Virtualization:

* ESXI -specialized hypervisor to run and manage virtual machines.
* Has its own kernel (VMware kernel)
* TYPE 1

VM’s – An isolated system created on Hardware.

NIC – Network card

Hypervisor-

A **hypervisor**, also known as a **virtual machine monitor (VMM)**, is a piece of software, firmware, or hardware that creates and manages **virtual machines (VMs)**. It allows multiple operating systems to run on a single physical machine by abstracting the hardware and allocating resources to each VM.

* **🧠 Types of Hypervisors**
  + There are two main types:
  + **Type 1: Bare-metal Hypervisor**
    - Runs **directly on the physical hardware**.
    - More efficient and secure.
    - Common in enterprise environments.
    - **Examples**: VMware ESXi, Microsoft Hyper-V, Xen, KVM.
  + **Type 2: Hosted Hypervisor**
    - Runs **on top of a host operating system**.
    - Easier to set up, often used for development or testing.
    - **Examples**: Oracle VirtualBox, VMware Workstation, Parallels Desktop.
* **🔧 What Does a Hypervisor Do?**
  + **Isolates** each VM from others.
  + **Allocates** CPU, memory, storage, and network resources.
  + **Manages** VM lifecycle (start, stop, snapshot, migrate).
  + **Enables** running different OSes (e.g., Linux on a Windows host).
* **🧩 Use Cases**
  + Cloud computing (e.g., AWS, Azure).
  + Server consolidation.
  + Software testing and development.
  + Running legacy applications.

**🧱 1. What is Virtualization?**

**Virtualization** is the process of creating a **virtual version** of something—like a server, desktop, operating system, storage device, or network resources.

Instead of using one physical machine for one task, virtualization allows **multiple virtual machines (VMs)** to run on a **single physical machine**, each with its own OS and applications.

**🎯 2. Benefits of Virtualization**

* **Resource Efficiency**: Better utilization of CPU, memory, and storage.
* **Cost Savings**: Fewer physical machines = lower hardware and energy costs.
* **Isolation**: Each VM is isolated, so issues in one don’t affect others.
* **Scalability**: Easy to create, clone, or migrate VMs.
* **Testing & Development**: Run multiple OSes or test environments on one machine.

**🧩 3. Types of Virtualization**

| **Type** | **Description** | **Example** |
| --- | --- | --- |
| **Hardware Virtualization** | Virtual machines run full OSes on virtual hardware. | VMware, VirtualBox |
| **OS-level Virtualization** | Multiple isolated user-space instances on a single OS kernel. | Docker, LXC |
| **Application Virtualization** | Apps run in isolated containers, not installed on the host OS. | Citrix, ThinApp |
| **Storage Virtualization** | Combines multiple storage devices into one. | SAN, NAS |
| **Network Virtualization** | Abstracts physical network into logical segments. | VLANs, SDN |

**🧠 Types of Hypervisors**

Hypervisors are mainly classified into **two types** based on how they interact with the hardware and host operating system:

**🧱 Type 1 Hypervisor (Bare-Metal Hypervisor)**

**🔍 What it is:**

* Runs **directly on the physical hardware**.
* Doesn’t require a host operating system.
* Acts as the OS itself, managing hardware and virtual machines.

**✅ Pros:**

* **High performance**: Direct access to hardware.
* **Better security**: Less attack surface since there’s no host OS.
* **Used in data centers** and enterprise environments.

**❌ Cons:**

* More complex to set up and manage.
* Requires dedicated hardware.

**🧪 Examples:**

* **VMware ESXi**
* **Microsoft Hyper-V (Server Core)**
* **Xen**
* **KVM (Kernel-based Virtual Machine)** – technically a Linux module, but often used like a Type 1.

**🧰 Type 2 Hypervisor (Hosted Hypervisor)**

**🔍 What it is:**

* Runs **on top of a host operating system** (like Windows, macOS, or Linux).
* Uses the host OS to access hardware resources.

**✅ Pros:**

* **Easy to install and use**.
* Great for **development, testing, and learning**.
* Can run on your personal laptop or desktop.

**❌ Cons:**

* **Slightly slower** due to the extra layer (host OS).
* **Less secure** than Type 1.

**🧪 Examples:**

* **Oracle VirtualBox**
* **VMware Workstation / Fusion**
* **Parallels Desktop (macOS)**

**🆚 Summary Table**

| **Feature** | **Type 1 Hypervisor** | **Type 2 Hypervisor** |
| --- | --- | --- |
| Runs on | Bare metal (hardware) | Host OS |
| Performance | High | Moderate |
| Use Case | Data centers, servers | Personal use, testing |
| Examples | ESXi, Hyper-V, Xen, KVM | VirtualBox, VMware Workstation |
| Setup Complexity | Higher | Lower |