ISSN: 2348 - 2117
International Journal of Engineering Technology and Computer Research (IJETCR)
Available Online at www.ijetcr.org
Volume 3; Issue 3; May-June; Page No. 36-40

An Analysis of Virtualization and Discover the Benefits and Challenges in Current Era

Puja Kumari
M.Tech. Scholar, Department of Computer Science and Engineering
Jayoti Vidyapeeth Women's University, Jaipur,
Rajasthan (India)

Abstract:
Virtualization is considered as one of the emerging arenas of computer science in recent times. The virtualization forms the foundation of cloud technology. Using virtualization, users can access servers or storage without knowing specific server or storage detail. We can say that virtualization is the key component of cloud computing, with the use of virtualization, cloud computing brings about convenience and efficiency benefits and great challenges in the field of data security and privacy protection. This paper presents a brief introduction of virtualization, its types, benefits and challenges.

Keywords: Cloud Computing, Virtualization, Hypervisor, Virtual Machine.

1. Introduction

Virtualization is one of the technologies that give the ability to create the abstraction of computer with ability to perform all the behavior of the actual computer. In virtualization technology, there is one piece of software that allows the physical servers can have multiple instances of virtual machines and it is called as hypervisor. These instances are virtual machines that create in virtualization environment and the hypervisor is responsible for supervising and controlling these machines for communication, resource sharing and reallocating the virtual machines.

Virtualization lets each application run in its own secure environment. The main components of virtualization in the cloud are virtual machines, because all of the operating systems and applications are inside them. They are like a container which are isolated and separated from each other, even in the physical host.

The connection between virtual parts and physical parts is very important in a cloud computing environment and it is the only path to the dynamic data centers [1].

In computing, virtualization means to create a virtual version of a device or resource, such as a server, storage device, network or even an operating system. The most common form of virtualization is the operating system-level virtualization. In operating system-level virtualization, it is possible to run multiple operating systems on a single piece of hardware. Virtualization technology involves separating the physical hardware and software by emulating hardware using software. When a different operating system is operating on top of the primary operating system by means of virtualization, it is referred to as a virtual machine.

The main goal of virtualization is to manage workloads by radically transforming traditional computing to make it more scalable. It is the single most effective way to reduce IT expenses while boosting efficiency and agility, not only for large enterprises, but also for small and midsize businesses [2].

1.1. Need of Virtualization for Cloud Computing

Virtualization is the fundamental technology that powers cloud computing. It is software that separates physical infrastructures to create various dedicated resources, and makes it possible to run multiple operating systems and multiple applications on the same server at the same time.

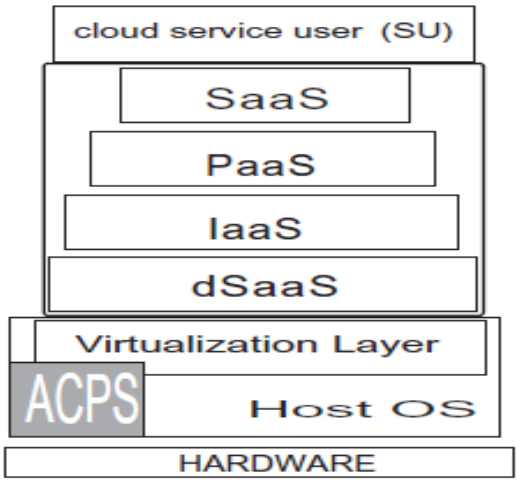

Figure 1: Virtualization Layer in Cloud Computing

Corresponding author: Puja Kumar

Virtualization is needed for cloud computing for a variety of reasons [3]:

- It provides resource utilization i.e. multiple tenants (VMs) executing on the same physical hardware, but with much stronger isolation from each other than IIS's process walls. It lowers the cost and facilitates resource utilization and also seamless deployment and migration of software between nodes.
- Virtualization prevents possible damage to the underlying system. Since users want the environment to work transparently so that nodes can be added and excluded seamlessly, those nodes need to be completely bulletproof so that the user software they run can't make them unusable.
- Virtualization makes servers, workstations, storage and other systems independent of the physical hardware layer. This is done by installing a Hypervisor on the top of the hardware layer, where the systems are then installed.

1.2. Characteristics that Makes Virtualization Ideal for Cloud Computing:

- **Partitioning:** In virtualization we can use partitioning to support many applications and operating systems in a single physical system.
- **Isolation:** Each machine is protected from crashes and viruses in the other machines because each virtual machine is isolated from each other. Virtualization decouples the software from the hardware.
- **Encapsulation:** Using encapsulation, a virtual machine can be represented and stored as a single file, it makes it easy to identify and present to other applications.

