

VIRTUALIZATION

By

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AGENDA

- Overview of Virtualization
- Evolution of Virtualization and VMware history
- Types of Virtualization
- Advantages and Disadvantages of Virtualization
- Hyperthreading and Memory virtualization overview
- VMware products overview



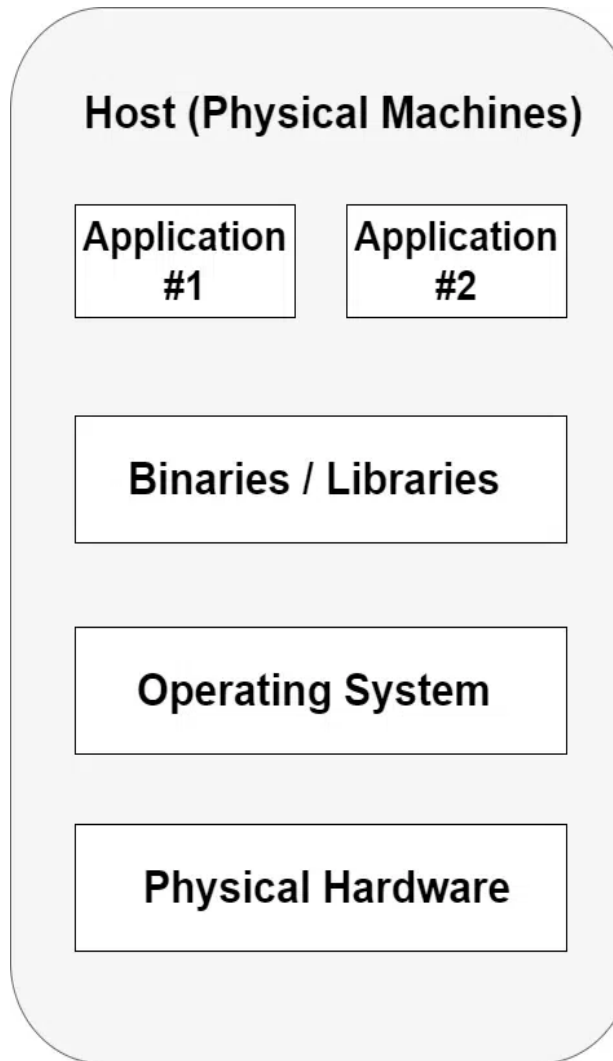
OVERVIEW

- Virtualization is technology that you can use to create virtual representations of servers, storage, networks, and other physical machines.
- Virtualization refers to the process of creating virtual computers on top of a single physical computer.
- These virtual computers are known as virtual machines. Virtual machines use the hardware of the physical computer, but they do have their own operating systems.
- Each virtual machine functions as an independent computer.
- Virtualization allows the organizations to utilize the hardware of a single computer to create multiple virtual computers and therefore increase productivity.



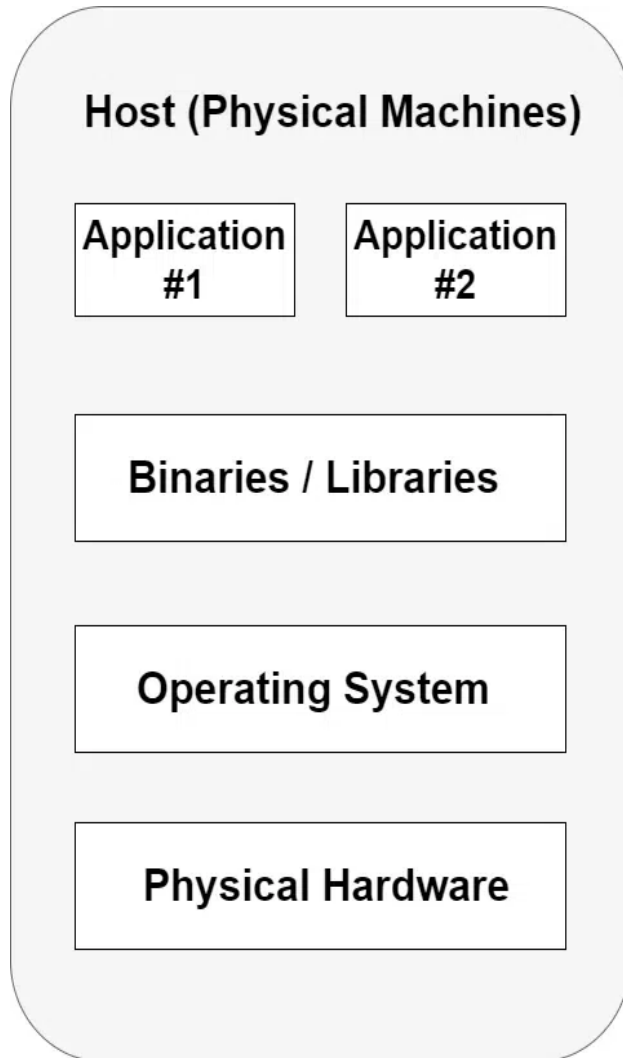
EVOLUTION OF VIRTUALIZATION

Bare metal computing

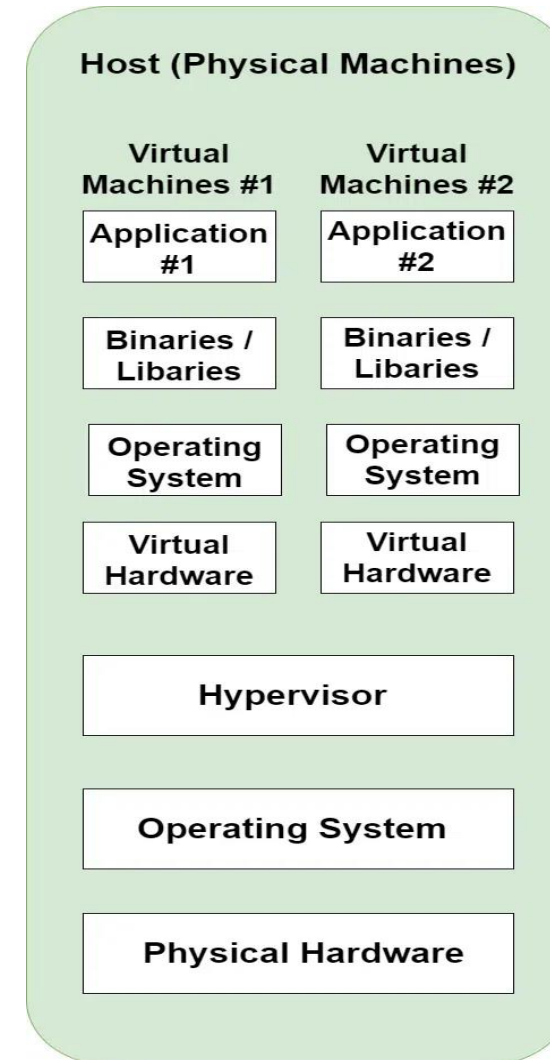


EVOLUTION OF VIRTUALIZATION

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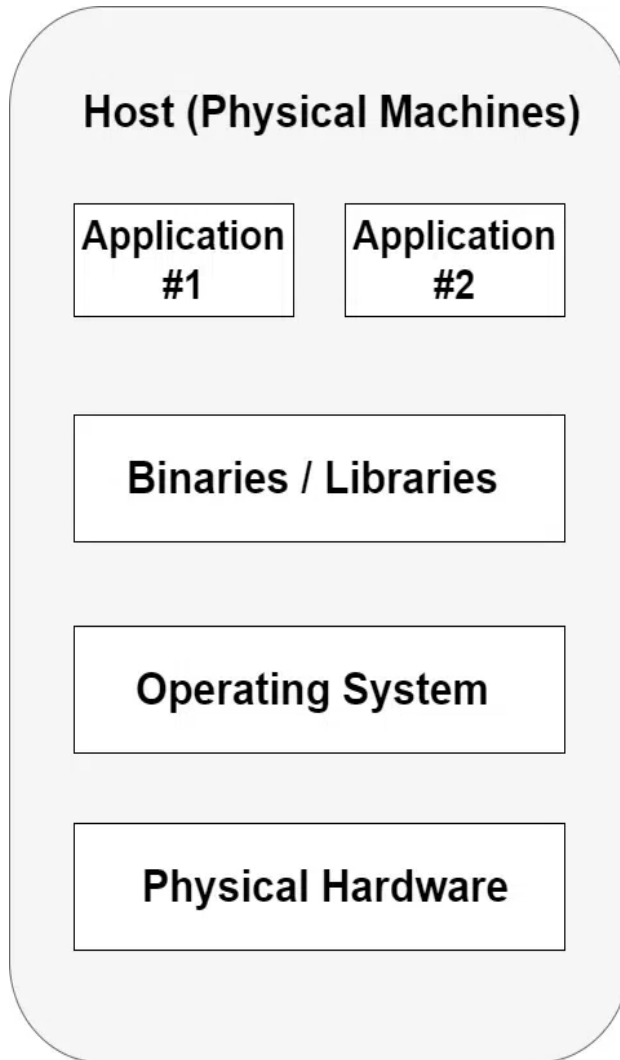


