Introduction to Cloud Computing

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Virtualization in Cloud Computing

- Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources".

- In other words, virtualization is a technique, which allows to share a single physical instance of a resource or an application among multiple customers and organizations.

- It does by assigning a logical name to a physical storage and providing a pointer to that physical resource when demanded.

What is the concept behind the Virtualization?

- Creation of a virtual machine over existing operating system and hardware is known as Hardware Virtualization.

- A virtual machine provides an environment that is logically separated from the underlying hardware.

- The machine on which the virtual machine is going to create is known as Host Machine and that virtual machine is referred as a Guest Machine.

Types of Virtualization

- A list of types of Virtualization is given below:
  - Data Virtualization,
  - Hardware virtualization,
  - Software virtualization,
  - Server virtualization,
  - Storage virtualization,
  - Operating system virtualization.

Data Virtualization

- Data virtualization is the process of retrieve data from various resources without knowing its type and physical location where it is stored.
- It collects heterogeneous data from different resources and allows data users across the organization to access this data according to their work requirements.
- This heterogeneous data can be accessed using any application such as web portals, web services, E-commerce, Software as a Service (SaaS), and mobile application.
- We can use Data Virtualization in the field of data integration, business intelligence, and cloud computing.

Advantages of Data Virtualization

- There are the following advantages of data virtualization:

- It allows users to access the data without worrying about where it resides on the memory.
- It offers better customer satisfaction.
- It provides various security mechanism that allows users to safely store their personal and professional information.
- It reduces costs by removing data replication.
- It provides a user-friendly interface to develop customized views.
- It increases business user efficiency by providing data in real-time.

Disadvantages of Data Virtualization

- It creates availability issues, because availability is maintained by third-party providers.
- It required a high implementation cost.
- It creates the scalability issues.
- Although it saves time during the implementation phase of virtualization but it consumes more time to generate the appropriate result.

Hardware Virtualization

- Previously, there was "one to one relationship" between physical servers and operating system.
- Low capacity of CPU, memory, and networking requirements were available.
- So, by using this model, the costs of doing business increased.
- The physical space, amount of power, and hardware required meant that costs were adding up.

Hardware Virtualization

- Virtualization means abstraction.
- Hardware virtualization is accomplished by abstracting the physical hardware layer by use of a hypervisor or VMM (Virtual Machine Monitor).
- When the virtual machine software or virtual machine manager (VMM) or hypervisor software is directly installed on the hardware system is known as hardware virtualization.

Hardware Virtualization

- The hypervisor manages shared the physical resources of the hardware between the guest operating systems and host operating system.
- The physical resources become abstracted versions in standard formats regardless of the hardware platform.
- The abstracted hardware is represented as actual hardware.
- Then the virtualized operating system looks into these resources as they are physical entities.

Hardware Virtualization

- The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources.
- After virtualization of hardware system we can install different operating system on it and run different applications on those OS.

Advantages of Hardware Virtualization

- More Efficient Resource Utilization: Physical resources can be shared among virtual machines.
- Lower Overall Costs Because Of Server Consolidation (Combination): Now it is possible for multiple operating systems can coexist on a single hardware platform, so that the number of servers, rack space, and power consumption drops significantly.
- Increased IT Flexibility: Hardware virtualization helps for quick deployment of server resources in a managed and consistent ways.

Software Virtualization

- Managing applications and distribution becomes a typical task for IT departments.
- Installation mechanism differs from application to application.
- Some programs require certain helper applications or frameworks and these applications may have conflict with existing applications.

Software Virtualization

- Software virtualization is just like a virtualization but able to abstract the software installation procedure and create virtual software installations.

- Virtualized software is an application that will be "installed" into its own self-contained unit.

- Example of software virtualization is VMware software.

Advantages of Software Virtualization

- Easily installing : Copying a file to a workstation or linking a file in a network then we can easily install virtual software.

- Easy to manage: To manage updates becomes a simpler task. You need to update at one place and spread the updated virtual application to the all clients.

- Software migration: Without software virtualization, moving from one software platform to another platform takes much time for deploying and impact on end user systems. With the help of virtualized software environment the migration becomes easier.

Server virtualization

- Server Virtualization is the process of dividing a physical server into several virtual servers, called virtual private servers.
- Each virtual private server can run independently.
- The concept of Server Virtualization widely used in the IT infrastructure to minimizes the costs by increasing the utilization of existing resources.

