VIRTUALIZATION

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OUTLINES

- Evolution
- What is Virtualization ?
- Types of Virtualization
- Hypervisor
- Types of Hypervisor
- Virtualization vs Containerization
- KVM
- VirtualBox

EVOLUTION

Emulation

Virtualization to Cloud

QEMU & BOCHS

Cloud to Containers

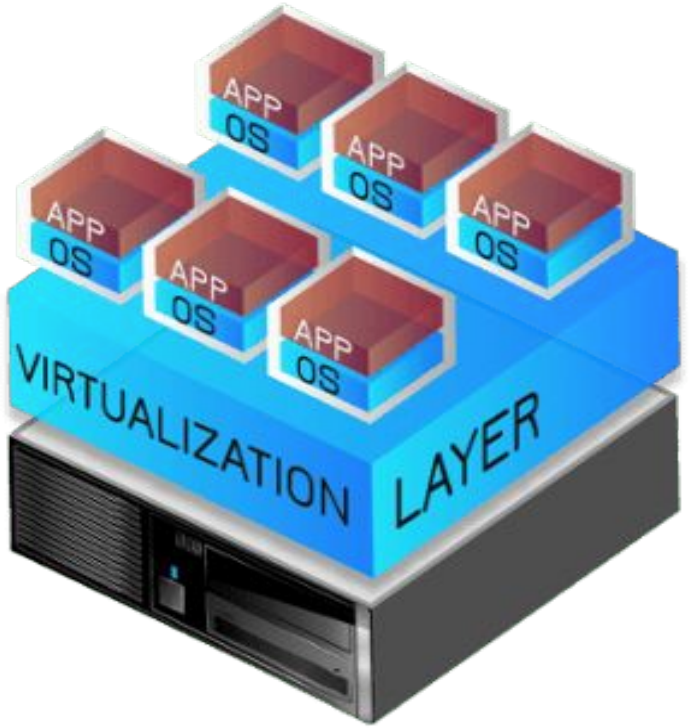
Physical servers to Virtualization

Containers to Serverless

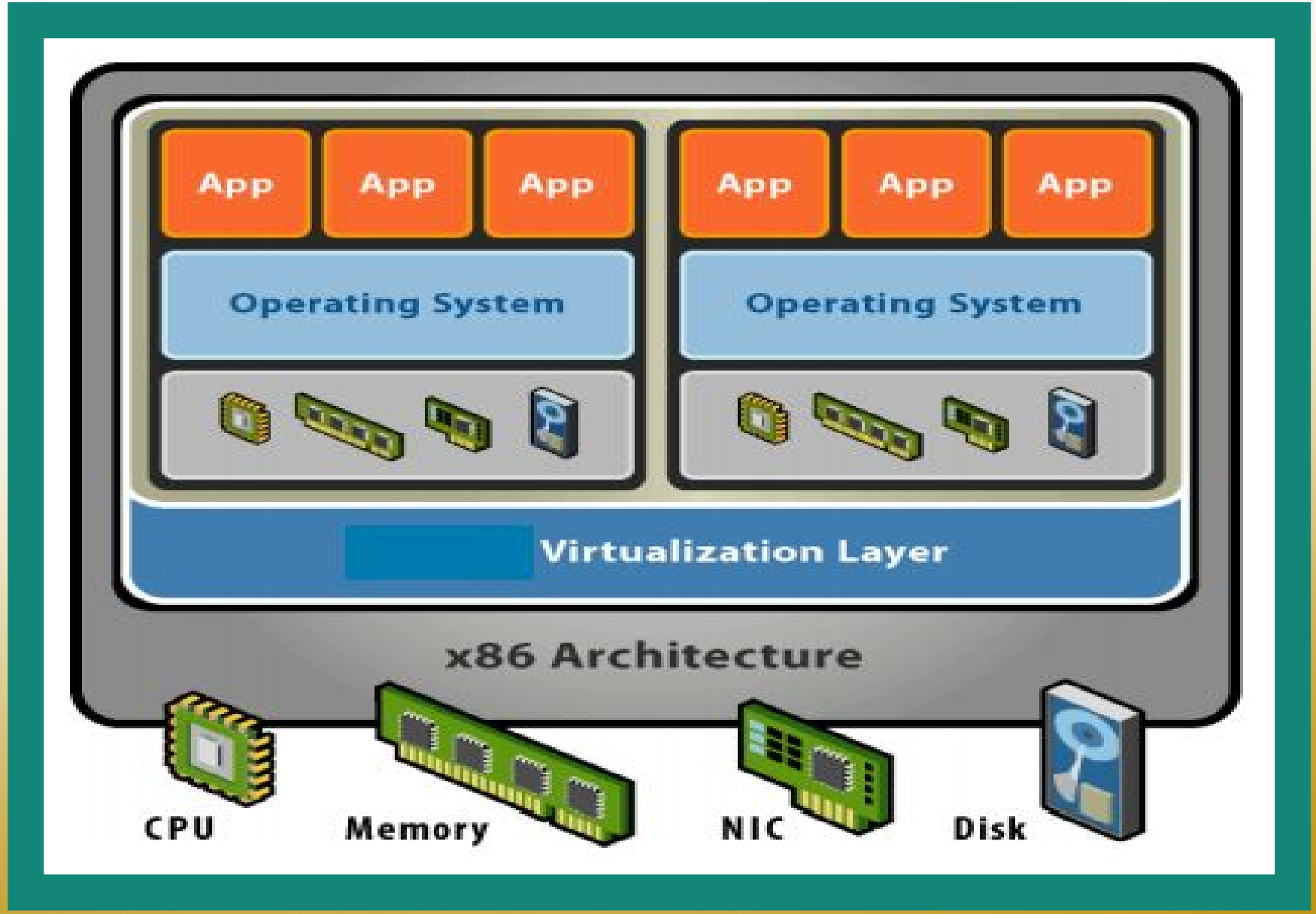
WHAT IS VIRTUALIZATION?

- Abstraction of computer hardware in a software
- Physical resources like Processor, Memory, Storage, Network appears as multiple logical resources and vice versa.
- Enables organizations to run more than one virtual system – and multiple operating systems and applications – on a single server.