Virtual Machines

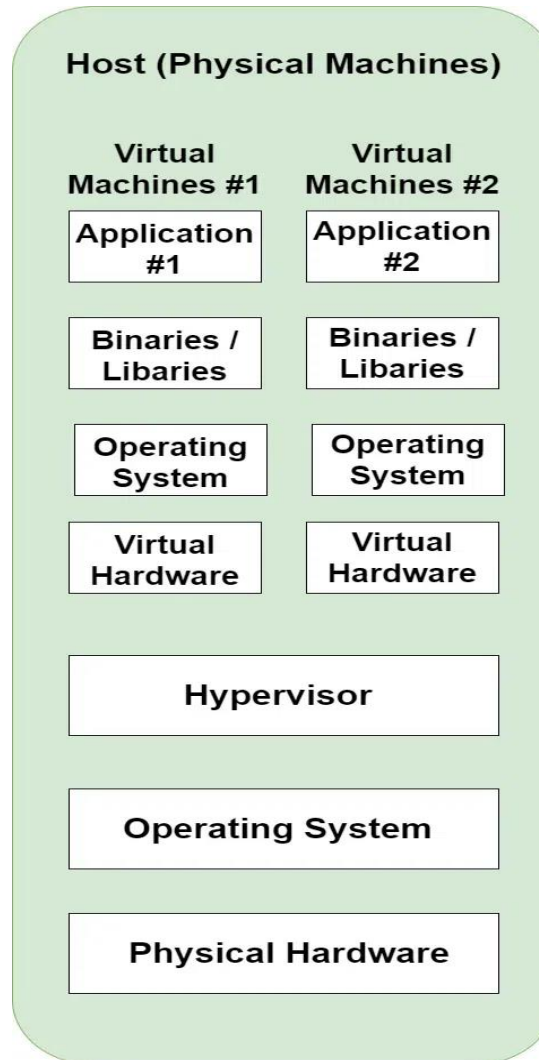


EVOLUTION OF VIRTUALIZATION

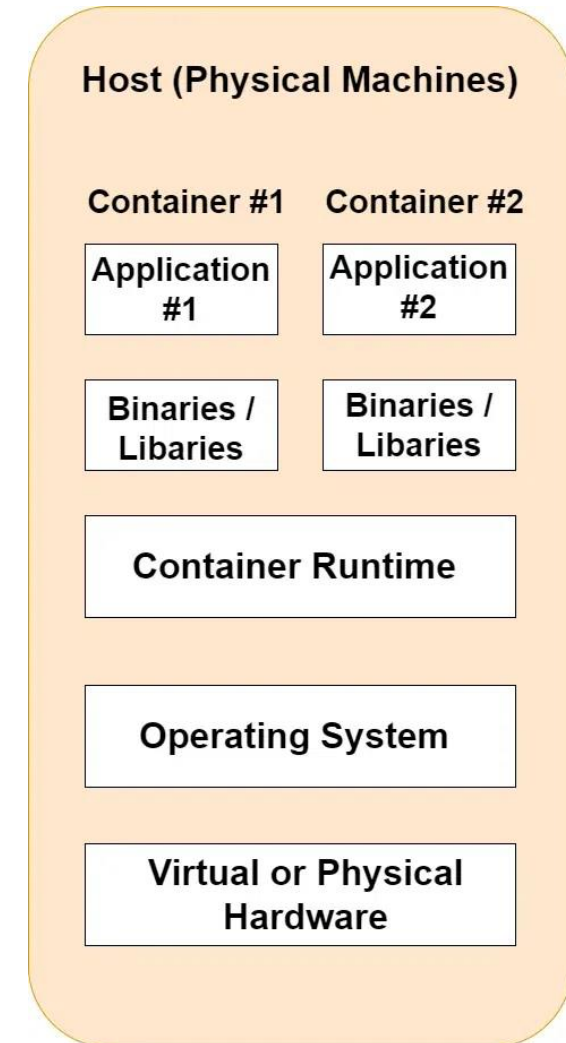
Bare metal computing



Virtual Machines



Containers

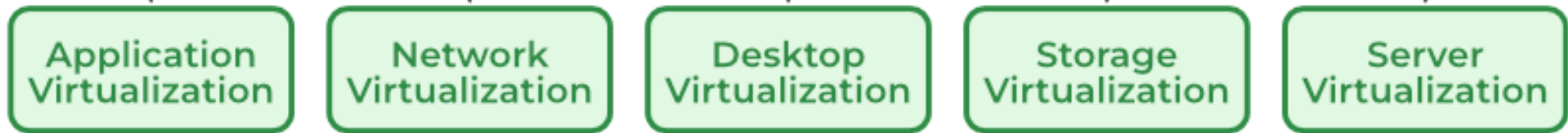


EVOLUTION OF VIRTUALIZATION

	Bare Metal	Virtual Machine	Container
Dependency Management	Poor	Good	Good
Utilization	Poor	Fine	Good
Isolation	Good	Good	Fine
Start up Speed	Poor	Fine	Good
Dev/Prod Parity	Poor	Fine	Good
Control	Good	Fine	Fine
Operational Overhead	Poor	Fine	Good



TYPES OF VIRTUALIZATION



APPLICATION VIRTUALIZATION

- Application virtualization is a technology that allows applications to run in an isolated environment on a host system.
- This isolation provides several benefits, such as compatibility across different platforms, easier deployment, and enhanced security.
- The application is separated from the underlying operating system and other applications.
- The application and its dependencies (like specific versions of libraries) are packaged together into a single executable or container.
- This allows the application to run without needing to install those dependencies on the host system.



TYPES OF APPLICATION VIRTUALIZATION

- Remote Application Virtualization
 - ✓ The application runs on a remote server, and only the user interface is delivered to the client device.
 - ✓ Citrix Virtual Apps, Microsoft RemoteApp.
- Streaming Application Virtualization
 - ✓ The application is streamed to the client device on demand.
 - ✓ Only the parts of the application that are needed are delivered initially, with other components streamed as needed.
- Local Application Virtualization
 - ✓ The application is fully encapsulated and runs locally on the client device but within a virtualized environment.
 - ✓ This method is typically used for *legacy applications* or those requiring specific environments.



NETWORK VIRTUALIZATION

- It is a method of combining hardware and software network resources and functionalities into a single, software-based administrative entity, which allows for the efficient management and deployment of network resources.
- It abstracts physical network components like switches, routers, and firewalls into virtual counterparts, enabling more flexible, scalable, and dynamic network configurations.
- Types of Network Virtualization
 - External Network Virtualization
 - Internal Network Virtualization



KEY COMPONENTS OF NETWORK VIRTUALIZATION

- Key Components:
 - Virtual Switches (vSwitches)
 - Virtual Routers
 - Virtual Firewalls
 - Software-Defined Networking (SDN)
 - Network Functions Virtualization (NFV)
- Popular Network Virtualization Solutions
 - VMware NSX
 - Cisco ACI (Application Centric Infrastructure)
 - OpenStack Neutron
 - Microsoft Hyper-V Network Virtualization



DESKTOP VIRTUALIZATION

- Desktop virtualization is a technology that separates the desktop environment and its applications from the physical client device that is used to access it.
- This allows users to run their desktop from a central server, making it accessible from virtually any device.
- Desktop virtualization provides numerous benefits in terms of flexibility, security, and manageability.
- Desktop virtualization is a powerful technology for organizations seeking to provide secure, flexible, and manageable desktop environments for their users, particularly in remote work, education, and BYOD scenarios.