1.3. How is Virtualization Different from Cloud Computing:

- Virtualization and cloud computing are both ways to do more with less by maximizing computing and infrastructure resources. Virtualized environments are used in cloud based applications. Each has their own benefits.
- Virtualization differs from cloud computing because virtualization is software that manipulates hardware, while cloud computing refers to a service that results from that manipulation. In virtualization we are controlling the internal management of hardware and in cloud computing, services are already taken care by the provider of our wide area network.
- Virtualization is a simple process in which software is used to simulate hardware. It can exist without the cloud, but cloud computing cannot exist without virtualization.
- Cloud computing is an internet based computing with the ability to share resources like- hardware, storage, software, network on-demand and dynamically. Virtualization is a technique for hiding the physical characteristics of computing resources from the way in which other systems, applications or end users interact with those resources. With the help of virtualization technology, we can easily create different virtual machines (not physically) and share all available resources between these virtual machines. Each virtual machine can have its own resources based on the duty which defined for it [4].
- Cloud computing gives our company access to complex applications and computing resources via the Internet. Virtualization is the backbone of cloud computing. It allows a user to run multiple operating systems on one computer simultaneously. The technology behind virtualization is known as "virtual machines monitor (VMM)" or "virtual manager".

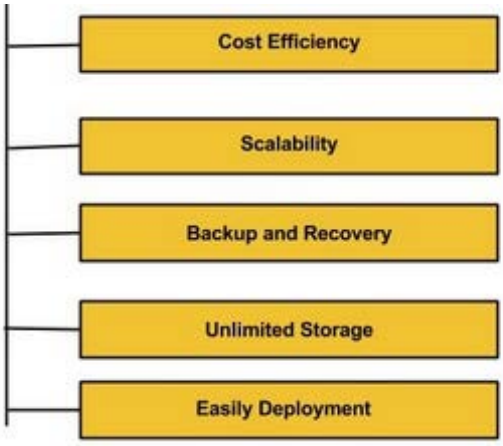

Figure 2: Advantages of Cloud Computing

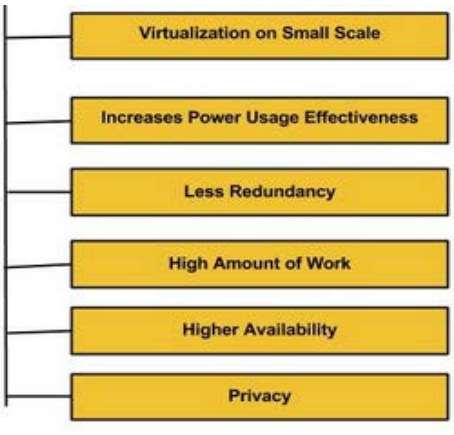

Figure 3: Advantages of Virtualization

1.4. Types of Virtualization:

Virtualization can be utilized in many different ways and can take many forms. Some of these are –

i. Application Virtualization-

It allows the user to access the application, not from their workstation, but from a remotely located server. The server stores all personal information and other characteristics of the application, but can still run on a local workstation. Technically, the application is not installed, but acts like it is. Each application brings down its own set of configuration on-demand, and executes in a way so that it sees only its own settings. This leaves the host operating system and existing settings unaltered.

ii. Desktop Virtualization-

It provides a way for users to maintain their individual desktops on a single, central server. The users may be connected to the central server through a LAN, WAN or over the Internet. Virtualized desktops are generally hosted on a remote central server, rather than the hard drive of the personal computer. It creates and stores a client's desktop on a server that can be remotely accessed by the client over a network.

iii. User Virtualization-

It is pretty similar to desktop virtualization, but allows users the ability to maintain a fully personalized virtual desktop when not on the company network. Users can basically log into their desktop from different types of device like smartphones and tablets.

iv. Storage Virtualization-

It is the process of grouping the physical storage from multiple network storage devices so that it acts as if it is one storage device. It is used to hide geographical positions of the data over the cloud environment and maps the logical storage to the physical storage as blocks of data [5].

In new virtual storage systems, technology which is used is known as Redundant Array of Independent Node (RAIN). This technology helps in availability of data even if server goes down [6].

v. Hardware Virtualization-

It is a form of virtualization that uses one processor to act as if it were several different processors. The user can then run different operating systems on the same hardware, or more than one user can use the processor at the same time. This type of virtualization requires a virtual machine manager (VM) called a Hypervisor.

vi. Software Virtualization-

It allows different versions of an operating system to coexist and run on the same physical machine, providing the ability to run applications in different environments without the need to invest in additional hardware.

vii. Memory Virtualization-

There are three different types of memory- One is used by the guest OS, we can call it as virtual memory. Another memory is addressed in the hypervisor and we can call it as real memory and the last one is the physical memory.