Traditional Server Architecture

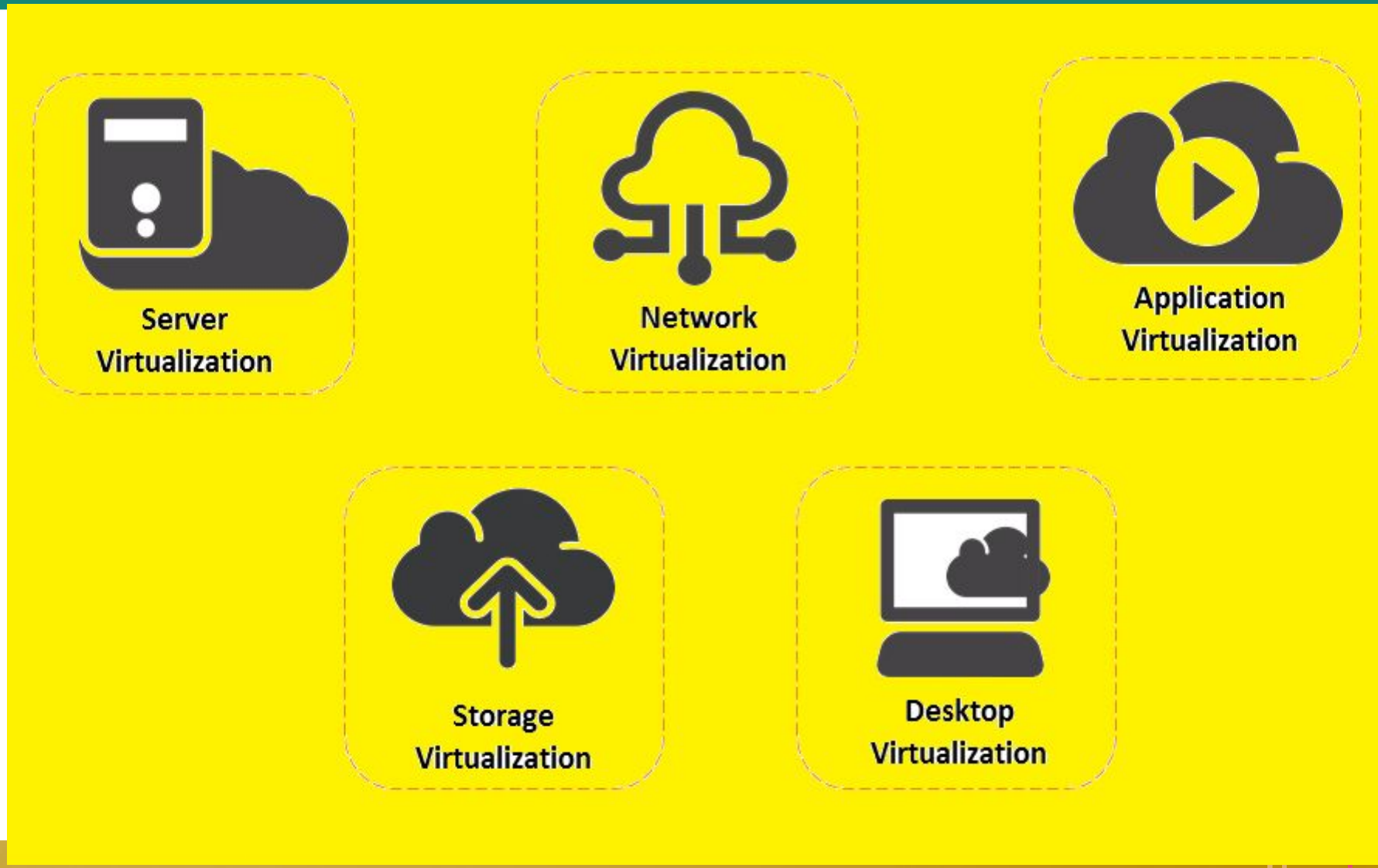


Virtualized Server Architecture


App
App
App
App
App
App
Operating System
Operating System
Virtualization Layer
x86 Architecture
CPU
Memory
NIC
Disk

TYPES OF VIRTUALIZATION?

- Application Virtualization.
- Server Virtualization.
- Network Virtualization.
- Desktop Virtualization.
- Storage Virtualization.



1. Application

Application virtualization helps a user to have a remote access of an application from a server. The server stores all personal information and other characteristics of the application but can still run on a local workstation through internet. Also application can run in an encapsulated form without being dependent upon the operating system.

2. Server

The virtualization of servers is the masking of server resources from server users, including the number and identity of physical servers, processors, and operating systems.

3. Storage

It is ability to pool the hardware storage space from several interconnected storage devices into a simulated single storage device that is managed from one single command console. Copies of data can be stored and moved to another location.

4. Desktop

The user’s desktop is stored on a remote server, allowing the user to access his desktop from any device or location. Employees can work conveniently from the comfort of their home.

5. Network

The ability to run multiple virtual networks on top of one physical network. In this logical switches, routers, firewalls etc can be created.

