a detailed review is being done on virtualization technology and further its role in Cloud Computing Environment.

Index Terms **- Cloud computing, Network, Virtualization, Technology, Storage Virtualization.**

I. INTRODUCTION

01. INTRODUCTION TO CLOUD COMPUTING

Cloud computing in simple words we can define on demand availability of computer system hardware resources and computing power, for computing or storage purpose over the Internet instead of our computer's hard drive without direct active management by the user [7]. W can say that cloud computing is a technology of computing services such as servers, networking, storage, databases, analytics, software, and intelligence over the Internet instead of buying, owning, and maintaining physical data centers and servers, which makes faster innovation, flexible resources, and economies of scale. [2].It makes users enable to access services which are actually available outside the working site and can be accessed remotely through internet. Cloud-based storage is making it possible to use of computer resources c effectively and efficiently like save files, documents to a remote database and retrieve them on demand by consuming less computing power [4]. National Institute of Standards and Technology (NIST) has defined Cloud computing which says that [11] Cloud Computing is a technology for enabling appropriate, on-demand network access to a shared pool of capable of being configured computing resources such as networks, applications, servers, storage, and services) that can be rapidly provisioned and released with a minimum amount of management effort or service provider interaction. NIST has listed five essential essential quality of cloud computing which include de on-demand self-service, broad network access, resource pooling, rapid elasticity and measured related service. Internet is making possible of accessing applications and data from anywhere at any time[37]. By the study of Juniper research , the mobile consumer and enterprise market for particularly mobile cloud based applications worth are expected to increase to very great degree[15].Mobile Cloud Computing is a new paradigm for mobile applications whereby the analytics, data processing and storage are switched from the mobile devices to promising and centralized computing platforms established in clouds[6][8].Centralized applications are possible to be accessed over the wireless connection based on a thin local client(with few locally stored programs)or web browser on the mobile devices[13][39].

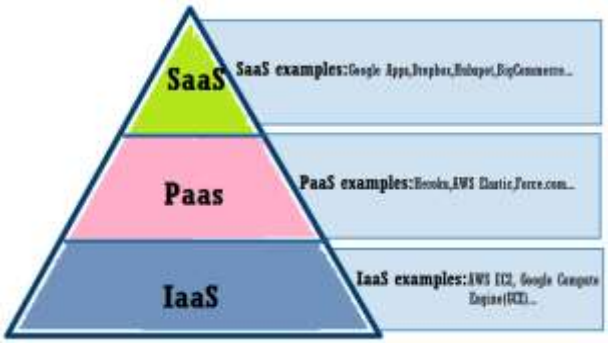

figure. 1: cloud computing services type [7]

02. VIRTUALIZATION

Virtualization occurs when we create a virtual instance rather than actual version of something, like an operating system (OS), a storage device, a server or network resources. Hardware and software engineering together creates Virtual Machines and make possible for multiple operating systems to run on the same platform simultaneously. In the field of Information Technology, the fundamental change happening all over is obviously Cloud Computing. Virtualization in computing is creation of virtual (not real) of virtual something such as hardware, software, platform or an operating system or storage or a network device [10].

Increasing IT productivity in a virtualized environment IT enterprises must have the flexibility to adopt and managing various changes as the virtual environment because of virtualization clouds is scalable and agile.Virtualization can also be defined as it is a technology that gives the mechanism of separating the physical (like server) resources logically; to increase performance and availability of resources, and use all centralized resources as different isolated machines, called Virtual Machines. A key use of virtualization technology is creating a software-based, or virtual, representation of server which uses a software layer to run virtual machines called a hypervisor to emulate the underlying hardware. In this technology single CPU becomes various virtual CPUs, and the RAMs become various virtual RAMs and same happens in the case for Hard Disks [17].

Virtualization [16] [14] is a technique which enables to develop an abstract layer of system resources without showing the complexity of actual hardware and software working environment [12][18]. Virtualization technique enhances hardware independence, isolation of separate guest operating system and encapsulation of whole virtual machine grouped in a one file. Virtualization technique is commonly implemented with hypervisor [19][20] technology, which is a piece of computer software or firmware elements that can virtualizes system resources and creates and runs virtual machines [22].