The guest OS map virtual memory to the real memory which are controls by the hypervisor. After that, real memory or hypervisor memory maps to the physical memory. It means if an application needs to retrieve the data, before access to exact data, the virtual address should be translated into a physical address and then the VM can use that page of memory.

viii. Network Virtualization-

It is a method of combining the available resources in a network by splitting up the available bandwidth into channels, each of which is independent from the others, and each of which can be assigned to a particular server or device in a real time. The idea is that virtualization disguises the true complexity of the network by separating it into manageable parts. This virtualization treats all servers and services in the network as a single pool of resources that can be accessed without regard for its physical components [7].

ix. Data Virtualization-

It is the process of aggregating data from different sources of information to develop a single, logical and virtual view of information so that it can be accessed by front-end solutions such as applications, dashboards and portals without having to know the data's exact storage location. The process involves abstracting, transforming, federating and delivering of data from disparate sources. The main goal of this technology is to provide a single point of access to the data by aggregating it from a wide range of data sources. This allows users to access the applications without having to know their exact location.

x. Server Virtualization-

It is the masking of server resources (like- number and identity of individual physical servers, processors, and operating system) from server users. The main intention is to spare the user from having to understand and manage complicated details of server resources while increasing resources sharing and utilization and maintaining the capacity to expand later. This technique involves partitioning a physical server into a number of small, virtual servers with the help of virtualization software. In this each server runs multiple operating system instances at the same time.

- **Operating System virtualization-**

It is a type of server virtualization technology which works at the operating system (Kernel) level. In OS virtualization, the operating system is altered so that it

operates like several different, individual systems. The virtualized environment accepts commands from different users running different applications on the same machine. The users and their requests are handled separately by the virtualized operating system. It provides application-transparent virtualization to users by decoupling applications from the OS.

2. Benefits of Virtualization

Virtualization provides lots of benefits to an enterprise. Not only is it beneficial for companies but for data centers as well [8][9][10]. Some of the benefits are-

- **Server consolidation-** By collapsing physical servers into virtual servers and reducing the number of physical servers, our company will reap a tremendous savings in power and cooling costs. We will able to reduce the datacenter footprint which can include diesel generator costs, UPS costs, network switch costs, rack space and floor space.
- **Reduce capital and operating costs-** Server consolidation lets us get more out of our existing hardware by running multiple virtual machines (VM) on a single physical server. Fewer server means lower capital and operating costs.
- **High application availability-** All the machines we are using here is virtual, it means they are pieces of software that easily we can copy them whenever and anywhere we want. So if any trouble happens to our physical servers or related devices, we can easily move the virtual machines to a new location. It means the virtual machines easily can move across our data center to avoid downtime of the service which that particular virtual machine will provide [11].
- **Scalability of cloud-** In cloud computation process, if any of virtual machines need to increase one of the resources, it can be increased by the cloud management system. Even if a user needed to increase any of the resources, as service level agreement, the cloud management system can manage these resources and user environment can be expanded. This expansion and shrinking the available resources for active virtual machines is ability of dynamic virtualization technology.
- **Improve business continuity-** Virtualization makes it easier to survive unplanned potential IT disasters. We can move VMs from one server to another in a different location.
- **Increase IT productivity-** Streamlined and automated management tasks mean we will spend less time on maintenance and more time on innovation.
- **Improve responsiveness-** Virtualization lets our business scale rapidly because we can deploy desktops, applications and servers quickly and flexibly.
- **Less heat buildup-** Virtualization virtualize our servers and we are using less physical hardware so less heat will generate.
- **Ease of management-** Virtual environments have the ability to take a point in time image i.e. snapshot of a virtual machine before an upgrade which can be reverted to if the upgrade is not successful. With this features set, virtualization can also reduce some of the concerns about application upgrades by making it easy to provide test environments or simply creating a snapshots of a virtual machine that can be used if things do not go as planned.
- **Easier backups-** Not only we can do full backups of our virtual server; we can do backups and snapshots of our virtual machines. These virtual machines can be moved from one server to another and redeployed easier and faster.
- **Dynamic load balancing and disaster recovery-** As server workloads vary; virtualization provides the ability for virtual machines that are over utilizing the resources of a server to be moved to underutilized servers. This dynamic load balancing creates efficient utilization of server resources. Disaster recovery is a critical component for IT, as system crashes can create huge economic losses. Virtualization technology enables a virtual image on a machine to be instantly re-imaged on another server if a machine failure occurs.
- **Testing and development-** Use of a VM enables rapid deployment by isolating the application in a known and controlled environment. Unknown factors such as mixed libraries caused by numerous installs can be eliminated. Several crashes that required hours of reinstallation now take moments by simply copying a virtual image.