BENEFITS

Fully utilize hardware resources

Running Heterogeneous environments

Manageability

Isolation

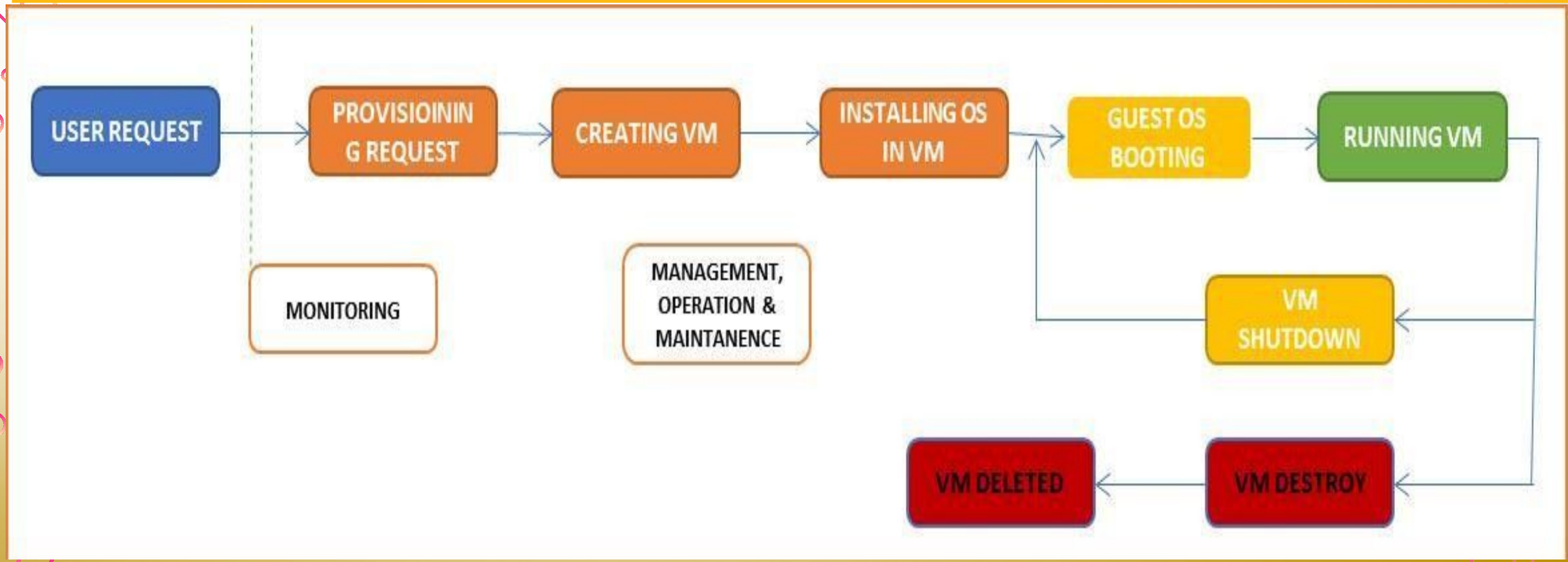
Reduced Power requirements

Reduced ownership cost

VIRTUAL MACHINES (VM)

- Virtualization relies on software to simulate hardware functionality and create a virtual computer system known as a “virtual machine” or VM.
- It is a tightly isolated software container with an operating system and application inside.
- Each self-contained VM is completely independent.
- Putting multiple VMs on a single computer enables several operating systems and applications to run on single physical server or host.
- A thin layer of software called a “hypervisor” decouples the virtual machines from the host and dynamically allocates computing resources to each virtual machine as needed.

VM LIFE CYCLE



Benefits of VMs

Partitioning

- Run multiple operating systems on one physical machine.
- Divide system resources between virtual machines.

Security

- Host system protected from VMs & VMs protected from each other.
- Sharing though shared file system volume, network communication.

Encapsulation

- Save the entire state of a virtual machine to files.
- Move and copy virtual machines as easily as moving and copying files.

Backup & Restore

- Snapshot of a given state, able to restore back to that state
- Clone by creating copy and running both original and copy

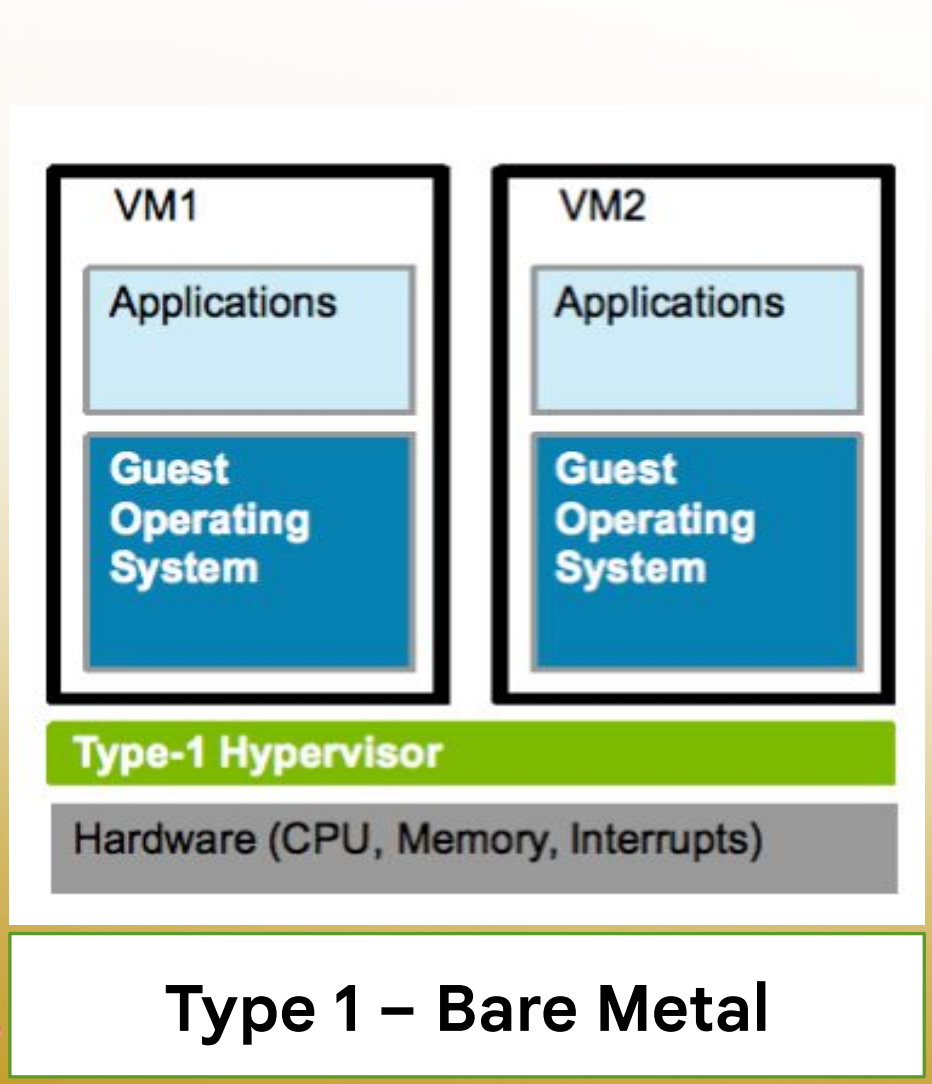
Hardware Independence

- Provision or migrate any virtual machine to any physical server.

