

01 Virtualization Intro

Virtualization

What is Virtualization?

Definition: Virtualization is a technology that allows you to create virtual, simulated environments from a single, physical machine.

Imagine you have a powerful computer, but you only use a small part of its abilities. Virtualization is a clever trick that lets you make the most of that single computer by creating several "virtual" versions of it. Each virtual version acts like a separate computer, even though they all share the same physical machine.

Key Concepts:

- **Resource Optimization:** Makes full use of physical hardware by distributing resources across multiple virtual environments
- **Cost Efficiency:** Reduces need for multiple physical machines
- **Flexibility:** Allows multiple operating systems to run on the same hardware
- **Scalability:** Easy to add or remove virtual resources as needed

Historical Context:

- Used for decades in IT infrastructure
- Originally developed for mainframe computers
- Now essential for modern cloud computing

Core Benefits:

- Multiple operating systems can share the same physical hardware
- Improves resource utilization
- Reduces physical maintenance costs
- Enhances security through isolated systems

How Does Virtualization Work?

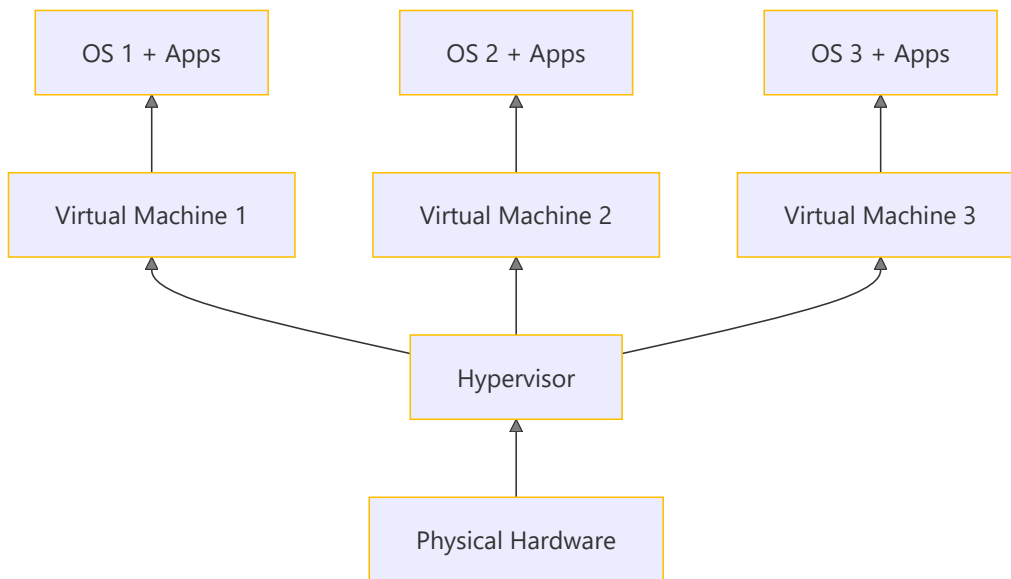
Virtualization depends on two fundamental concepts:

1. Virtual Machines (VMs)

Virtual computing environments that act like independent computers

2. Hypervisors

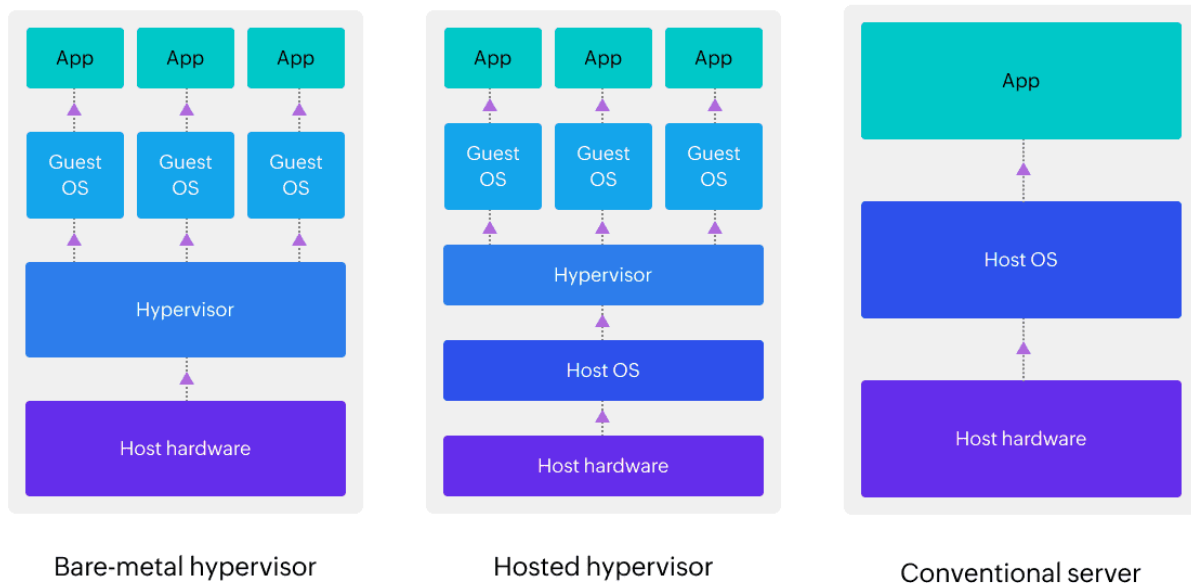
Software that manages and allocates physical resources to virtual machines



