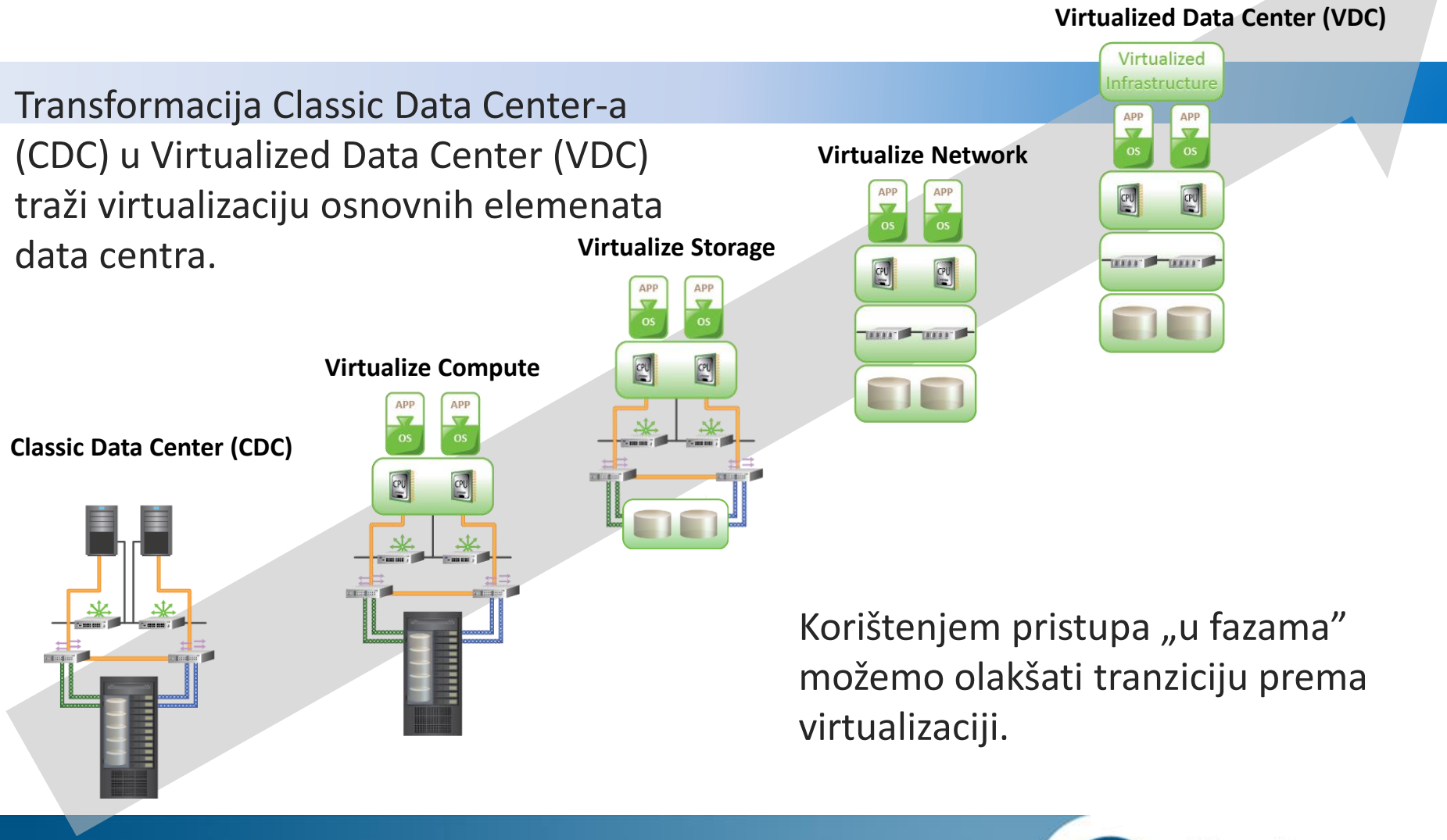
Osnovni pojmovi i terminologija u virtualizaciji

4. PREDAVANJE

Virtualized Data Center

Transformacija Classic Data Center-a (CDC) u Virtualized Data Center (VDC) traži virtualizaciju osnovnih elemenata data centra.