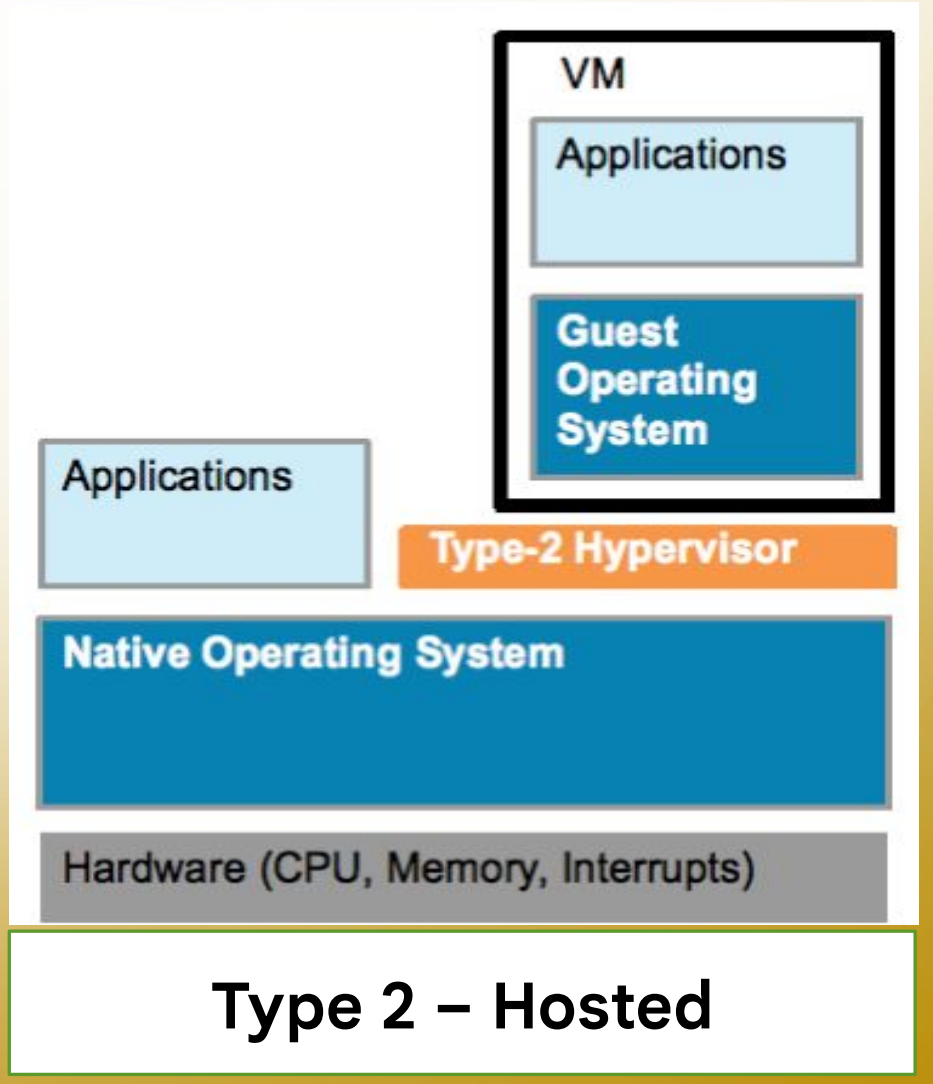
HYPERVISOR

- A hypervisor also known as virtual machine manager/monitor (VMM), or virtualization manager, is a program that allows multiple operating systems to share a single hardware host.
- A hypervisor is the software layer that coordinates VMs.
- It serves as an interface between the VM and the underlying physical hardware, ensuring that each has access to the physical resources it needs to execute.
- It also ensures that the VMs don’t interfere with each other by impinging on each other’s memory space or compute cycles.