DESKTOP VIRTUALIZATION

- Types:
 - Virtual Desktop Infrastructure (VDI)
 - Remote Desktop Services (RDS)
 - Desktop as a Service (DaaS)
 - Local Desktop Virtualization
- Popular Desktop Virtualization Solutions:
 - VMWare Horizon
 - Citrix Virtual Desktop
 - Microsoft Azure Virtual Desktop
 - Amazon Workspaces



STORAGE VIRTUALIZATION

- Storage virtualization is a technology that abstracts physical storage resources from multiple storage devices and consolidates them into a single, centralized, and manageable virtual storage pool.
- This virtualization layer allows administrators to manage storage as a unified resource, irrespective of the underlying hardware, improving flexibility, efficiency, and scalability in storage management.
- Storage virtualization allows:
 - Improved utilization
 - Simplified management
 - Scalability & flexibility
 - Cost efficiency



TYPES OF STORAGE VIRTUALIZATION

- Block-Level Storage Virtualization
 - Virtualizes storage at the block level, which means it abstracts the physical storage blocks from multiple storage devices (like SANs) and presents them as a unified storage pool.
 - This type is commonly used in storage area networks (SANs) to improve storage utilization and simplify management.
 - Examples include IBM SAN Volume Controller (SVC) and EMC VPLEX.
- File-Level Storage Virtualization:
 - Virtualizes storage at the file level, allowing files to be abstracted from the physical storage devices.
 - This type is used in network-attached storage (NAS) environments and can provide features like global namespace and transparent file migration across storage systems.
 - Examples include Microsoft DFS (Distributed File System) and NetApp's ONTAP.



TYPES OF STORAGE VIRTUALIZATION

- Object-Level Storage Virtualization:
 - Abstracts storage into objects, which include data and metadata, and stores them in a flat address space.
 - It's commonly used in cloud storage solutions, providing scalability and efficient management of large amounts of unstructured data.
 - Examples include Amazon S3 and OpenStack Swift.
- Popular Storage Virtualization Solutions
 - VMware vSAN
 - IBM SAN Volume Controller (SVC)
 - EMC VPLEX
 - NetApp ONTAP
 - Hitachi Virtual Storage Platform (VSP)



SERVER VIRTUALIZATION

- Server virtualization is a technology that allows multiple virtual servers to run on a single physical server.
- Server virtualization provides significant benefits in terms of resource optimization, cost savings, and flexibility.
- Future Trends
 - Hybrid Cloud Integration
 - Hyper-Converged Infrastructure (HCI)
 - Automation and Orchestration



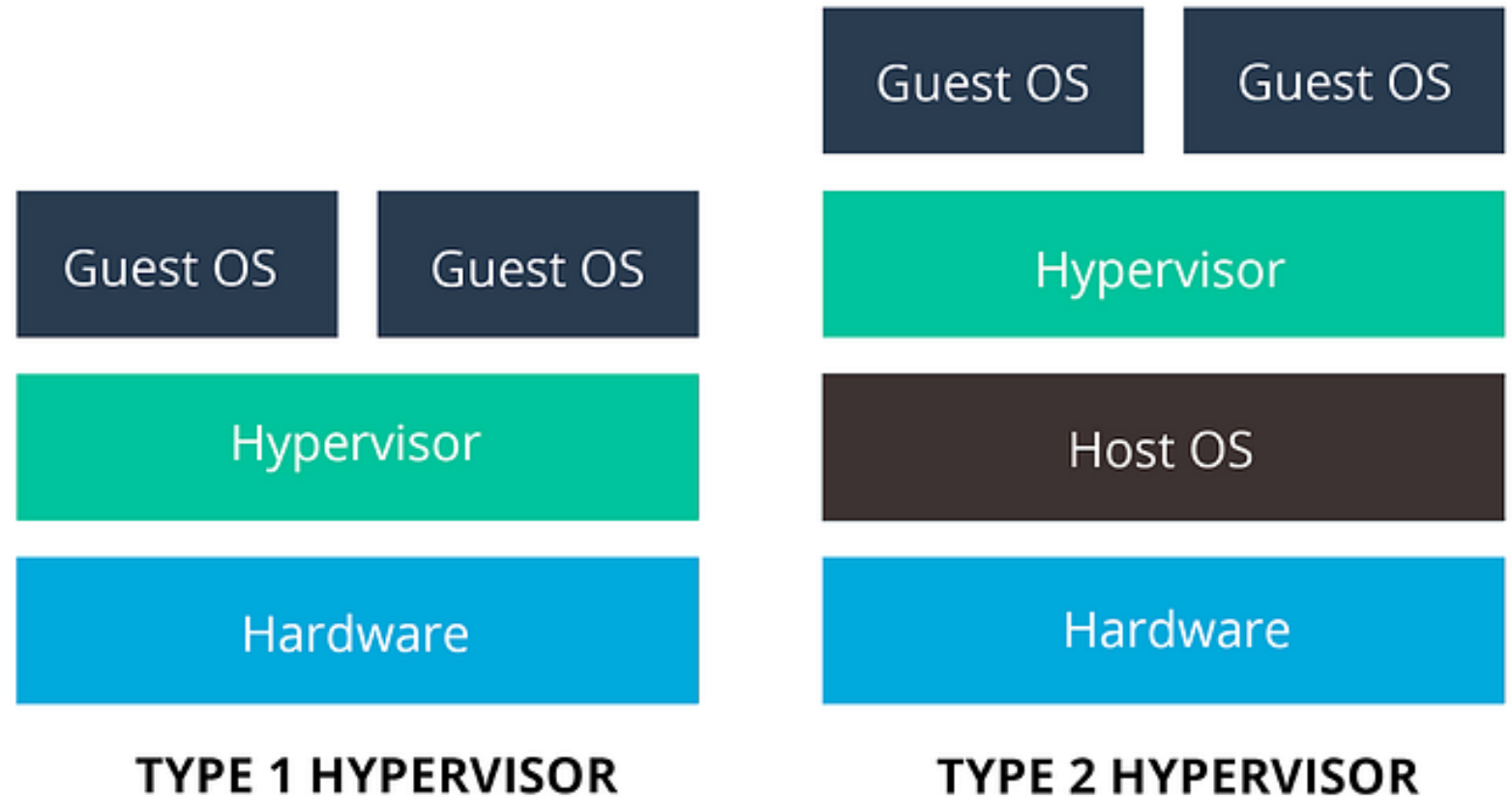
TYPES OF SERVER VIRTUALIZATION

- Full Virtualization
 - The most common form, where the hypervisor provides a complete virtual environment that emulates the underlying hardware.
- Para-Virtualization
 - The guest OS is aware that it is running in a virtualized environment and communicates directly with the hypervisor for certain operations.
- OS-Level Virtualization (Containerization)
 - Containers share the same OS kernel but are isolated from each other, making them lightweight and highly efficient.