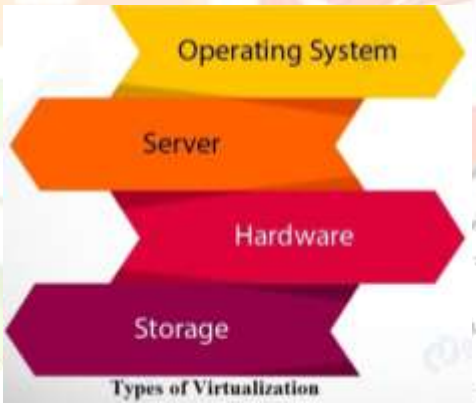

figure. 2: types of virtualization

03. ADVANTAGES AND DISADVANTAGES OF VIRTUALIZATION

The advantages of switching to a virtual environment are abundant, saving cost and time with this advance in technology providing much greater business continuity and ability to recover from disaster;[25] following may be included as advantages of virtualization [17]:

Advantages of Virtualization

- It is cheaper and reduces the workload.
- It offers better uptime and faster deployment of resources.
- It promotes digital entrepreneurship.
- It provides better disaster recovery solutions.
- It allows efficient and economic use of energy.

Disadvantages of Virtualization

- It can have a high cost of implementation and may require powerful machines.
- It still has limitations.
- It creates a security risk and creates an availability issue.
- It creates a scalability issue and takes time.
- It needs several links in a chain that must work together cohesively.

04. ROLE OF VIRTUALIZATION IN CLOUD COMPUTING

One of the main cost effective, time increasing, hardware reducing, energy saving techniques used by cloud providers is virtualization which is the backbone of Cloud Computing and it plays a very important role in cloud computing technology and its working procedure and mechanism. The cloud's virtualization technique mainly deals with the server virtualization where virtual machine provides a separate environment. Cloud Computing provides promising advantages as well as makes it more convenient and efficient with the help of Virtualization; it also provides solutions for great challenges in the field of data security related issues and privacy protection when collecting, storing and utilizing big data. Virtualization is technique how to separate a service or the imitation of hardware within a software program. A Single machine is capable to perform the role of multiple machine means running multiple operating systems on a single machine but sharing all the hardware resources. The machine on which the virtual machine is going to be created is called as Host Machine and that virtual machine is referred as a Guest Machine. In a web server or a file, the usage of purchasing, maintenance service, depreciation, energy efficiency, managing workloads and floor space is double, but by creating virtual web or file server all of our important objectives are fulfilled like improvement in security, the use of hardware resources to its maximum, flexibility, and reduced cost. Virtualization technique provides numerous advantages including efficient use of resources, increased security, portability, cheaper infrastructure problem free testing, easier manageability, increased flexibility, fault isolation, rapid deployment etc.

Virtualization in Cloud Computing:

- Allows combining local and networking resources data storage virtualization.
- It lowers the cost of IT infrastructure.
- Improves performance using virtualization
- Provides grouping physical storage devices into the single unit
- Provides the high level of availability using virtualization
- Improves capacity

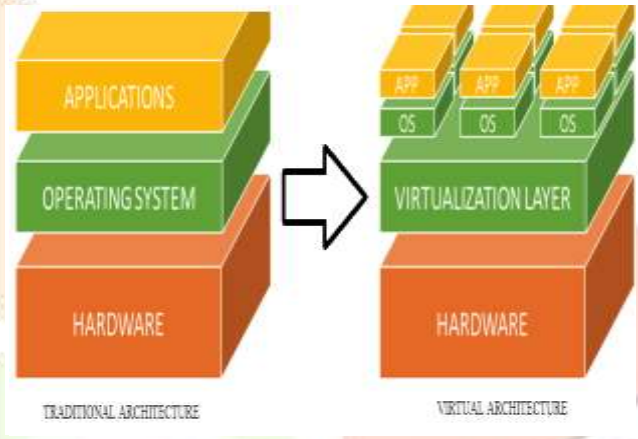

figure. 3: cloud computing services type

A server or a central machine actually hosting an application for multiple users, preventing need for separately installing required software's and utility on every machine is virtualization in Cloud Computing. The information from different resources like databases, hard drives, and USB drives are merged into one centralized location thereby increasing its accessibility, availability and security. Virtualization in cloud computing refers to the creation of virtual version of software, hardware, or an operating system, a storage or network device. Virtual changes are expected to occur more rapidly rather than physical changes in IT environment. This occurring changes has to be managed in a way, such changes are scalable and agile because of virtualization in Cloud Computing.