TYPES OF HYPERVISOR



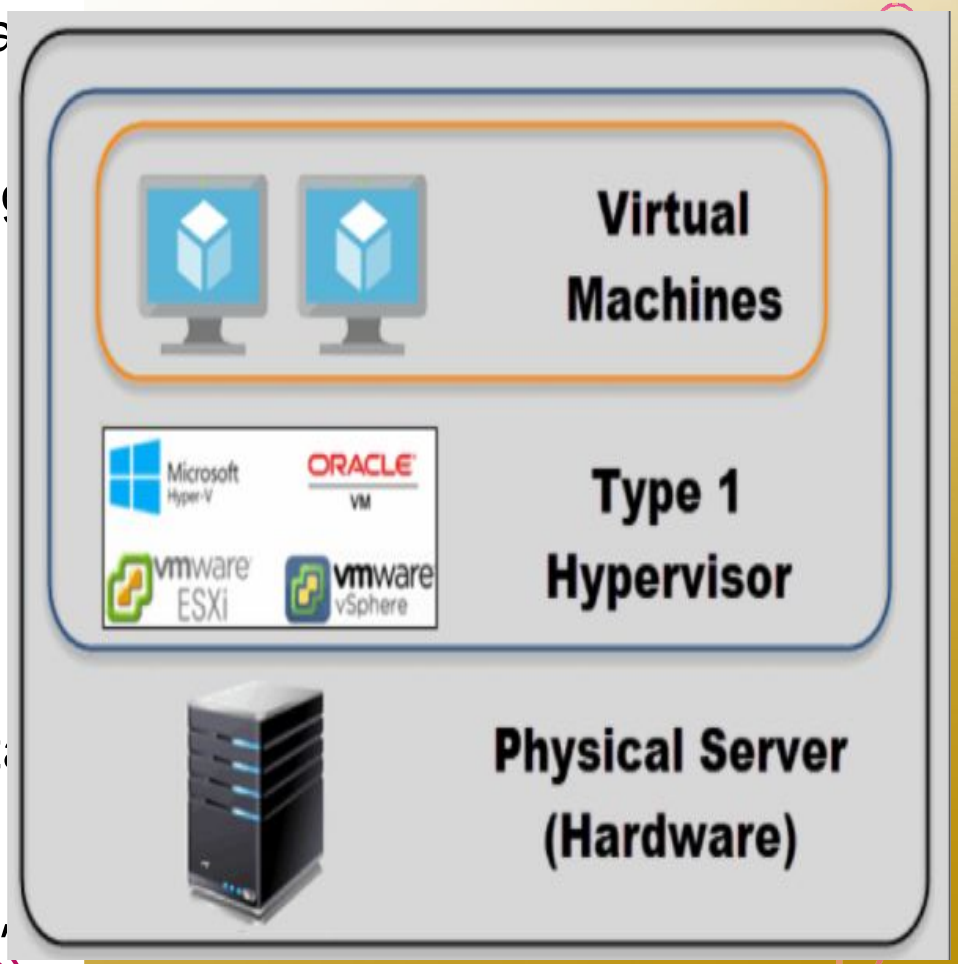
Type 1 – Bare Metal



Type 2 – Hosted

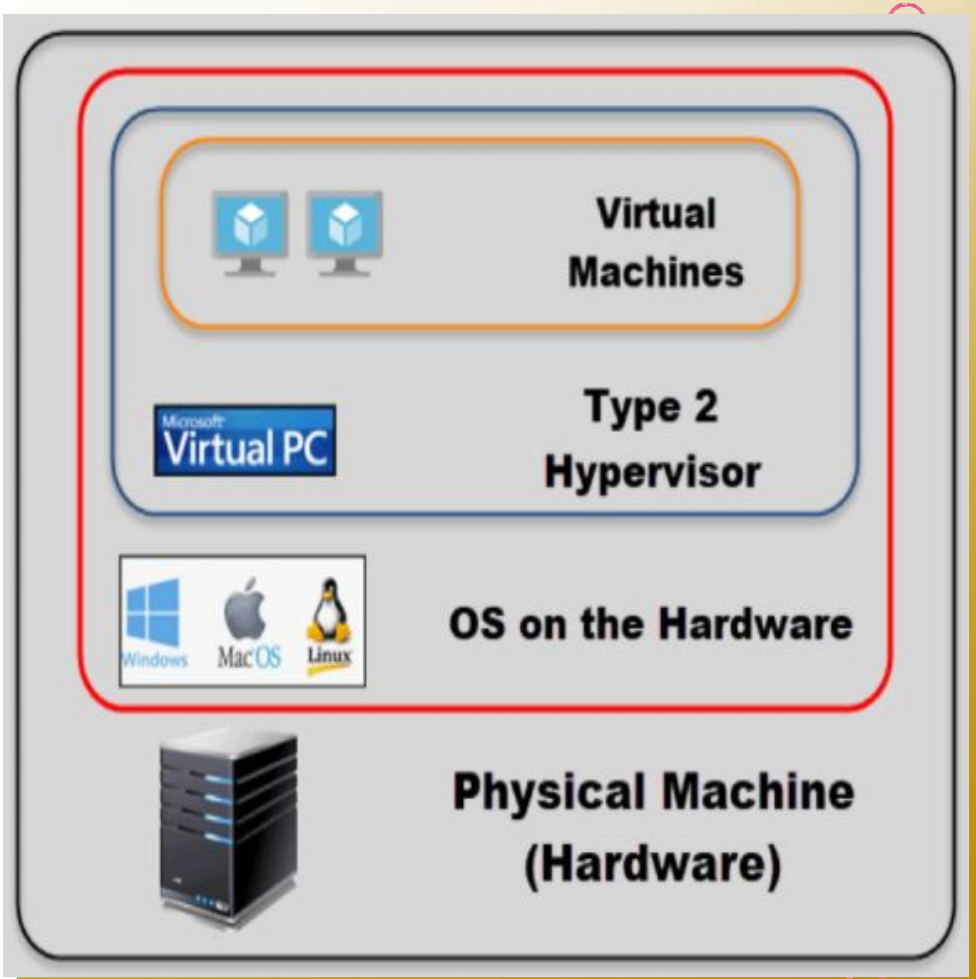
TYPE1 – BARE METAL

- It acts like a lightweight operating system like software tha runs directly on the host's hardware.
- They may also be included with general-purpose operatin systems that provide standard functions as well as VMM functions.
- They are extremely secure since isolated from the attack-prone operating system.
- It performs better and more efficiently than hosted hypervisors.
- Enterprises usually choose bare-metal hypervisors for dat center computing needs.
- Examples- VMware ESX and Citrix XenServer (without OS), Windows Server with HyperV and Linux with KVM (with OS).