Types of Server Virtualization: Hypervisor

- Hypervisor is a program used to run and manage one or more virtual machines on a computer.
- In the Server Virtualization, Hypervisor plays an important role.
- It is a layer between the operating system (OS) and hardware.
- There are two types of hypervisors.
  - Type 1 hypervisor (also known as bare metal or native hypervisors)
  - Type 2 hypervisor (also known as hosted or Embedded hypervisors)
- The hypervisor is mainly used to perform various tasks such as allocate physical hardware resources (CPU, RAM, etc.) to several smaller independent virtual machines, called "guest" on the host machine.

Types of Server Virtualization: Full Virtualization

- Full Virtualization uses a hypervisor to directly communicate with the CPU and physical server.
- It provides the best isolation and security mechanism to the virtual machines.
- The biggest disadvantage of using hypervisor in full virtualization is that a hypervisor has its own processing needs, so it can slow down the application and server performance.
- VMWare server is the best example of full virtualization.

Types of Server Virtualization: Paravirtualization

- Paravirtualization is an enhancement of virtualization technology in which a guest OS is modified prior to installation inside a virtual machine (VM) in order to allow all guest OSes within the system to share resources and successfully collaborate, rather than attempt to emulate an entire hardware environment.
- Paravirtualization is quite similar to the Full Virtualization.
- The advantage of using this virtualization is that it is easier to use, Enhanced performance, and does not require emulation overhead.
- The difference between full and paravirtualization is that, in paravirtualization hypervisor does not need too much processing power to manage the OS.

Types of Server Virtualization: Operating System Virtualization

- Operating system virtualization is also called as system-level virtualization.
- It is a server virtualization technology that divides one operating system into multiple isolated user-space called virtual environments.
- The biggest advantage of using server visualization is that it reduces the use of physical space, so it will save money.
- Linux OS Virtualization and Windows OS Virtualization are the types of Operating System virtualization.

Types of Server Virtualization: Hardware Assisted Virtualization

- Hardware Assisted Virtualization was presented by AMD and Intel.
- It is also known as Hardware virtualization, AMD virtualization, and Intel virtualization.
- It is designed to increase the performance of the processor.
- The advantage of using Hardware Assisted Virtualization is that it requires less hypervisor overhead.

Types of Server Virtualization: Kernel-Level Virtualization

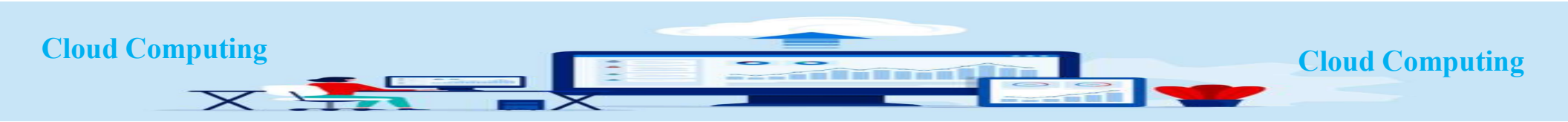
- Kernel-level virtualization is one of the most important types of server virtualization.
- It is an open-source virtualization which uses the Linux kernel as a hypervisor.
- The advantage of using kernel virtualization is that it does not require any special administrative software and has very less overhead.
- User Mode Linux (UML) and Kernel-based virtual machine are some examples of kernel virtualization.

Advantages of Server Virtualization

- There are the following advantages of Server Virtualization:
- Independent Restart: In Server Virtualization, each server can be restart independently and does not affect the working of other virtual servers.
- Low Cost: Server Virtualization can divide a single server into multiple virtual private servers, so it reduces the cost of hardware components.

Advantages of Server Virtualization

- There are the following advantages of Server Virtualization:
- Disaster Recovery: Disaster Recovery is one of the best advantages of Server Virtualization. In Server Virtualization, data can easily and quickly move from one server to another and these data can be stored and retrieved from anywhere.
- Faster deployment of resources: Server virtualization allows us to move our resources in a simpler and faster way.
- Security: It allows uses to store their sensitive data inside the data centers.



Disadvantages of Server Virtualization

- There are the following disadvantages of Server Virtualization:

- The biggest disadvantage of server virtualization is that when the server goes offline, all the websites that are hosted by the server will also go down.
- There is no way to measure the performance of virtualized environments.
- It requires a huge amount of RAM consumption.
- It is difficult to set up and maintain.
- Some core applications and databases are not supported virtualization.
- It requires extra hardware resources.