The Virtualization Process:

1. **Physical Resources** (CPU, Memory, Storage) are abstracted
2. **Hypervisor** manages and allocates these resources
3. **Virtual Machines** use allocated resources as if they were physical
4. **Guest Operating Systems** run independently on each VM

Virtualization architecture



Virtual Machines (VMs)

Definition:

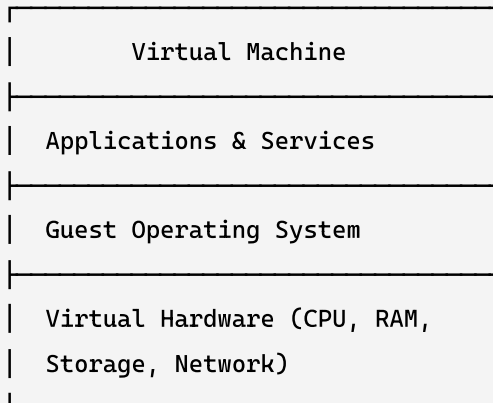
A Virtual Machine (VM) is a computing environment that functions as an isolated system with its own CPU, operating system, memory, network interface, and storage.

Think of a Virtual Machine (VM) as a computer created entirely in software. It behaves exactly like a physical computer, with its own virtual CPU, memory, storage, and network connection. But it's not a physical box; it's a set of files on your physical machine.

Key Characteristics:

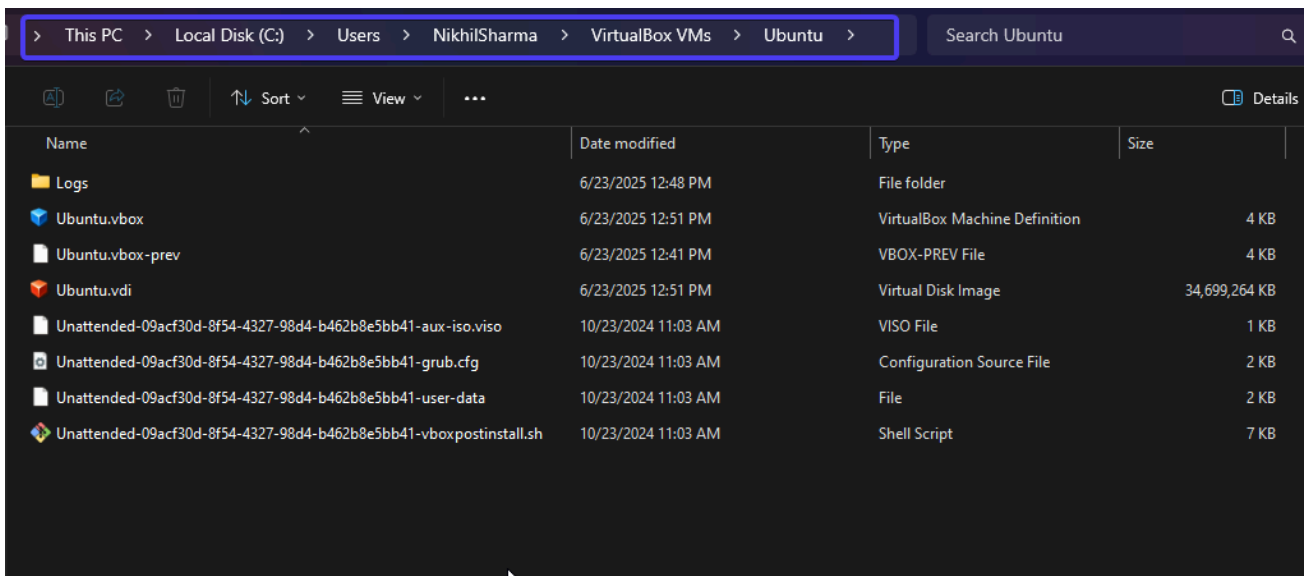
- **Isolation:** Each VM operates independently
- **Portability:** Can be moved between different physical machines
- **Consistency:** Runs the same way regardless of underlying hardware
- **Resource Allocation:** Gets dedicated virtual resources