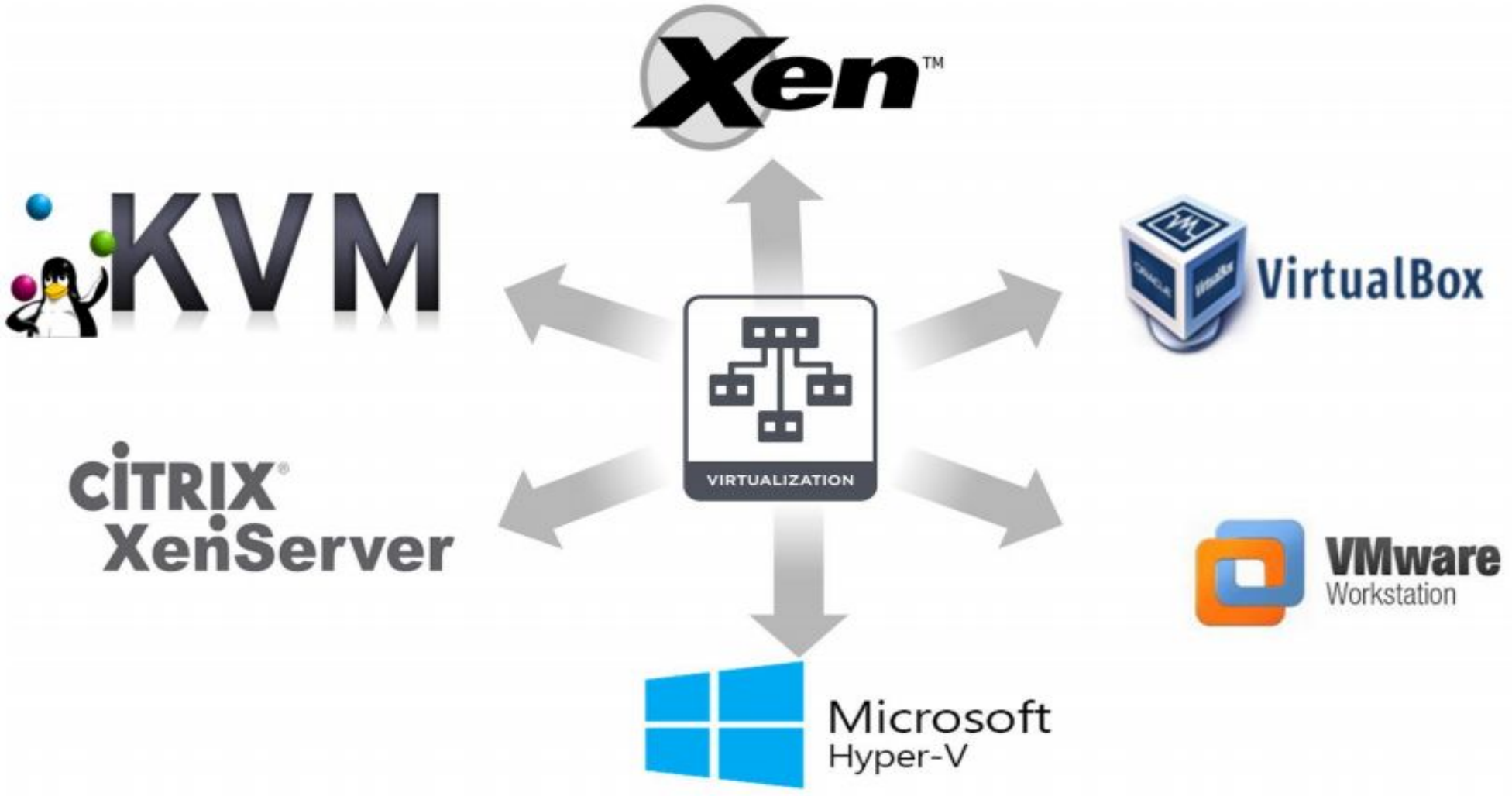


TYPE2 – HOSTED

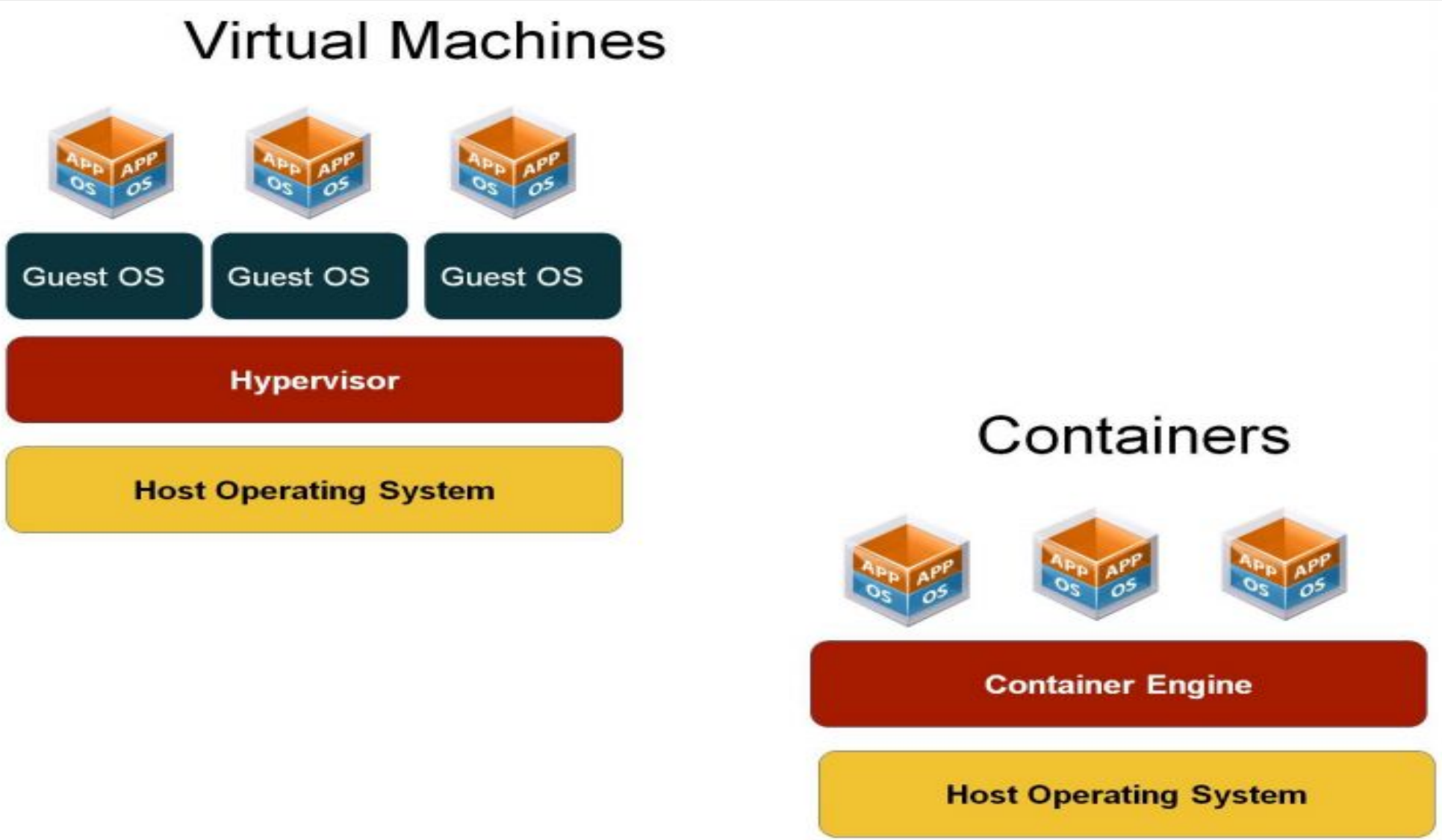
- It runs on top of the operating system of the host machine as a software layer like other computer programs.
- Additional (and different) operating systems are installed on top of the hypervisor.
- Communication between the hardware and the hypervisor must pass through the extra layer of the OS, hence latency is higher than bare-metal hypervisors.
- They are usually used by clients for testing purpose.
- Example- VMware Workstation and Oracle VirtualBox.