Uses of Server Virtualization

- A list of uses of server virtualization is given below:
- Server Virtualization is used in the testing and development environment.
- It improves the availability of servers.
- It allows organizations to make efficient use of resources.
- It reduces redundancy without purchasing additional hardware components.

Storage Virtualization

- As we know that, there has been a strong link between the physical host and the locally installed storage devices.
- However, that paradigm has been changing drastically, almost local storage is no longer needed.
- As the technology progressing, more advanced storage devices are coming to the market that provide more functionality, and obsolete the local storage.

Storage Virtualization

A RAID controller is a hardware device or software program used to manage hard disk drives (HDDs) or solid-state drives (SSDs) in a computer or storage array so they work as a logical unit.

- Storage virtualization is a major component for storage servers, in the form of functional RAID levels and controllers.
- Operating systems and applications with device can access the disks directly by themselves for writing.
- The controllers configure the local storage in RAID groups and present the storage to the operating system depending upon the configuration.
- However, the storage is abstracted and the controller is determining how to write the data or retrieve the requested data for the operating system.

Advantages of Storage Virtualization

- Data is stored in the more convenient locations away from the specific host. In the case of a host failure, the data is not compromised necessarily.

- The storage devices can perform advanced functions like disaster recovery functionality.

- By doing abstraction of the storage level, IT operations become more flexible in how storage is provided, partitioned, and protected.

Operating System (OS) Virtualization

- With the help of OS virtualization nothing is pre-installed or permanently loaded on the local device and no-hard disk is needed.
- Everything runs from the network using a kind of virtual disk.
- This virtual disk is actually a disk image file stored on a remote server.
- The client will be connected by the network to this virtual disk and will boot with the Operating System installed on the virtual disk.

How does OS Virtualization works?

- Components needed for using OS Virtualization in the infrastructure are given below:
- The first component is the OS Virtualization server.
- This server is the center point in the OS Virtualization infrastructure.
- The server manages the streaming of the information on the virtual disks for the client and also determines which client will be connected to which virtual disk (using a database, this information is stored).

How does OS Virtualization works?

- Components needed for using OS Virtualization in the infrastructure are given below:
- Also the server can host the storage for the virtual disk locally or the server is connected to the virtual disks.
- In high availability environments there can be more OS Virtualization servers to create no redundancy and load balancing.
- The server also ensures that the client will be unique within the infrastructure.

How does OS Virtualization works?

- Secondly, there is a client which will contact the server to get connected to the virtual disk and asks for components stored on the virtual disk for running the operating system.

- The available supporting components are database for storing the configuration and settings for the server, a streaming service for the virtual disk content, and a boot service for connecting the client to the OS Virtualization servers.

How does OS Virtualization works?

- As it is already mentioned that the virtual disk contains an image of a physical disk from the system that will reflect to the configuration and the settings of those systems which will be using the virtual disk.

- When the virtual disk is created then that disk needs to be assigned to the client that will be using this disk for starting.

- The connection between the client and the disk is made through the administrative tool and saved within the database.

How does OS Virtualization works?

- When a client has a assigned disk, the machine can be started with the virtual disk using the following process:

- Connecting to the OS Virtualization server: First we start the machine and set up the connection with the OS Virtualization server.

- Connecting the Virtual Disk: When the connection is established between the client and the server, the server will look into its database for checking the client is known or unknown and which virtual disk is assigned to the client. When more than one virtual disk are connected then a boot menu will be displayed on the client side. If only one disk is assigned, that disk will be connected to the client.

How does OS Virtualization works?

- When a client has a assigned disk, the machine can be started with the virtual disk using the following process:

- VDisk connected to the client: After the desired virtual disk is selected by the client, that virtual disk is connected through the OS Virtualization server. At the back-end, the OS Virtualization server makes sure that the client will be unique (for example computer name and identifier) within the infrastructure.

- OS is "streamed" to the client: As soon the disk is connected the server starts streaming the content of the virtual disk. The software knows which parts are necessary for starting the operating system smoothly, so that these parts are streamed first. The information streamed in the system should be stored somewhere (i.e. cached).

How does OS Virtualization works?

- When a client has a assigned disk, the machine can be started with the virtual disk using the following process:

- Additional Streaming: After that the first part is streamed then the operating system will start to run as expected. Additional virtual disk data will be streamed when required for running or starting a function called by the user (for example starting an application available within the virtual disk).

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