Importance of virtualization:

For the maintaining of resources job in cloud computing environment, virtualization technique is a necessity as it makes it easier. Virtualization in Cloud Computing provides efficiency in security by protecting both the integrity of cloud components and guest virtual machines. In Cloud Component significantly virtualized machines can also be scaled up or down on reliable manner. High utilization of resource sharing, pooled resources, and rapid provisioning are also some of the crucial factors Managed Service Provider VA.

Few reasons why you should use Managed Service Provider VA:

- Simplified Management and Resource Optimization.
- Reduced system administrative work.
- Easier software installation and Data protection.
- It saves Money and Increased CPU utilization.
- Data center consolidation and decreased power consumption.
- Testing of Drive's live without even burning them.
- It gives better use from the hardware and Network solutions.
- Virtual machine can run on any x86 based server.

5. VIRTUALIZATION TECHNIQUES:

Advancement of Virtualization technology diverts the human's perspective for utilizing IT resources from physical to logical [24] [26].Most growing number of organizations using Virtualization Techniques for Server Consolidation, Dynamic Load Balancing, Testing and Development, Improved System Reliability and Security, Disaster Recovery, and to reduce power consumption. The main goal of virtualization is to collectively utilize the IT resources such as processor, storage, and network to maximum level and to reduce power consumption and the cost of IT resources that can be achieved by combining various idle resources into shared pools and creating different virtual machines to perform different types of various tasks simultaneously. The resources for different utility can be allocated or altered dynamically. User should be conscious while using Virtualization in cloud computing basic techniques such as hypervisor, emulation, full virtualization, para virtualization and hardware assisted virtualization [21].

Virtual Machine Monitor or Hypervisor: A computer software, firmware or hardware software layer that can monitor and virtualizes the resources of a host machine conferring to the user requirements [28]. Hypervisor is a hardware virtualization technique which is an intermediate layer between operating system and hardware. Hypervisor cab be classified as native and hosted [30]. The native or "bare metal" hypervisor runs directly on the hardware like VMware ESXi whereas host hypervisor runs on the host operating system [7] like VMware Workstation. The software layer creates virtual resources available such as storage, CPU, memory, and drivers.

Emulation: Virtualization is a technique which occurs when we create a virtual instance rather than actual version of something, like an operating system (OS), a storage device, a server or network resources. Emulation provides us to use a current platform to access an older application, operating system or any other data without the older software realization that it's not running in its original environment. Emulation provides various flexibility to guest operating system but at the expense of performance speed of translation process is low compared to hypervisor [32].

Full Virtualization: Full virtualization is a common and cost-effective type of virtualization, which is basically a technique by which completely simulates the underlying hardware means computer service requests are separated from the physical hardware that facilitates them. In full virtualization technique, the VM simulates enough hardware to allow an unmodified guest OS to be run in isolation. With full virtualization, operating systems and their hosted applications are allowed to run on top of virtual hardware. This technique differs from other forms of virtualization mechanisms such as para virtualization and hardware-assisted virtualization in process of its total isolation of guest operating systems from their hosts [34].

Para Virtualization: It is an enhancement of virtualization technology that provides an interface to virtual machines that are similar to their underlying hardware. It virtualization technology relates communication between guest operating system and hypervisor to improve performance and its efficiencies offer better scaling. Accessing resources in para virtualization is comparatively better than the full virtualization model since all available resources must be emulated in full virtualization model [36]. The drawback of this technique is involves modifying the OS kernel. This model is only suitable with open source operating systems which replace nonvirtualizable instructions with hypercalls.

06. VIRTUALIZATION TYPES

There are three major kinds of virtualization such as Server virtualization, Client virtualization and Storage virtualization as shown in figure 4.

figure. 4: cloud computing services type

Server Virtualization: In server virtualization is a virtualization technique that, single server performs the task of multiple servers by portioning out the resources of an individual physical server across multi-environment. In this concept each virtual server is running its own operating system and applications which is possible by the help of hypervisor layer. The advantages of server virtualization in IT infrastructure include efficient use of resources, cost savings, lower capital expenses and high availability increasing the utilization of existing servers.