VIRTUALIZATION PLAYERS



Virtualization Vs Containerization



VIRTUALIZATION VS CONTAINERIZATION

VIRTUALIZATION

- Virtualization is however less efficient because there is guest OS.
- Required pre-allocation of RAM.
- Several time to create VM.
- Size in Gbs

CONTAINERIZATION

- Containerization brings abstraction to the Operating level
- Containerization is however more efficient because there is no guest OS.
- No pre-allocation of RAM.
- Take a second to create container.
- Less in size Mbs

KVM – Kernel virtual machine

- KVM is a type-1 open source hypervisor based on Linux.
- KVM can run on Linux operating systems like Ubuntu and Red Hat Enterprise Linux.
- With KVM, Linux turns into a hypervisor that enables host computer to run and support several other virtual machines or guests.
- Every guest machine runs like usual Linux operating system with hardware like graphics adapter, memory, network card, CPUs and disks.
- with Linux 2.6.20 or newer, *KVM is part of Linux*.

KVM INSTALLATION

1. **Verify CPU to support hardware virtualization**

egrep -c '(vmx|svm)' /proc/cpuinfo

0 - no support

1 or higher - virtualization enabled

2. **Install packages**

apt-get install qemu-kvm

apt-get install libvirt-bin

apt-get install bridge-utils

apt-get install virt-manager

apt-get install qemu-system

3. **Change configuration file /etc/libvirt/libvirtd.conf**

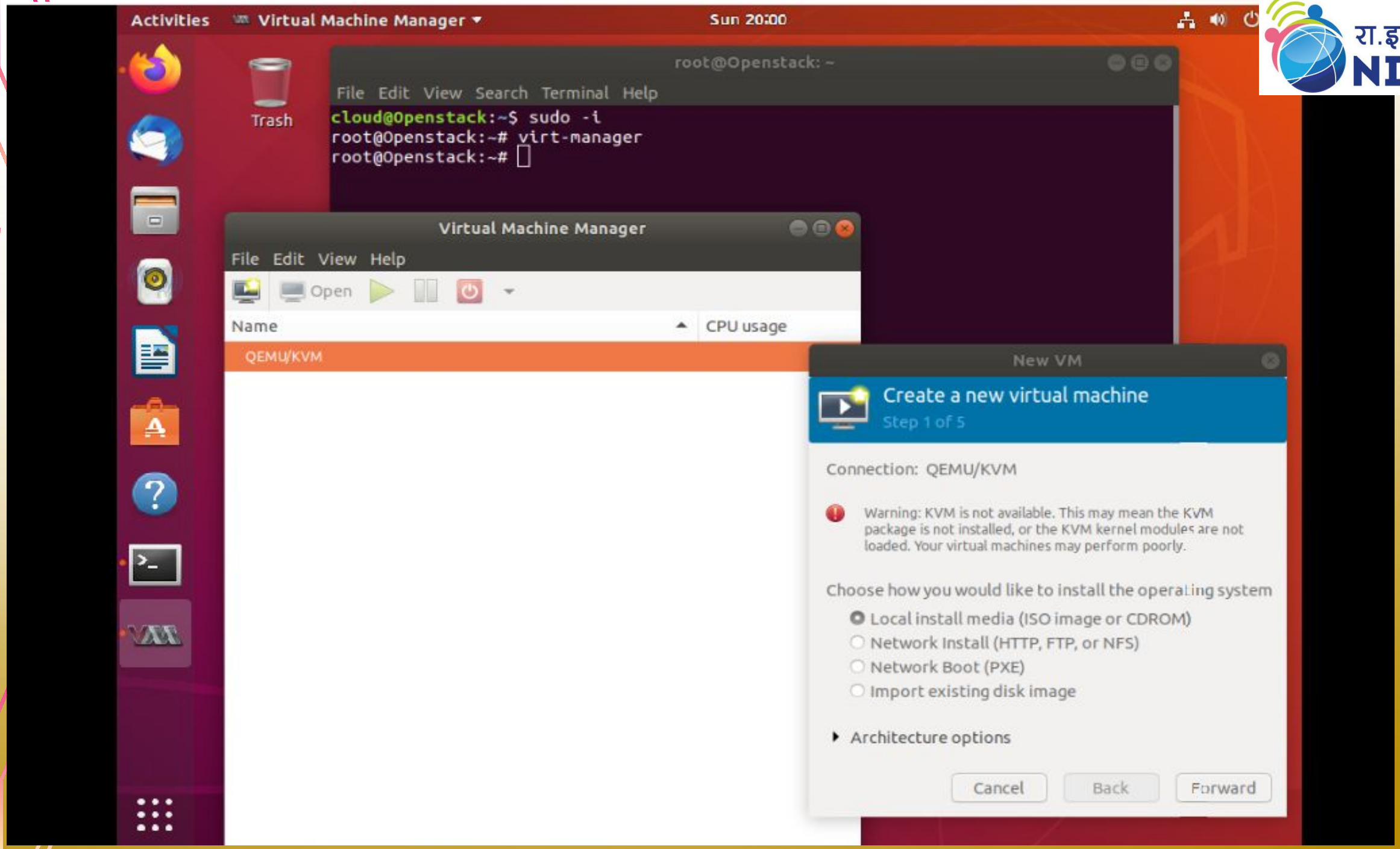
listen_addr = "0.0.0.0"
unix_sock_group = "libvirt"
unix_sock_ro_perms = "0777"
unix_sock_rw_perms = "0777"
unix_sock_dir = "/var/run/libvirt"
auth_unix_ro = "none"
auth_unix_rw = "none"