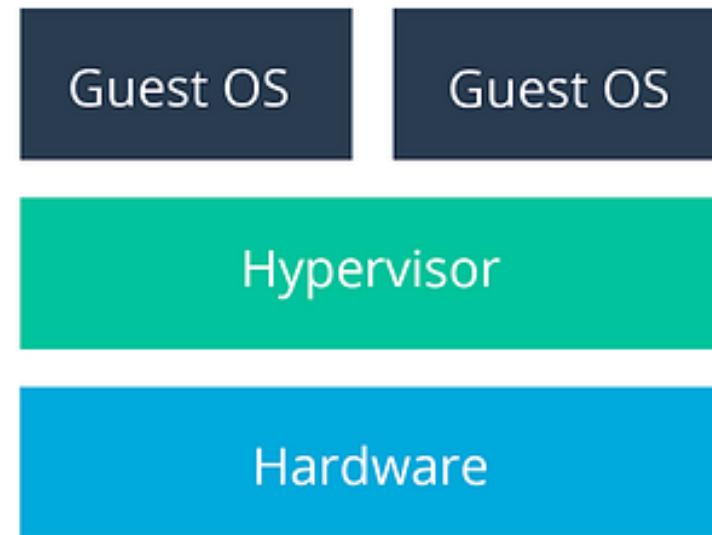
COMPONENTS OF SERVER VIRTUALIZATION

- Hypervisor
 - Type 1 (Bare-Metal Hypervisor)
 - Type 2 (Hosted Hypervisor)
- Virtual Machines (VMs)
- Management Tools



TYPES OF HYPERVISORS

- Type-1
 - Microsoft Hyper-V
 - VMWare ESXi
 - KVM
 - Xen
 - Oracle VM server
 - RedHat Virtualization
 - Citrix Hypervisor
 - OpenVZ
 - LXC (Linux Container)

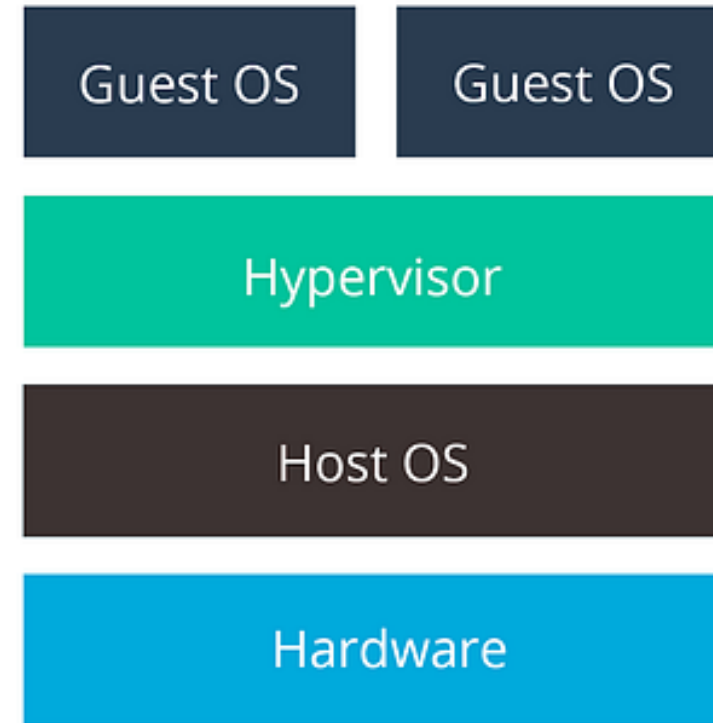


TYPE 1 HYPERVISOR



TYPES OF HYPERVISORS

- Type-2
 - Oracle VirtualBox
 - QEMU (Quick Emulator)
 - KVM
 - Hyper-V Manager
 - Parallel Desktops
 - VMWare Workstation
 - VMWare Fusion
 - Bochs
 - PearPC



TYPE 2 HYPERVISOR



VMWARE PRODUCTS OVERVIEW

- Compute Virtualization
 - *VMware vSphere*: The core hypervisor that enables virtualization of servers.
 - *VMware vCenter*: A centralized management platform for vSphere environments.
 - *VMware vCloud Suite*: A comprehensive suite of products for building and managing private clouds.
- Networking and Security
 - *VMware NSX*: A software-defined networking (SDN) platform for virtualizing network functions.
 - *VMware vRealize Network Insight*: A network visibility and analytics tool.
 - *VMware vShield*: A security platform for protecting virtualized environments.
- Storage
 - *VMware vSAN*: A hyper-converged storage platform.
 - *VMware Virtual Volumes*: A storage abstraction layer that enables independent management of storage.