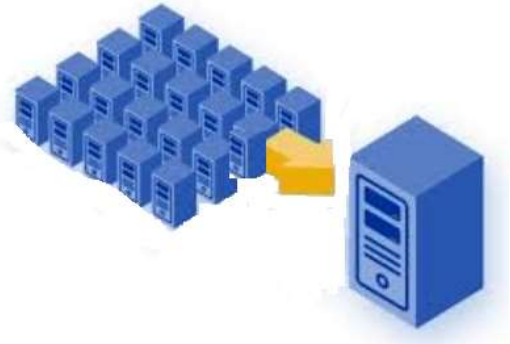

figure. 5: server virtualization

Server virtualization in cloud is the most common type of virtualization technique and it provides various advantages like optimum hardware utilization and application uptime. The main idea behind is to combine multiple small physical servers into one large physical server, among multiple customers and organizations so that the processor can be used more effectively. The operating system that is directly installed and run on a physical server gets converted into a well-defined operating system that runs on the virtual machine. The hypervisor or VMM(virtual machine monitor) controls the processor, memory, hard drives and other components by allowing different operating systems to run on the same machine without the need for a source code.

Server virtualization in cloud computing is further subdivided into the following types:

- **Full Virtualization** – It can emulate the underlying hardware means the complete simulation of the actual hardware takes place to allow software to run an unmodified guest OS, unmodified operating system can run on the top of the hypervisor.
- **Para Virtualization** – In Para-virtualization model, software unmodified runs in modified OS as a separate system.
- **Partial Virtualization** – In this technique entire operating systems cannot run in the virtual machine, but some or many software can, it is known as Partial Virtualization. Actually, it partially simulates the physical hardware of a system.

Client Virtualization: It is also called "endpoint virtualization" that makes the system administrator to virtually monitor and update the user's computerized machines like laptops, workstation desktop and mobile devices [21]. It upgrades the user's machines management and increases the security to defend from hackers and cybercriminals. There are three types of client virtualization [38]:
First, server hosted or remote virtualization is a software technology that is hosted on a server machine and operated by the client across a network. Second, local or client hosted virtualization technology in which the secured and virtualized operating environment runs and accessed on local machine [23]. Third, application virtualization [40] that provides various ways to run an application which is not traditional. In this technology an isolated virtualized environment or partitioning technique is used to run an application.

Storage Virtualization: Storage virtualization in Cloud Computing technique is nothing but the sharing of physical storage into number of storage devices which proceeds and further appears to be a single storage device means creates the abstraction of logical storage from physical storage. Three kinds of storage virtualization in Cloud Computing: these include DAS (Direct Attached Storage), NAS (Network Attached Storage) and SAN (Storage Area Network). Direct Attached Storage (DAS) is the traditional digital method of data storage where storage drives are directly attached to server machine. The most familiar example of DAS is the internal hard drive in a laptop or desktop PC; few other examples of DAS are like solid-state drives, optical disc drives, and storage on external drives. NAS speedily gaining popularity with enterprise and small businesses in many industries as an effective, scalable, low-cost storage solution is the shared storage mechanism which connects through network. The Network Attached Storage is simple to operate, a dedicated IT professional is generally not required and it is used for device sharing, file sharing and backup storing among machines. Storage Area Network (SAN) is a dedicated high-speed network storage device which is shared with different servers over a high accelerate network. Here many network storage resources are available as a single storage device for easier and more effective management of these resources [29].
It provides various advantages as follows:

- Improved storage management and High-Speed Data Transfer
- Easy updates, better availability of Your Data and Applications
- Reduced downtime
- Security and Centralized Backup
- Better Disk Utilization
- Automated management

In general, there are two kinds of storage virtualization:

- **Block**- It provides a translation layer between the hosts and the storage arrays and works before the file system exists. Here servers are redirected to virtualized LUNs instead of LUN's on the individual storage array.
- **File**- It happens at NAS (network attached storage) level. The server that uses the storage must have software installed to solve NAS problems on it in order to enable file-level usage.