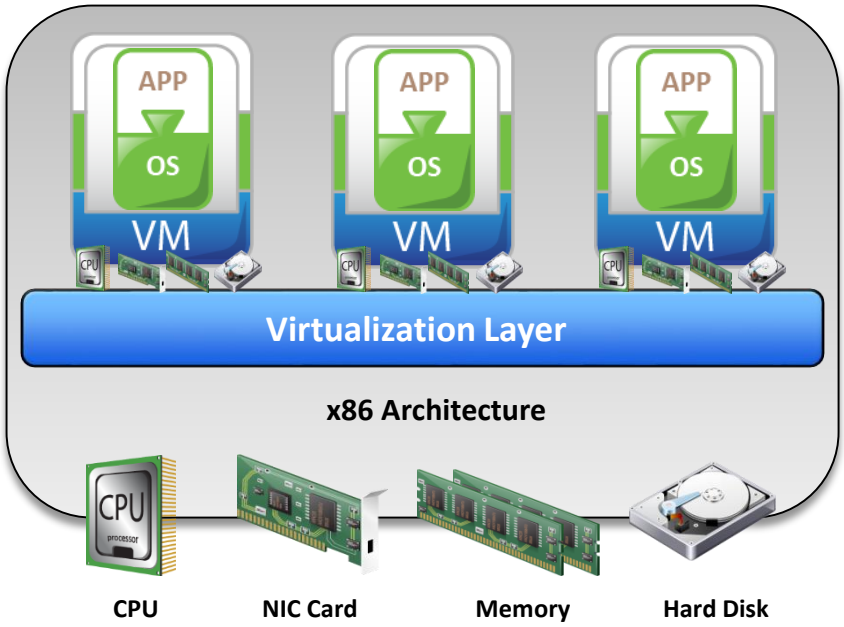
Korištenjem pristupa „u fazama” možemo olakšati tranziciju prema virtualizaciji.