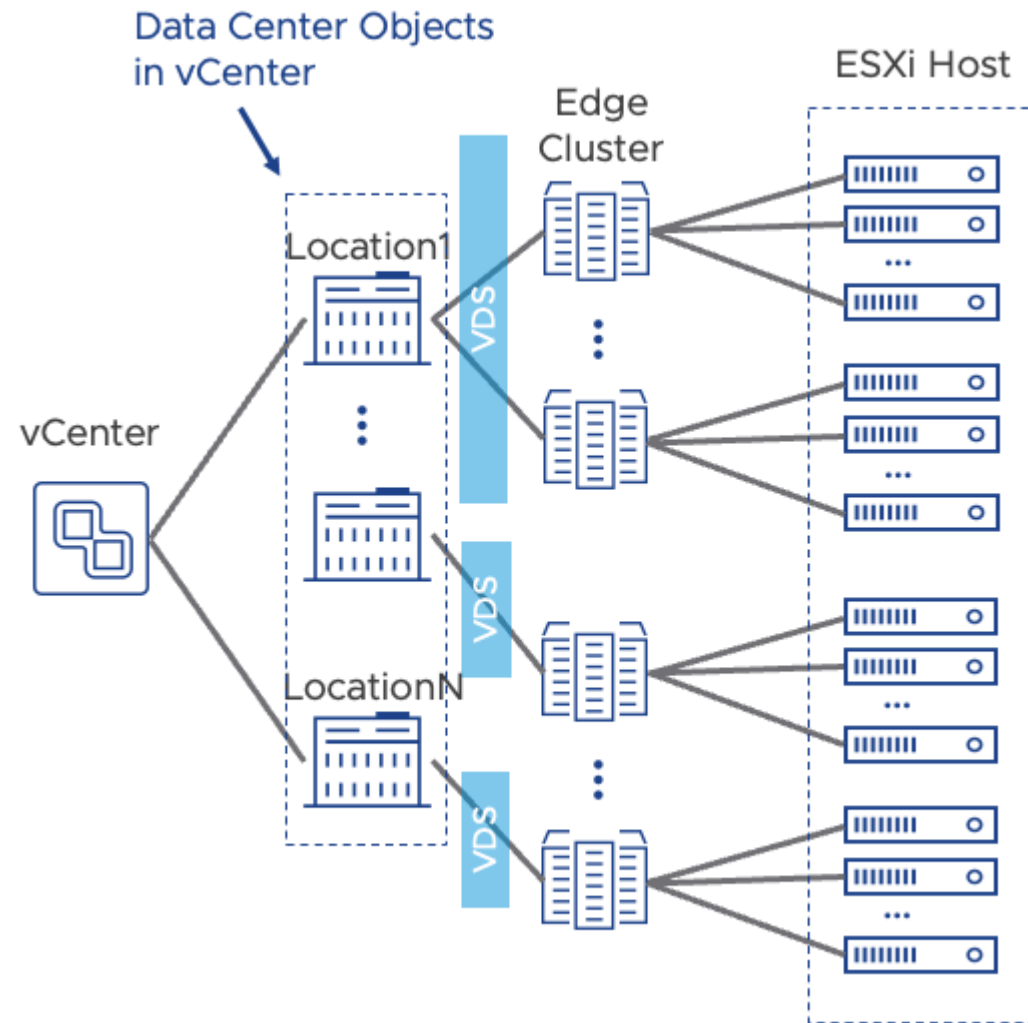


VMWARE PRODUCTS OVERVIEW

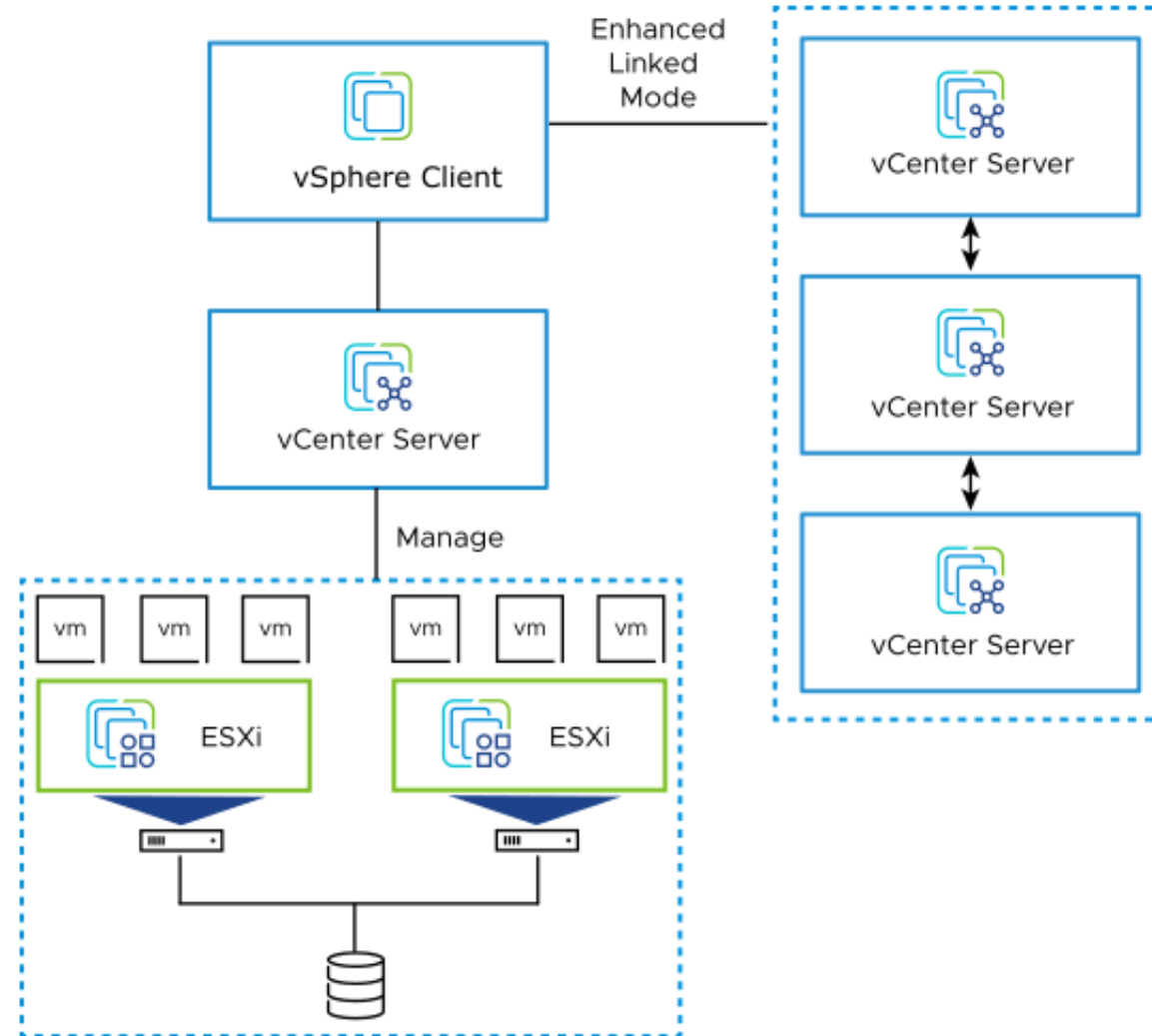
- Cloud Management
 - *VMware vRealize Automation*: An automation platform for IT infrastructure.
 - *VMware vRealize Operations*: A cloud management platform for monitoring and optimizing IT resources.
 - *VMware Cloud Foundation*: A pre-integrated platform for building and running hybrid clouds.
- End-User Computing
 - *VMware Horizon*: A desktop virtualization platform.
 - *VMware Workspace ONE*: A unified endpoint management platform.
- Other Products
 - *VMware Tanzu*: A platform for building and running modern applications.
 - *VMware Aria*: A cloud operations platform.
 - *VMware vCloud Director*: A multi-tenant cloud management platform.



VMWARE ARCHITECTURE



VMWARE VSPHERE



MINIMUM REQUIREMENTS FOR VMWARE ESXI 6.7

- CPU:
 - *Minimum:* 2 cores (4 logical processors)
 - *Recommended:* 4 cores (8 logical processors) or more
- Memory:
 - *Minimum:* 8 GB
 - *Recommended:* 8 GB or more
- Storage:
 - *Minimum:* 20 GB for the ESXi installation
 - *Recommended:* At least 100 GB for the operating system and virtual machines
- Network Interface Card (NIC):
 - *Minimum:* 1 NIC
 - *Recommended:* 2 NICs or more for redundancy and improved performance



MINIMUM REQUIREMENTS FOR VMWARE ESXI 6.7

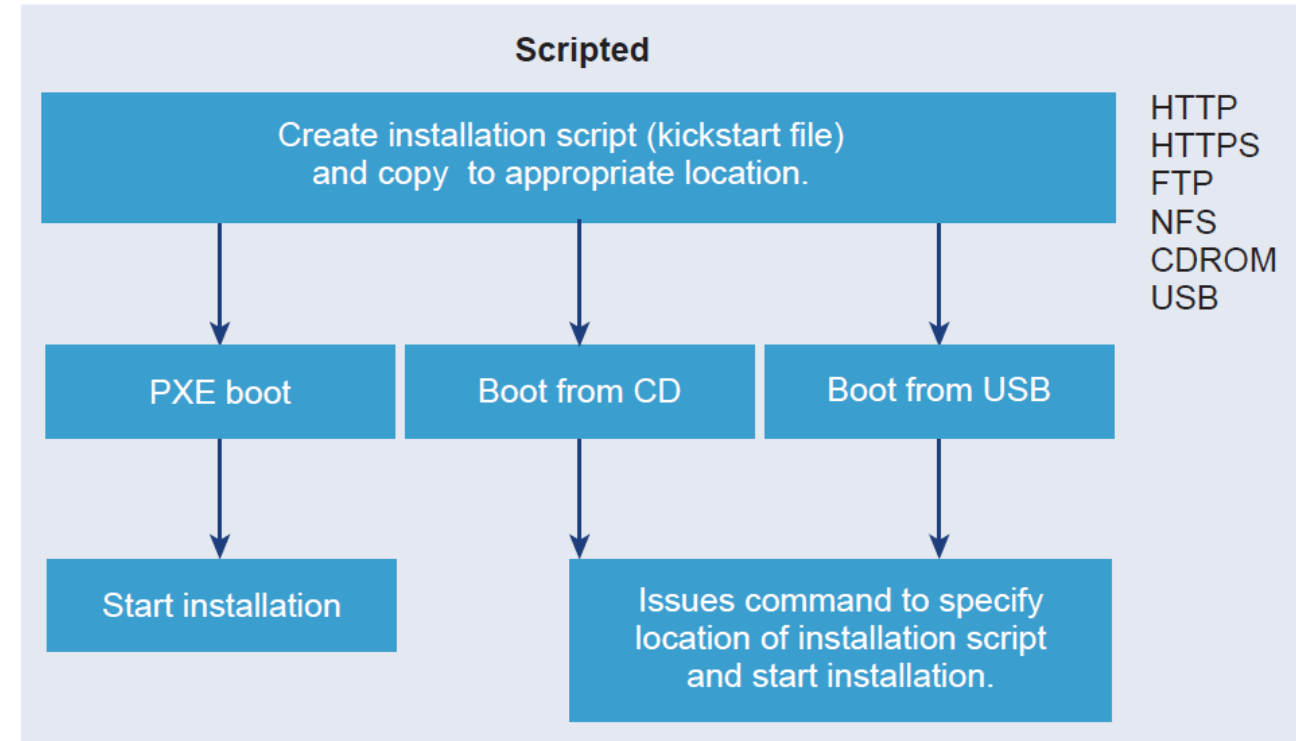
Additional Considerations:

- Virtual Machines (VMs): The amount of CPU, memory, and storage required will depend on the number and type of VMs you plan to run.
- Workload: The specific workload (e.g., database, web server, virtual desktop) will also affect the hardware requirements.
- High Availability: If you require high availability features like HA and DRS, you may need additional hardware resources.



OPTIONS FOR INSTALLING ESXi

- Interactive ESXi Installation
 - You boot the installer from a CD or DVD, from a bootable USB device, or by PXE booting the installer from a location on the network.
- Scripted ESXi Installation
 - Running a script is an efficient way to deploy multiple ESXi hosts with an unattended installation.