VM Components:



VM File Structure:

- **Single Data File:** VM can be defined by one file
- **Configuration Files:** Store VM settings and properties
- **Virtual Disk Files:** Store the VM's operating system and data
- **Snapshot Files:** Store VM state at specific points in time



VirtualBox VM File Structure

Main VM Directory (typically located in `~/VirtualBox VMs/[VM Name]/` on Linux or `%USERPROFILE%\VirtualBox VMs\[VM Name]\` on Windows):

Configuration Files:

- `[VM Name].vbox` - Main VM configuration file (XML format) containing all VM settings
- `[VM Name].vbox-prev` - Previous version of configuration file (backup)
- `Logs/` directory containing:
 - `VBox.log` - Current session log
 - `VBox.log.1`, `VBox.log.2`, etc. - Previous session logs

Virtual Disk Files:

- `[VM Name].vdi` - Virtual Disk Image (VirtualBox's native format)
- OR `[VM Name].vmdk` - VMware disk format (if chosen)
- OR `[VM Name].vhd` - Microsoft Virtual Hard Disk format (if chosen)

Snapshot Files (if snapshots are created):

- `Snapshots/` directory containing:
 - `{snapshot-uuid}.vdi` - Differential disk files for each snapshot
 - Snapshot metadata stored in the main `.vbox` file

Additional Files:

- `[VM Name].vbox-tmp` - Temporary configuration file (during VM operations)
- `[VM Name]-ctXX-cpuXX.dmp` - Memory dump files (if VM crashes)

Global VirtualBox Files

Configuration:

- `~/.config/VirtualBox/VirtualBox.xml` (Linux) - Global VirtualBox settings
- `%USERPROFILE%\VirtualBox\VirtualBox.xml` (Windows) - Global settings

Machine Registry:

- All VM references are stored in the global configuration file

Hypervisors

Definition:

A hypervisor (also called Virtual Machine Monitor - VMM) is software that separates physical resources and allocates them to multiple VMs.

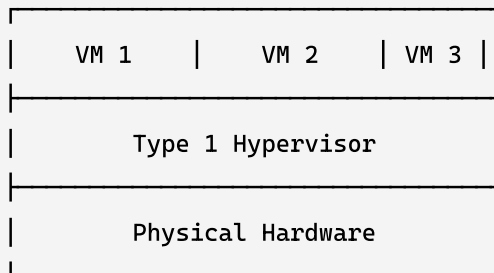
A hypervisor (sometimes called a Virtual Machine Monitor or VMM) is the special software that acts as the "manager". Its job is to create and run Virtual Machines by carefully dividing and allocating the physical computer's resources.

Hypervisor Functions:

- **Resource Allocation:** Distributes CPU, memory, storage to VMs
- **Isolation:** Ensures VMs don't interfere with each other
- **Management:** Creates, deletes, and manages VMs
- **Performance:** Optimizes resource usage across VMs

Types of Hypervisors:

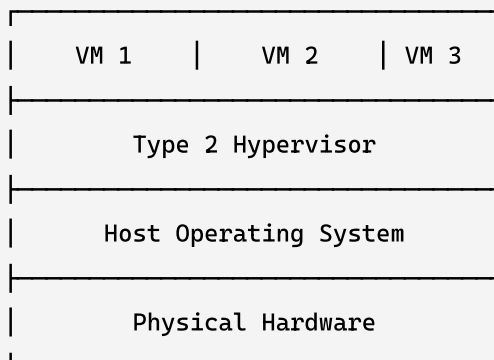
Type 1 Hypervisor (Bare-Metal/Native)



Characteristics:

- Runs directly on physical hardware
- No host operating system needed
- Better performance and efficiency
- Common in enterprise datacenters
- Examples: VMware vSphere, Microsoft Hyper-V, Citrix XenServer

Type 2 Hypervisor (Hosted)



Characteristics:

- Runs on top of a host operating system

- Acts as an application on the host OS
- Better for individual users
- Examples: VMware Workstation, Oracle VirtualBox, Parallels Desktop