4. **Display number of vms running**

virsh list

5. **Open virt-manager (GUI)**

virt-manager


Activities
Virtual Machine Manager
Sun 20:00
Trash
root@Openstack: ~
File Edit View Search Terminal Help
cloud@Openstack:~$ sudo -i
root@Openstack:~# virt-manager
root@Openstack:~#
Virtual Machine Manager
File Edit View Help
Open
Name
CPU usage
QEMU/KVM
New VM
Create a new virtual machine
Step 1 of 5
Connection: QEMU/KVM
Warning: KVM is not available. This may mean the KVM package is not installed, or the KVM kernel modules are not loaded. Your virtual machines may perform poorly.
Choose how you would like to install the operating system
Local install media (ISO image or CDROM)
Network Install (HTTP, FTP, or NFS)
Network Boot (PXE)
Import existing disk image
Architecture options
Cancel
Back
Forward

VIRTUAL BOX

- VirtualBox is a Type 2 hypervisor
- It is Open Source and free software
- Cross-Platform Host Support (windows, linux and others)
- Oracle VirtualBox enables you to set up one or more virtual machines (VMs) on a single physical machine, and use them simultaneously, along with the actual machine.
- VM created on one host can easily run on another and, by using **Open Virtualization Format (OVF)**, the guest VMs can be imported and exported when required.
- VirtualBox provides the ‘save snapshot’ feature to save state information of guest VM .

VIRTUALBOX INSTALLATION

- **Installation command**

apt-get install virtualbox

- **Command to open virtualbo**

virtualbox

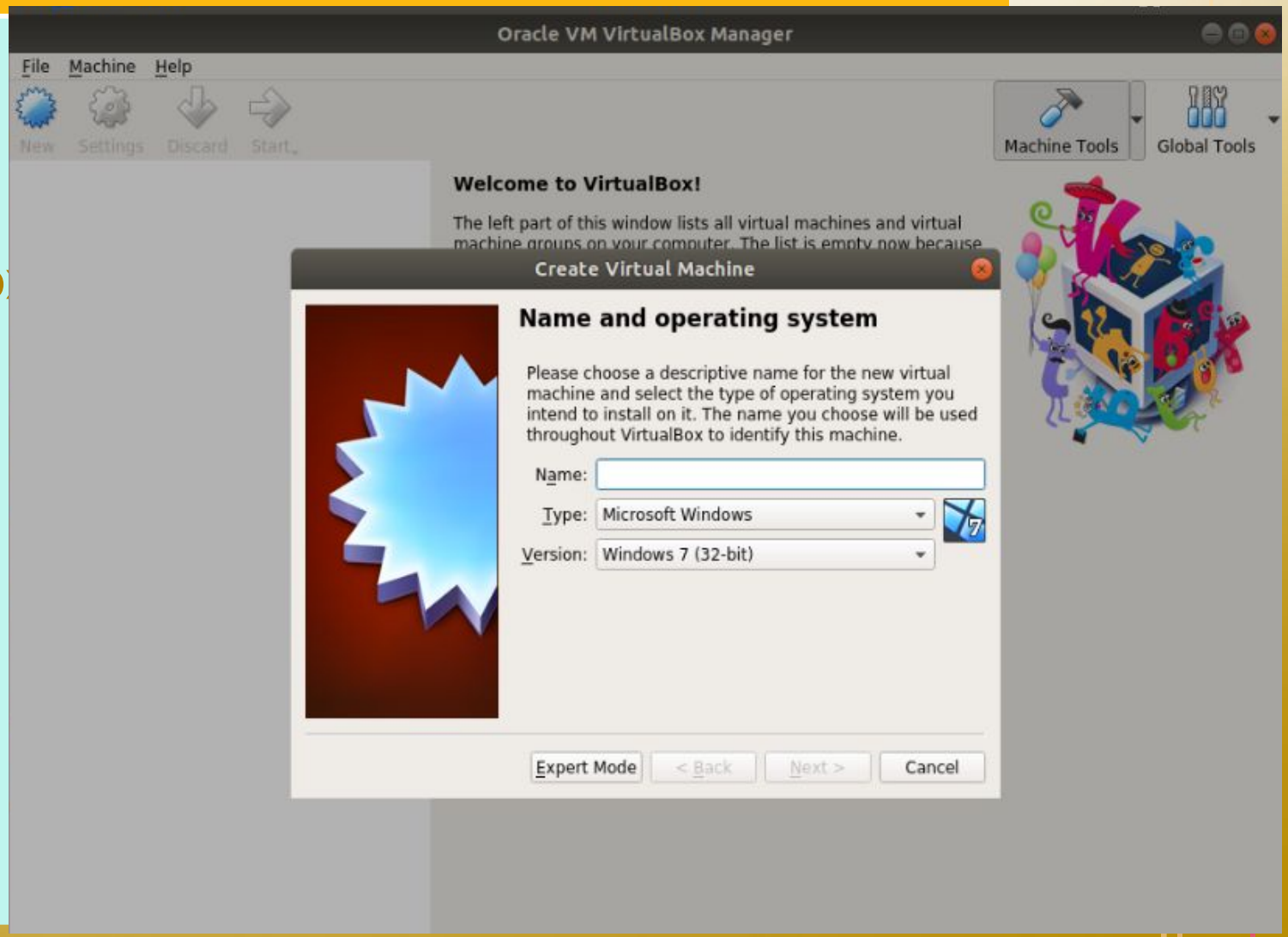


IMAGE FORMAT SUPPORTED

- KVM/QEMU – img (raw), qcow2, VDI
- Virtualbox – VDI (native), VMDK, VHD
- Vmware – VMDK (native), VHD
- Hyper-V – VHD (native)

Image conversion using qemu-img command

- Syntax

qemu-img convert –O output_format input_file output_file

Where output_format can be –

1. qcow2 – to convert to QCOW2 kvm/qemu image
2. raw – to convert to raw (.img) image
3. vdi – to convert to VDI virtualbox image
4. vpc – to convert to VHD hyper-V image format
5. vmdk – to convert to VMDK vmware image format

THANK YOU