VMWARE VSPHERE

- The two core components of vSphere are ESXi and vCenter Server.
 - ESXi is the virtualization platform on which you can create and run virtual machines and virtual appliances.
 - vCenter Server is a service that acts as a central administrator for ESXi hosts connected in a network. vCenter Server lets you pool and manage the resources of multiple hosts.
- You can install vCenter Server on a Windows virtual machine or physical server, or deploy the vCenter Server Appliance.
 - The vCenter Server Appliance is a preconfigured Linux-based virtual machine optimized for running vCenter Server and the vCenter Server components.
 - You can deploy the vCenter Server Appliance on ESXi hosts 6.0 or later, or on vCenter Server instances 6.0 or later.



VMWARE VSPHERE

- Starting with vSphere 6.0, all prerequisite services for running vCenter Server and the vCenter Server components are bundled in the VMware Platform Services Controller™.
- You can deploy vCenter Server with an embedded or external Platform Services Controller, but you must always install or deploy the Platform Services Controller before installing or deploying vCenter Server.



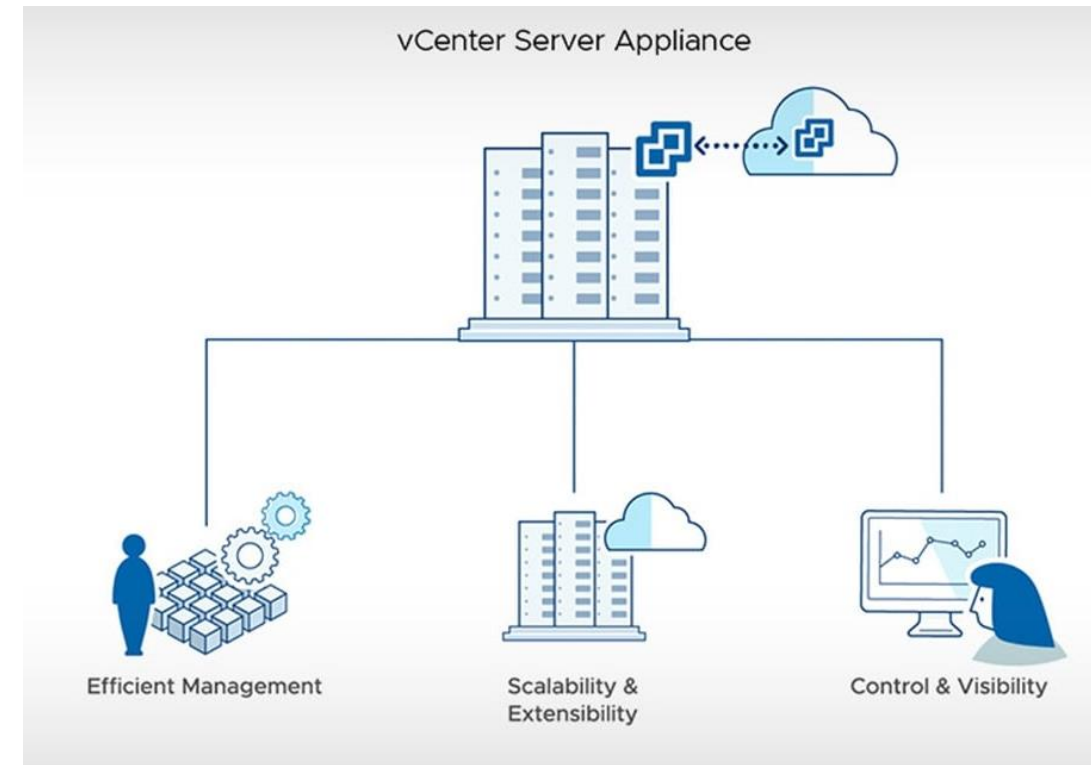
HARDWARE AND SYSTEM RESOURCES OF ESXI 6.7

- At least two CPU cores.
- It supports 64-bit x86 processors.
- It requires the NX/XD bit to be enabled for the CPU in the BIOS.
- ESXi 6.7 requires a minimum of 4 GB of physical RAM. It is recommended to provide at least 8 GB of RAM to run virtual machines in typical production environments.
- To support 64-bit virtual machines, support for hardware virtualization (Intel VT-x or AMD RVI) must be enabled on x64 CPUs.
- SCSI disk or a local, non-network, RAID LUN with unpartitioned space for the virtual machines.



VMWARE VCENTER

- VMware vCenter is advanced server management software that provides a centralized platform for controlling your VMware vSphere environments, allowing you to automate and deliver a virtual infrastructure across the hybrid cloud with confidence.
- VMware vCenter Features:
 - Simple Deployment
 - Extensibility and Scalability Across Hybrid Cloud
 - Centralized Control and Visibility



AUTHENTICATION SERVICES

- vCenter Single Sign-On
 - External identity provider federation
 - vCenter Server built-in identity provider
- vSphere License Service
 - The vSphere License service provides common license inventory and management capabilities to all vCenter Server systems within the Single Sign-On domain.
- VMware Certificate Authority
 - VMCA provisions each ESXi host with a signed certificate that has VMCA as the root certificate authority.



SERVICES INSTALLED WITH VCENTER SERVER

- PostgreSQL
 - PostgreSQL database for vSphere and vCloud Hybrid Services.
- vSphere Client
 - The HTML5-based user interface that lets you connect to vCenter Server instances by using a Web browser
- vSphere ESXi Dump Collector
 - The vCenter Server support tool that collects such memory dumps over the network.
- vSphere Auto Deploy
 - The vCenter Server support tool that can provision hundreds of physical hosts with ESXi software.
- VMware vSphere Lifecycle Manager
 - It enables centralized, automated patch and version management for VMware vSphere



PLATFORM SERVICES CONTROLLER SERVICES

- With PSC, all VMware products within the same environment can share the authentication domain and other services. Services include certificate management, authentication, and licensing.
- Some of the services are:
 - Appliance Management Service
 - License service
 - Component Manager
 - Identity Management Service
 - HTTP Reverse Proxy
 - Service Control Agent
 - Security Token Service
 - Common Logging Service
 - Syslog Health Service
 - Authentication Framework
 - Certificate Service
 - Directory Service



WHAT IS VCENTER SERVER APPLIANCE

- The vCenter Server appliance is a preconfigured virtual machine that is optimized for running vCenter Server and the associated services.
- The vCenter Server appliance package contains the following software:
 - Photon OS 3.0
 - The vSphere authentication services
 - PostgreSQL
 - VMware vSphere Lifecycle Manager Extension
 - VMware vCenter Lifecycle Manager
- Version 8.0 of vCenter Server is deployed with virtual hardware version 10, which supports 64 virtual CPUs per virtual machine in ESXi.



VCENTER SERVER APPLIANCE DEFAULT USER NAMES

- Root
 - Use this user name to log in to the appliance operating system and the vCenter Server Management Interface.
- administrator@yourdomainname
 - Use this user name for vCenter Single Sign-On login.
 - You set the password while creating the vCenter Single Sign-On domain.
 - You create a vCenter Single Sign-On domain during the deployment of a vCenter Server appliance in a new vCenter Single Sign-On domain.