Compute virtualizacija

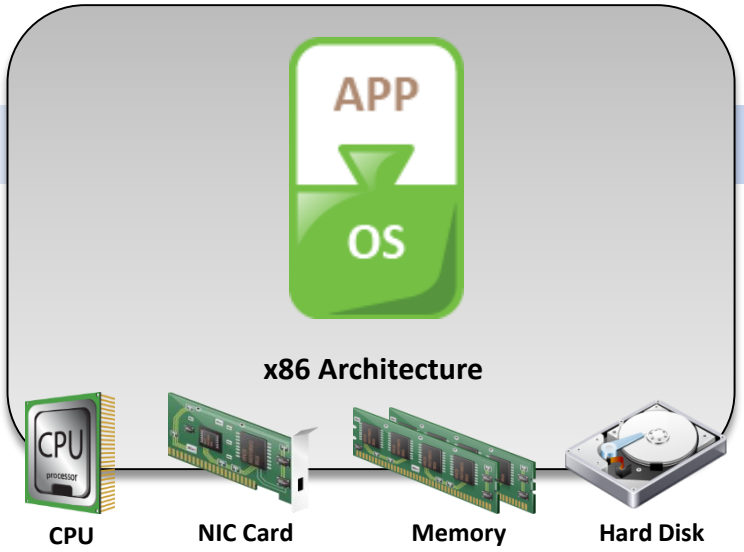
Compute Virtualization

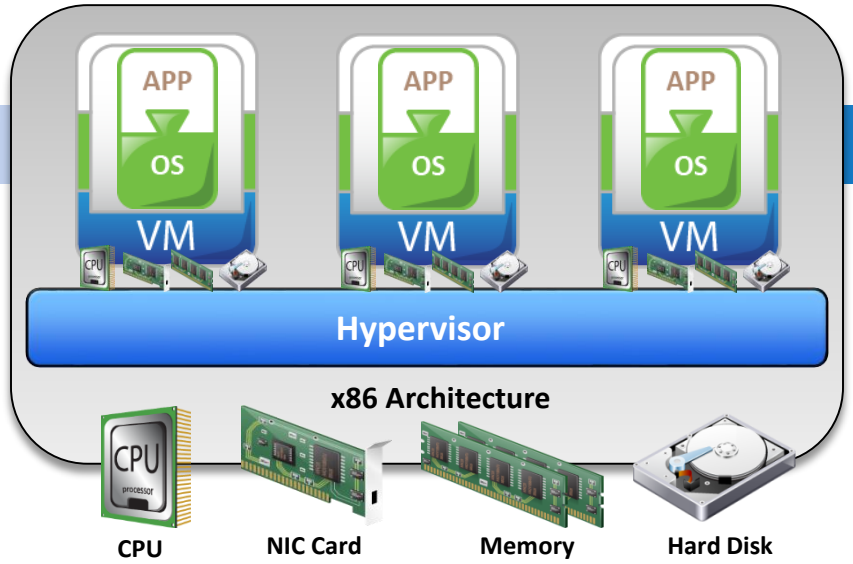
Tehnika maskiranja fizičkog compute hardvera i omogućavanje izvršavanja više OS-ova da se izvršavaju konkurentno na jednoj fizičkoj mašini ili unutar okvira klastera.

- Omogućava kreiranje više virtualnih mašina (VM), od kojih svaka ima svoj OS i aplikacije
  - VM je logički entitet koji se ponaša i izgleda kao fizička mašina
- Virtualization layer „sjedi" između hardvera i virtualnih mašina
  - To je ono što zovemo hypervisor



Potreba za Compute virtualizacijom





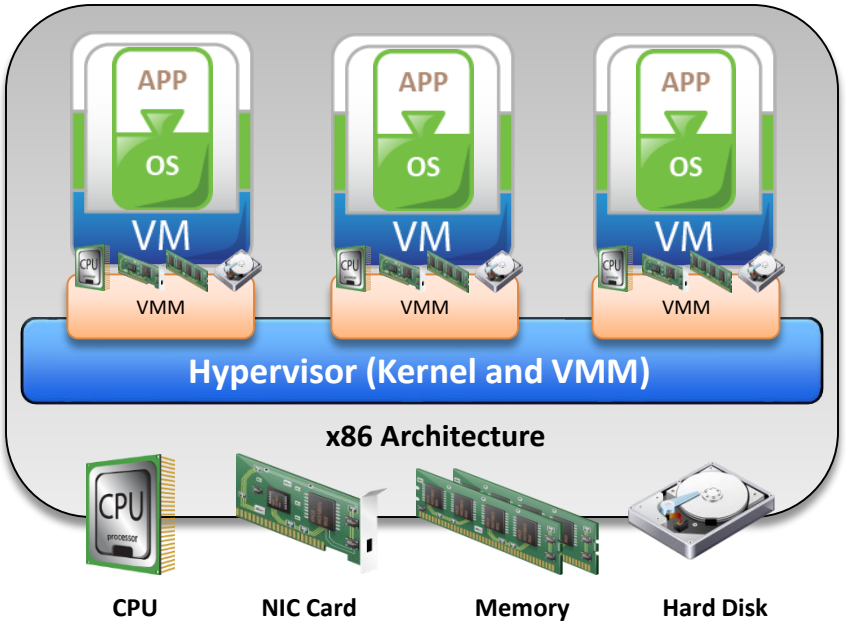
Prije virtualizacije	Nakon virtualizacije
• Jedan OS per server • Direktno „veže” HW i SW • Može doći do konflikata kada više aplikacija koristi istu fizičku mašinu • Infrastruktura obično radi ispod svojih mogućnosti, nije fleksibilna i prilično je skupa	• Više OS-ova po serveru • Odvaja OS i aplikacije od HW • Izolira virtualne mašine jednu od druge, manji konflikti • Poboljšava iskoristivost, fleksibilnost korištenja infrastrukture • Trošak - ?

