# Unit-2: Virtualization and Resource Management

Hypervisors

- A hypervisor, also known as a virtual machine monitor (VMM), is software, firmware, or hardware that creates and manages virtual machines (VMs).

- It allows multiple operating systems to run concurrently on a single physical machine by abstracting and allocating hardware resources to these VMs.

- Hypervisors are a fundamental component of virtualization technology, enabling resource optimization, isolation, and scalability in modern computing environments.
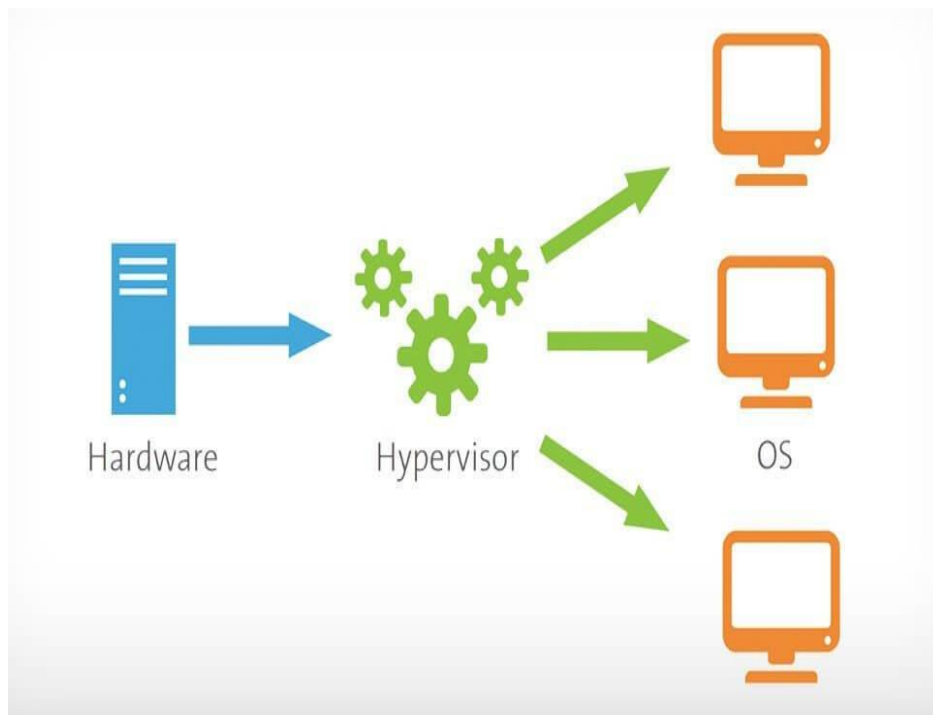
Types of Hypervisors

Hypervisors are broadly classified into two main types based on their architecture:

1. Type 1 Hypervisors (Bare-Metal)

Type 1 hypervisors run directly on the physical hardware of the host machine, without relying on a host operating system. They provide better performance and are typically used in enterprise environments where stability and efficiency are critical.

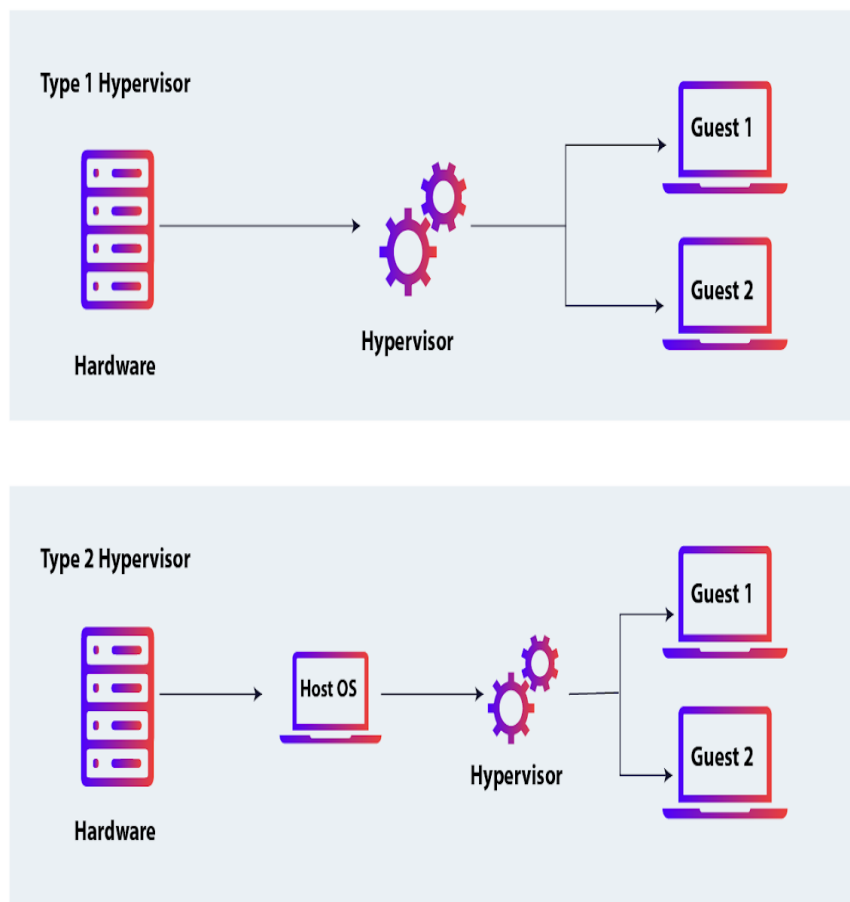**Examples:** VMware ESXi, Microsoft Hyper-V, Xen, Oracle VM Server

Advantages

- High performance due to direct access to hardware.

- Enhanced security and isolation.

- Lower overhead compared to Type 2 hypervisors.

Disadvantages:

- Complex setup and management.

- Requires dedicated hardware.

Hypervisor types

2. Type 2 Hypervisors (Hosted)

Type 2 hypervisors operate on top of a host operating system. They rely on the host OS to manage hardware resources and provide additional abstraction layers.

Examples: VMware Workstation, Oracle VirtualBox, Parallels Desktop, QEMU

Advantages

- Easier to set up and use.

- Suitable for development, testing, and personal use.

Disadvantages

- Higher overhead due to reliance on the host OS.

- Lower performance compared to Type 1 hypervisors.

Key Features of Hypervisors

Resource Allocation:

Hypervisors manage CPU, memory, storage, and network resources, allocating them efficiently to VMs as per their requirements.

Isolation:

Each VM operates independently, ensuring that issues in one VM do not affect others.

Scalability:

Hypervisors allow for the dynamic scaling of resources, making them ideal for cloud computing and data centers.

Migration:

Features like live migration enable the transfer of VMs between hosts without downtime.

Snapshots and Cloning:

Hypervisors can create snapshots of VMs, allowing rollback to a previous state or quick duplication of environments.

Applications of Hypervisors

Server Consolidation

Hypervisors enable multiple servers to be consolidated onto a single physical machine, reducing hardware costs and energy consumption.

Cloud Computing

Virtualization forms the backbone of cloud platforms like AWS, Azure, and Google Cloud, allowing them to offer scalable infrastructure as a service (IaaS).

Testing and Development

Developers use hypervisors to create isolated environments for testing software across different operating systems and configurations.

Disaster Recovery

Virtualized environments make it easier to back up and restore systems, ensuring business continuity in case of hardware failures.