07. NETWORK VIRTUALIZATION

It refers to the managing and monitoring by combining the available resources in a computer network as a single managerial entity from a single software-based administrator's console. It is intended to allow network optimization of network speed, data transfer rates, scalability, reliability, flexibility, and security. It also automates many network administrative environment tasks. Network virtualization is specifically useful for using networks efficiently that experience a huge, rapid, and unpredictable traffic increase. The intended result of network virtualization provides improved network productivity, easier backup and efficiency of IT operations.
Two categories of Network Virtualization:

- **Internal**: Provide network like functionality by combining multiple networks to a single system.
- **External**: Combine many networks as software containers, or parts of networks into a virtual unit.

08. MEMORY VIRTUALIZATION

It introduces a way to decouple volatile random access memory (RAM) from the server to provide a distributed, shared or networked function. This technique improves performance by providing enhanced memory capacity without any addition to the main memory. That's why a portion of the disk drive works as an extension of the main memory.

Implementations:

Application level integration – Applications and programs running on connected computers directly connect to the memory pool through an API or the file system.

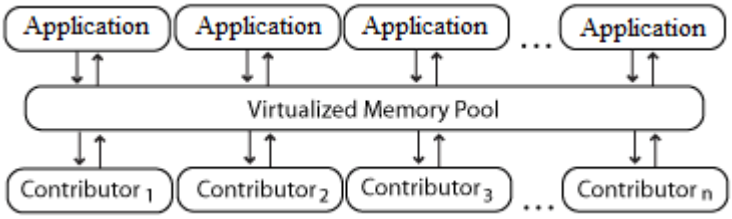

figure 6. application level integration

Operating System Level Integration – The operating system firstly connects to the memory pool, and makes that pooled memory available to applications.

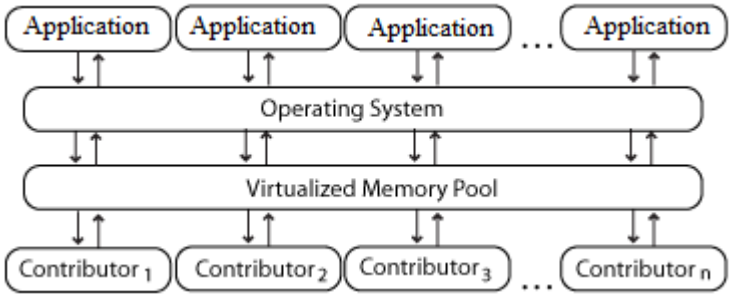

figure 7. operating system level integration

09. SOFTWARE VIRTUALIZATION

It provides the ability to abstract the main computer to run and create one or more virtual environments. It is used to make a complete computer system in order to allow a guest operating system to run. For instance letting Linux to run as a guest that is actually natively running a Microsoft Windows operating system (or vice versa, running Windows as a guest on Linux). For example, installing an android studio on client local windows machine and running Android Oreo version of OS inside it.

Types of Software virtualization:

- Operating system
- Application virtualization
- Service virtualization

10. DESKTOP VIRTUALIZATION

This technique is a virtualization technology used to separate a computer desktop environment from the physical computer which provides the work convenience and security. As one may be able to access remotely stored on a server in the data center. It provides a lot of flexibility for employees to work from home or travelling. It uses the server computing model protects confidential data from being lost or stolen by keeping it safe on central machine.

figure 8. virtual desktops for cloud technology

11. CONCLUSION

In this analytical article, we have covered what is virtualization in cloud computing, types of virtualization, Different techniques and how to understand that it is very promising so you really need this system in your IT infrastructure. Virtualization in cloud provides an easy process to set up environment in the cloud, so you don't have to manage a lot of them. By this technique user of cloud shares the data present in the cloud which can be application software etc. Making a virtual platform of server operating system and storage devices, keeping track of everything availability and how your physical resources are going to be used for virtual resources is crucial. Mainly Virtualization technique helps us to provide the pool of IT resources so that we can share these resources in order get various benefits in the business. Usually, it is done by centralizing the administrative parts to improve scalability, productivity and workloads, and many businesses derive a lot of benefits from it. Thus, virtualization is continuously gaining popularity.

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