Hypervisor

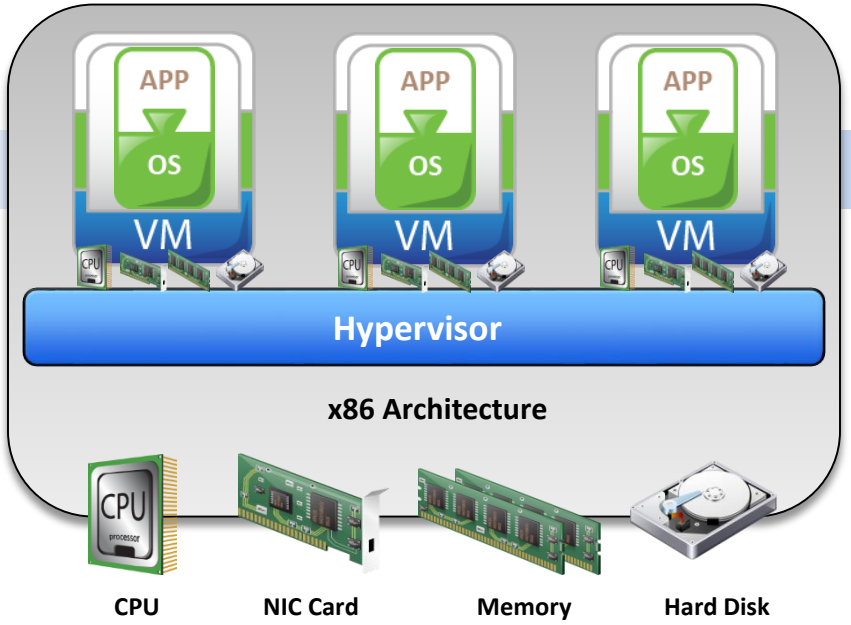
Hypervisor

Softverska komponenta koja omogućava pokretanje više OS-ova konkurentno na jednom fizičkom server u direktnu interakciju sa fizičkim hardverom.

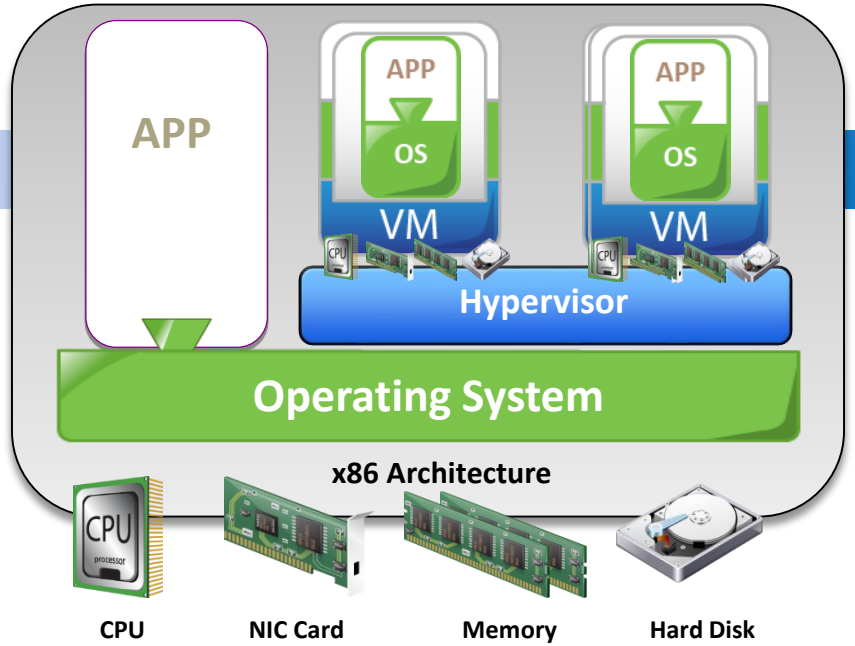
- Dvije komponente
  - *Kernel*
  - *Virtual Machine Monitor (VMM)*



Tipovi hipervizora



Type 1: Bare-Metal Hypervisor



Type 2: Hosted Hypervisor

Type 1: Bare-Metal Hypervisor

- U pitanju je operacijski sustav (OS)
- Instalira se i pokreće na x86 bare-metal hardveru
- Traži certificirani hardver

