

DAY 13

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TITLE: VIRTUALIZATION AND CLOUD COMPUTING

➤ **Virtualization**

Virtualization is the process of creating a virtual version of something - such as a server, storage device, network, or operating system - where the framework divides the resources of a physical machine into multiple isolated virtual environments.

Each Virtual Machine (VM) behaves like a separate physical computer, but all share the underlying hardware.

➤ **Benefits of Virtualization**

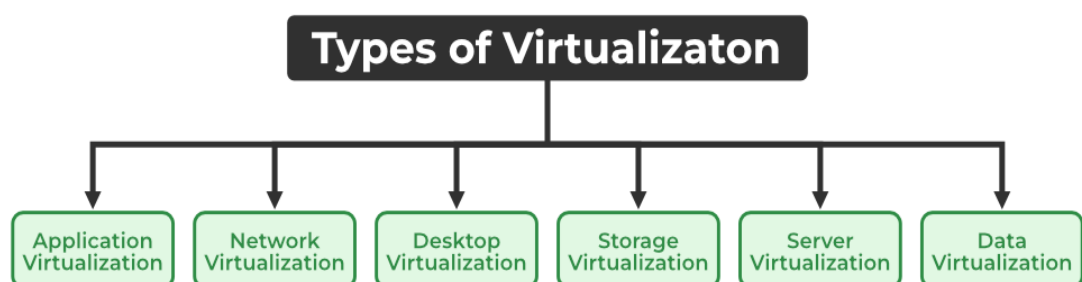
| Benefit | Description |
|--------------------------------|---|
| Resource Optimization | Utilizes physical resources efficiently by running multiple VMs on a single server. |
| Cost Savings | Reduces hardware requirements and operational costs. |
| Scalability | Easily create or remove VMs based on need. |
| Isolation | Each VM is isolated, enhancing security and testing capabilities. |
| Disaster Recovery | Easier backup, cloning, and restoration of systems. |
| Testing and Development | Allows safe testing of software and OS configurations. |

➤ **How is Virtualization Different from Cloud Computing**

- Below is the table that shows the comparison between virtualization and Cloud Computing:

| Aspect | Virtualization | Cloud Computing |
|----------------------|---|--|
| What it is | Creating multiple virtual versions of a physical resource | Accessing computing resources (like storage, servers) via the internet |
| Where it runs | On physical machines or servers | On remote servers provided by cloud service providers |
| Focus | Efficient use of physical resources | On-demand access to resources over the internet |
| Example | Running multiple virtual machines on a single physical server | Storing data on Google Drive or renting a virtual machine on AWS |
| Control | You have more control over the virtual environment | Cloud providers manage the physical hardware; you manage only what you use |

➤ Types of Virtualizations



| Type | Description | Example |
|-----------------------------------|--|--------------------------------------|
| Server Virtualization | Multiple virtual servers on one physical server | VMware ESXi, KVM |
| Storage Virtualization | Pools storage from multiple devices into a single resource | SAN/NAS |
| Network Virtualization | Virtual networks independent of physical networks | VLANs, SDN |
| Desktop Virtualization | Virtual desktops accessible remotely | VDI (Virtual Desktop Infrastructure) |
| Application Virtualization | Apps run on a virtual platform, not directly on OS | Citrix, VMware ThinApp |

- **Virtualization Architecture** - Virtualization architecture typically consists of the following layers:

a. Hardware Layer

The physical machine (CPU, RAM, disk, NICs, etc.).

b. Hypervisor Layer

The software layer that sits between the hardware and the VMs.

It allocates physical resources to VMs.

✓ Two types:

- **Type 1 (Bare-Metal Hypervisor):** Runs directly on the hardware.
Examples: VMware ESXi, Microsoft Hyper-V, Xen, KVM.
- **Type 2 (Hosted Hypervisor):** Runs on top of an existing OS.
Examples: Oracle VirtualBox, VMware Workstation.

c. Virtual Machines (VMs)

Guest OS runs on top of virtual hardware.

Each VM is isolated and can run different OSes (Linux, Windows, etc.).

- **Hypervisors**

A hypervisor is a form of virtualization software used in Cloud hosting to divide and allocate the resources on various pieces of hardware. The program which provides partitioning, isolation, or abstraction is called a virtualization hypervisor. The hypervisor is a hardware virtualization technique that allows multiple guest operating systems (OS) to run on a single host system at the same time. A hypervisor is sometimes also called a virtual machine manager (VMM).

1. Type 1 Hypervisor (Bare-Metal)

- Runs directly on physical hardware.
- High performance and efficiency.
- Used in enterprise environments.

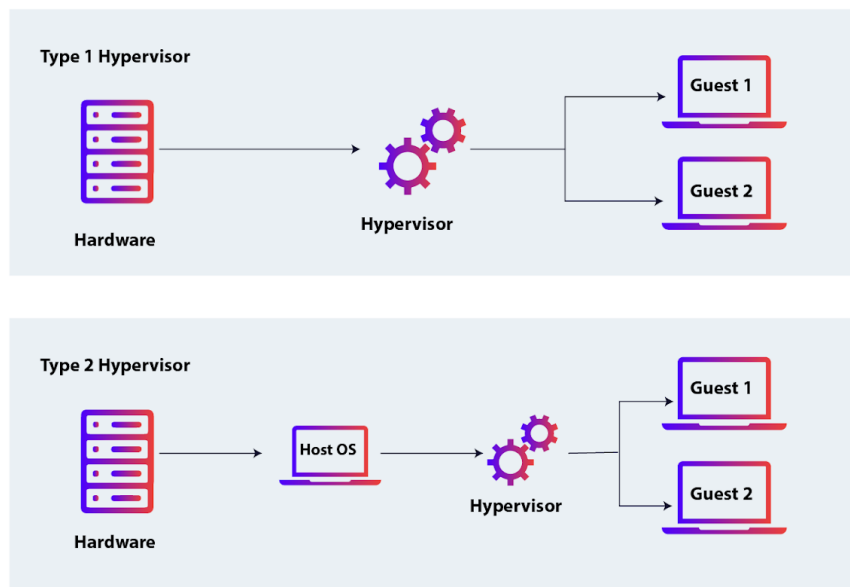
Examples: VMware ESXi, Microsoft Hyper-V, Citrix XenServer, KVM (Linux-based)

2. Type 2 Hypervisor (Hosted)

- Runs on a conventional operating system.
- Easier to set up and manage for personal use or testing.

Examples: Oracle VirtualBox, VMware Workstation, Parallels Desktop (macOS)

Hypervisor types



➤ Roles of the Hypervisor

- **Isolating/Emulating resources**
 - **CPU:** Scheduling virtual machines
 - **Memory:** Managing memory
 - **I/O:** Emulating I/O devices
- **Networking**
- **Managing virtual machines**

➤ What is Virtualization in Cloud Computing?

Virtualization in cloud computing refers to the process of creating virtual versions of physical resources—such as servers, storage, networks, and

even entire operating systems—using virtualization software (hypervisors). It allows cloud providers to offer on-demand, scalable, and multi-tenant services efficiently.

➤ **How It Works in the Cloud**

1. Cloud providers like **AWS, Azure, Google Cloud** use virtualization to:
2. Divide physical servers into multiple **Virtual Machines (VMs)**
3. Allocate them to different users
4. Isolate user environments
5. Manage resources dynamically