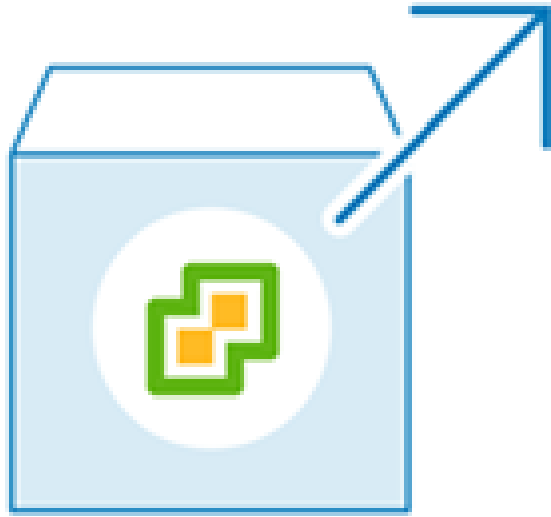
HARDWARE REQUIREMENTS FOR THE VCSA

	Number of vCPUs	Memory
Tiny environment (up to 10 hosts or 100 virtual machines)	2	14 GB
Small environment (up to 100 hosts or 1,000 virtual machines)	4	21 GB
Medium environment (up to 400 hosts or 4,000 virtual machine)	8	30 GB
Large environment (up to 1,000 hosts or 10,000 virtual machines)	16	39 GB
X-Large environment (up to 2,000 hosts or 35,000 virtual machines)	24	58 GB

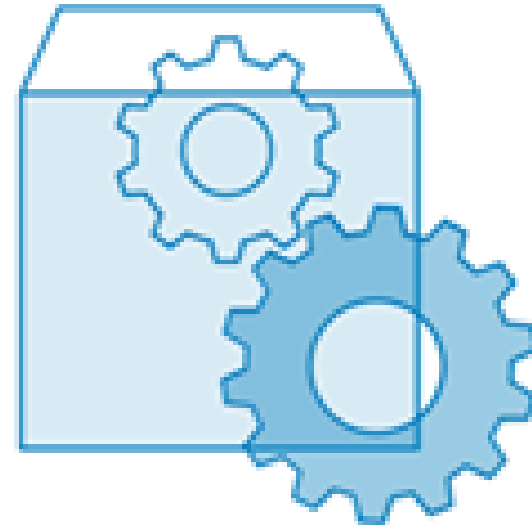


GUI DEPLOYMENT OF VCSCA

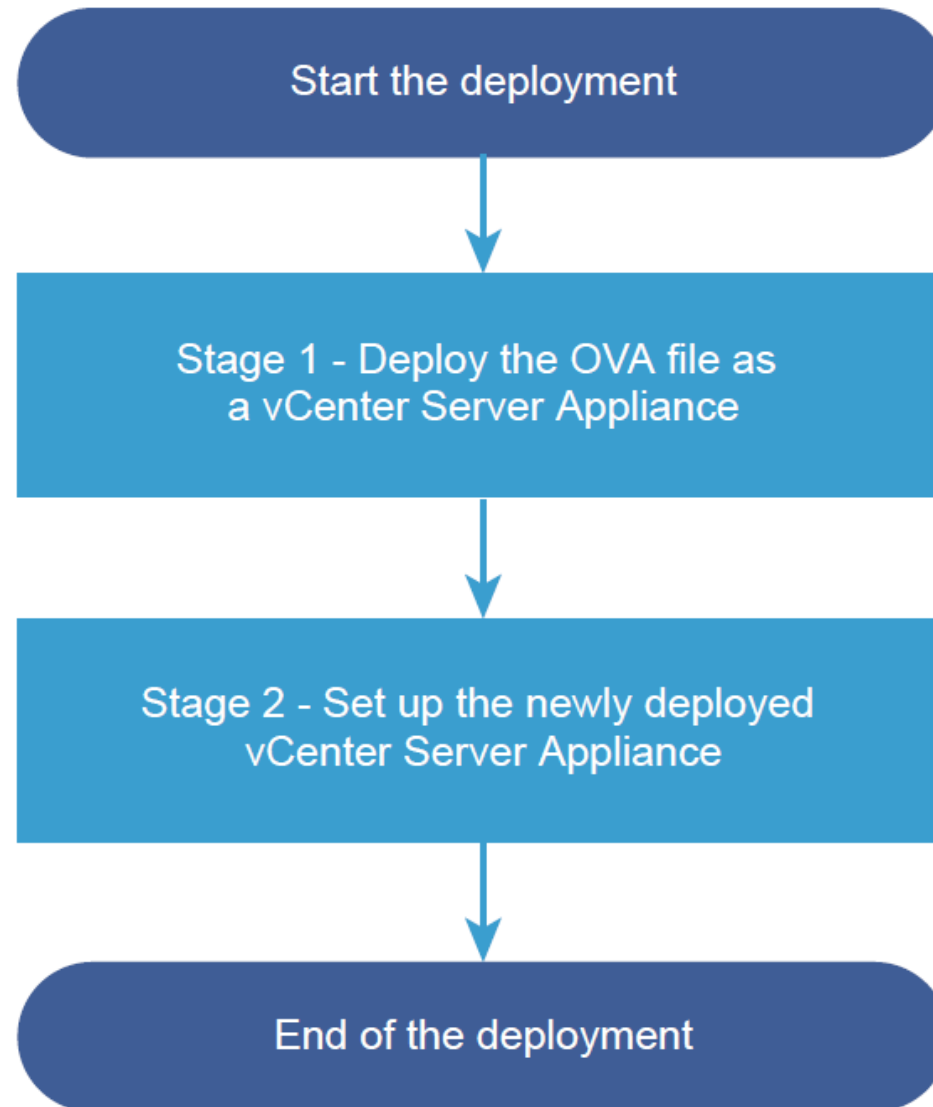
- Stage 1 - OVA Deployment



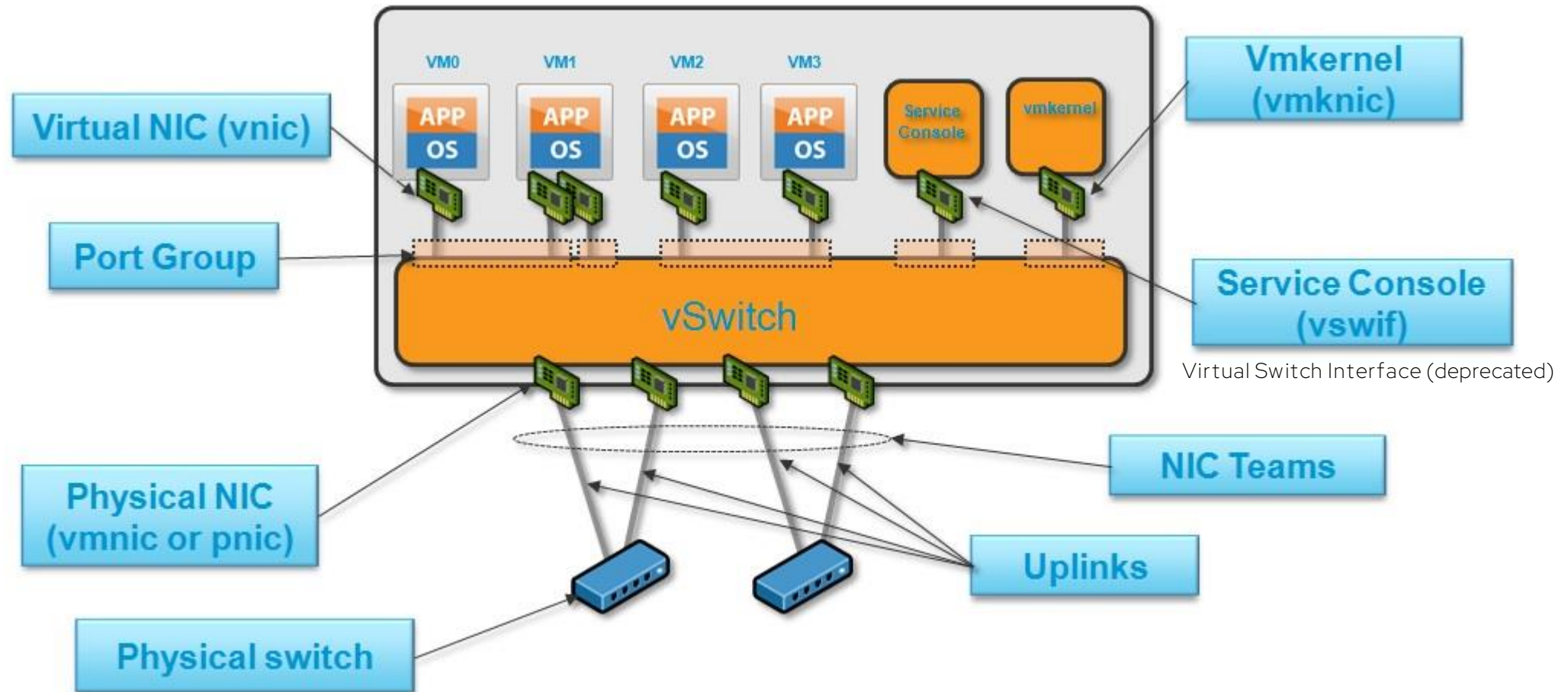
- Stage 2 - Appliance Setup



DEPLOYMENT WORKFLOW OF A VCSA



VIRTUAL NETWORKING IN VMWARE



TYPES OF TRAFFIC ON VIRTUAL NETWORK

- Virtual machine traffic
 - Traffic sourced & received from virtual machine(s)
 - Isolated from each other
- vMotion traffic
 - Traffic sent when moving a VM from 1 ESXi to another.
 - Must be dedicated and isolated.
- Management Traffic
 - Isolated from VM traffic
 - If HA is enabled, includes heartbeats
- IP Storage Traffic
 - NFS traffic, iSCSI initiator.