3. Security Challenges when using Virtualization in Cloud Computing

Virtualization is probably the most beneficial and transcendent factor of the cloud where enterprise level resource allocation and consumption can be performed within reduced time and cost. Virtual environments have always faced the vulnerabilities of systems and application based threats because of the multi-level centralized architecture with common and single point of failures.

Virtualization provides many benefits when used in a cloud computing platform. Despite all the advantages, when virtualization is used there are also a number of security concerns [12][13].

- **The Hypervisor-** The hypervisor is used to separate operating systems of virtual machines from the physical hardware. When we add a new virtual machine on top of the same physical machine, we must ensure that the operating system has the latest security updates installed

and the software has been properly patched. Once the attacker has gained administrative access to the guest operating system, he can further advance to exploiting the vulnerabilities that exist in a hypervisor-by successfully exploiting such vulnerability, the attacker can gain complete access to the host physical machine. Once the attacker has access to the host hypervisor, he can easily access all the virtual machines running on that physical machine.

- **Resource Allocation-** When a certain resource, like data storage or physical memory, is allocated to a virtual machine, the virtual machine can use it for storing its data. If the resources are later reallocated to another virtual machine due to this virtual machine not being needed anymore and is therefore removed, the new virtual machine could read the data from hard drive or memory. The data on such resources must be properly deleted when being transitioned from one virtual machine to the next.
- **Virtual Machine Attacks-** If attackers can successful gain access to one virtual machine by exploiting vulnerability in one of the applications running in that virtual machine, he can attack other applications running in different virtual machines over the network. If the virtual machine is running on the same physical host as the compromised virtual machine, it may be hard to detect such network attacks. We must be able to monitor the traffic coming to and from each virtual machine on the same physical host.
- **Migration Attacks-** When we migrate a virtual machine, the migration usually consists of transferring the whole virtual machine over the network from one physical machine to the other. For a successful attack, the attacker already needs to have access to the network where the migrations are taking place and reading/writing into memory at the time of migration. When the migration communication is not encrypted, the attacker can perform a MITM attack to copy the whole virtual machine VHD file.
- **Managing the Time Dimension-** There is no red line to commit the data log changes. In case the cloud channel crashes, there is a serious security risk of losing all of the information within a small time frame. Virtual machines need lots of memory, if VMs can be suspended when they are not in use; it's easier to provide memory to the VMs that need it. But suspending a VM can harm the application running inside it.

4. Conclusion

Virtualization is a powerful technology in cloud computing that is happening now. Without understanding the concept of virtualization, it is very difficult to understand the concept of cloud computing. This paper presents a brief idea about virtualization, the benefits of virtualization and its security challenges.

I believe that my paper will provide a better understanding of the virtualization and how it is helpful in cloud computing. But there are still so many issues to be explored.

5. References

1. http://www.vmware.com/virtualization/virtualization-basics/what-is-virtualization.
2. http://www.cio.com/article/2439494/virtualization/virtualization-definition-and-solutions.html.
3. www.businessnewsdaily.com/5791-virtualization-vs-cloud-computing.html.
4. M. Armbrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, M. Zaharia, "A View of Cloud Computing, Communications of the ACM," Vol. 53 No. 4, Pages 50-58, April 2010.
5. W. Zeng, Zhao, and K.Ou, "research on Cloud Storage Architecture and key technology", IEEE International Conference on Intelligent Computing and Intelligent System (ICIS 2009) November 24-26 2009.
6. R. Freeman on behalf of ChannelPro-SMB, "Getting Ready for Cloud Computing: Storage Virtualization Essentials", December 2011.
7. http://www.webopedia.com/TERM/N/network_virtualization_NV.html.
8. Top 10 benefits of server virtualization, http://www.infoworld.com/d/virtualization/top-10-benefits-server-virtualization-177828.
9. Golden, Bernard, Virtualization for Dummies, Wiley Publishing, Inc., 2008
10. VMware.com: Virtualization basics, http://www.vmware.com/virtualization/what-is-virtualization.html.
11. M.F. Mergen, V. Uhlig, O. Krieger, J. Xenidis, "Virtualization for high-performance computing," ACM SIGOPS Operating Systems Review, Volume 40 Issue 2, p 8 – 11, April 2006.
12. Blue Pill (software), https://en.wikipedia.org /wiki /BluePill (software).
13. SubVirt: implementing malware with virtual machines, http://vxheaven.org/lib/pdf/SubVirt%3A%20Implementing%20malware%20with%20virtual%20machines.pdf.