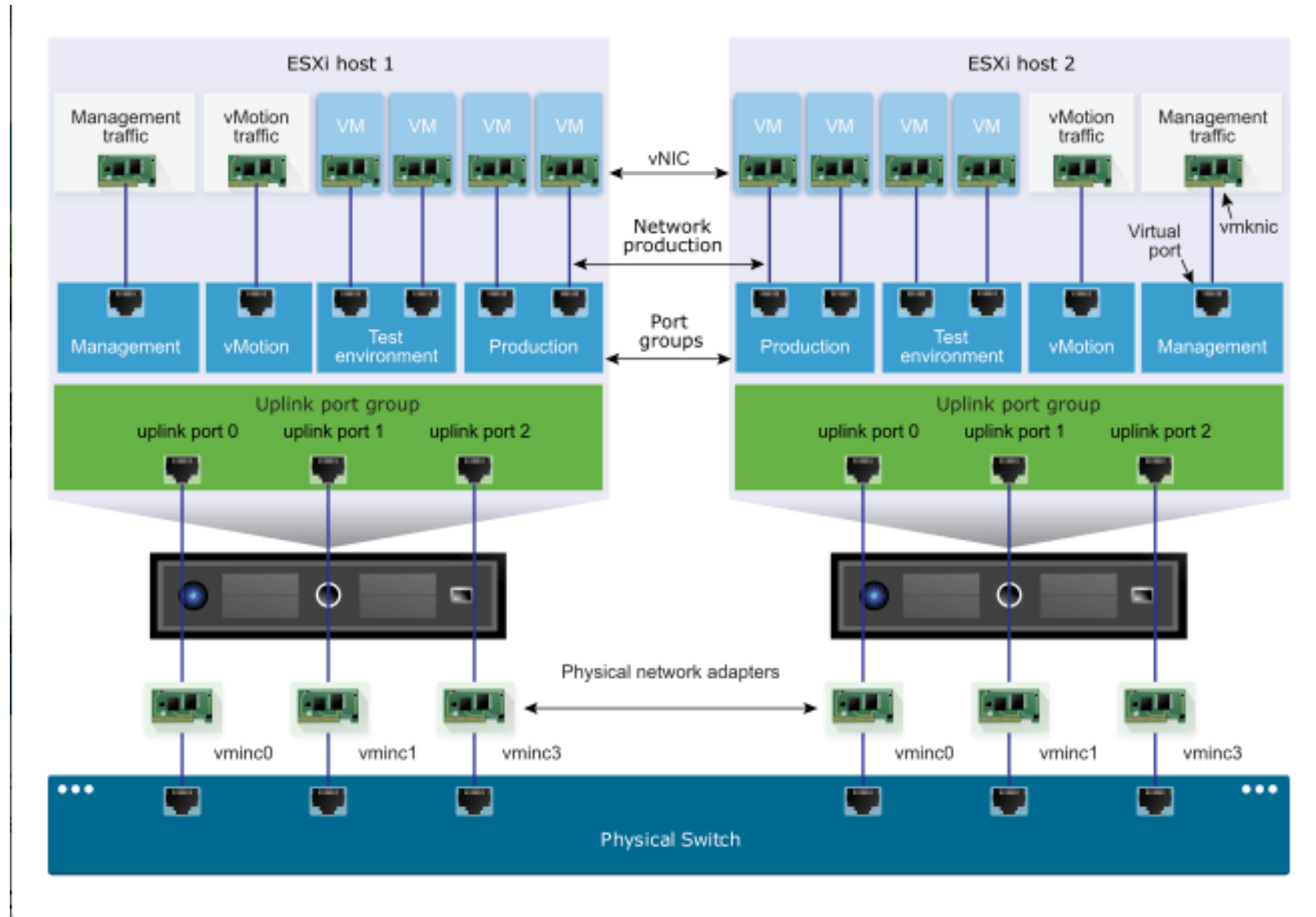


TYPES OF TRAFFIC ON VIRTUAL NETWORK

- FT Traffic
 - Heavy IOPS and low latency
- VSAN Traffic
 - Generated data during Read/Write operations performed across vSAN nodes.
- VXLAN Traffic
 - It get generates during VTEP (VXLAN tunnel endpoint) to VTEP communication in NSX
- Provisioning Traffic
 - VM clone operations generated provisioning traffic



STANDARD VIRTUAL SWITCH



STANDARD SWITCH FORWARDING RULES

- Allowed rules
 - VM \leftrightarrow VM
 - VM \leftrightarrow Uplink
- Unallowed rules
 - vSwitch \leftrightarrow vSwitch
 - Uplink \leftrightarrow Uplink
 - ESXi vSwitch till not create loops in the physical network.



NETWORKING COMPONENTS

- VMkernel Ports
 - Used for management traffic, vMotion, Fault Tolerance (FT), storage traffic (iSCSI/NFS), and other services.
 - Each VMkernel port is associated with an IP address on the host.
- Virtual Machine Port Groups
 - Allow virtual machines to connect to a specific VLAN or network segment.
 - Defines policies such as security, traffic shaping, and VLAN tagging.
- Uplink Adapters (Physical NICs)
 - Represent physical network interface cards (NICs) on the ESXi host.
 - Connect the virtual switches to the physical network.
- Network I/O Control (NIOC)
 - Provides traffic management and prioritization on distributed switches.
- VM Network
 - The logical network to which VMs are connected for communication.



VSPHERE STANDARD SWITCH (VSS)

- A Standard Switch is a virtual switch that is created and managed on individual ESXi hosts.
- Features
 - Host-specific: Configured and managed on a per-host basis.
 - Port Groups: Connect VMs to the network through virtual machine port groups.
 - VLAN Tagging: Supports VLAN tagging (802.1Q) at the port group level.
 - NIC Teaming: Provides redundancy and load balancing by combining multiple physical NICs.
 - Simple Management: Best for smaller environments without complex networking needs.
- Limitations
 - Configuration must be done manually on each ESXi host.
 - Does not provide centralized management or advanced features like Network I/O Control.



VSPHERE DISTRIBUTED SWITCH (VDS)

- A Distributed Switch is a centralized virtual switch that spans multiple ESXi hosts.
- Features
 - Centralized Management: Managed through vCenter Server, making configuration consistent across multiple hosts.
 - Port Groups: Offers distributed port groups that can be used across all hosts connected to the switch.
 - Advanced Networking: Supports features like Network I/O Control (NIOC), NetFlow, Port Mirroring, and Link Aggregation (LACP).
 - Backup & Restore: Configuration can be exported and imported for disaster recovery or migration.
 - Private VLANs (PVLANS): Enables isolation within the same VLAN.
- Benefits
 - Simplifies management of large-scale environments.
 - Ensures uniformity in network configuration.
 - Provides advanced monitoring and troubleshooting capabilities.



STANDARD SWITCH VS DISTRIBUTED SWITCH

Feature	Standard Switch (vSS)	Distributed Switch (vDS)
Management	Per host	Centralized via vCenter
Configuration Sync	Manual	Automatic across hosts
Advanced Features	Basic (VLAN, NIC Teaming)	Advanced (NIOC, PVLANs, etc.)
Monitoring	Limited	Enhanced (NetFlow, Port Mirroring)
Licensing	Included in all editions	Requires Enterprise Plus
Best Use Case	Small/simple environments	Large/complex environments