Type 2: Hosted Hypervisor

- Instalira se i pokreće kao dodatna aplikacija
- Koristi usluge OS-a za podršku pri korištenju uređaja i upravljanje resursima

Benefits of Compute Virtualization

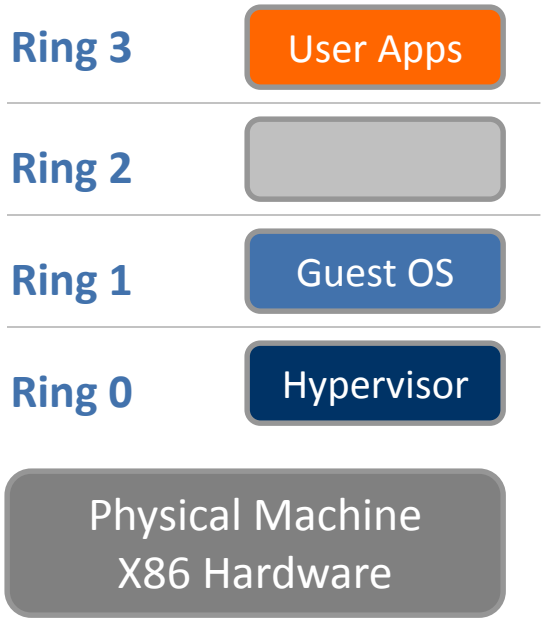
- Server consolidation
- Isolation
- Encapsulation
- Hardware independence
- Reduced cost

Requirements: x86 Hardware Virtualization

- An operating system (OS) is designed to run on a bare-metal hardware and to fully own the hardware
  - *x86 architecture offer four levels of privilege*
    - *Ring 0, 1, 2, and 3*
    - *User applications run in Ring 3*
    - *OS run in Ring 0 (most privileged)*
- Challenges of virtualizing x86 hardware
  - *Requires placing the virtualization layer below the OS layer*
  - *Is difficult to capture and translate privileged OS instructions at runtime*
- Techniques to virtualize compute
  - *Full, Para, and hardware assisted virtualization*

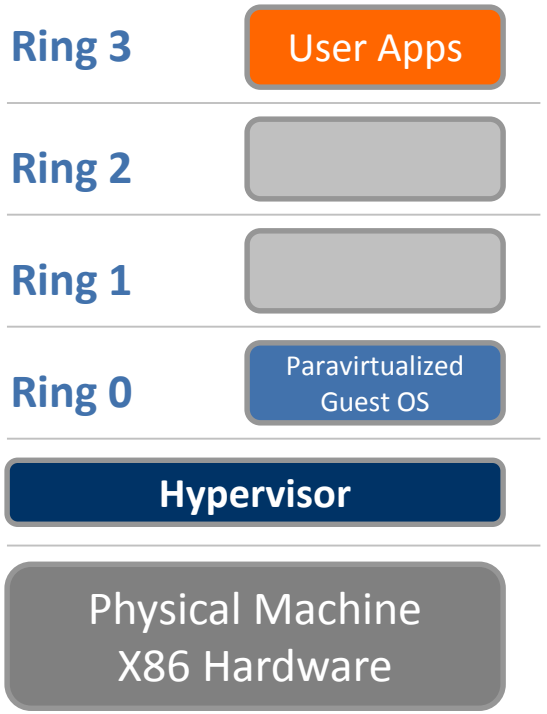
Full Virtualization

- Virtual Machine Monitor (VMM) runs in the privileged Ring 0
- VMM decouples guest operating system (OS) from the underlying physical hardware
- Each VM is assigned a VMM
  - Provides virtual components to each VM
  - Performs Binary Translation (BT) of non-virtualizable OS instructions
- Guest OS is not aware of being virtualized



Paravirtualization

- Guest operating system (OS) knows that it is virtualized
- Guest OS runs in Ring 0
- Modified guest OS kernel is used, such as Linux and OpenBSD
- Unmodified guest OS is not supported, such as Microsoft Windows

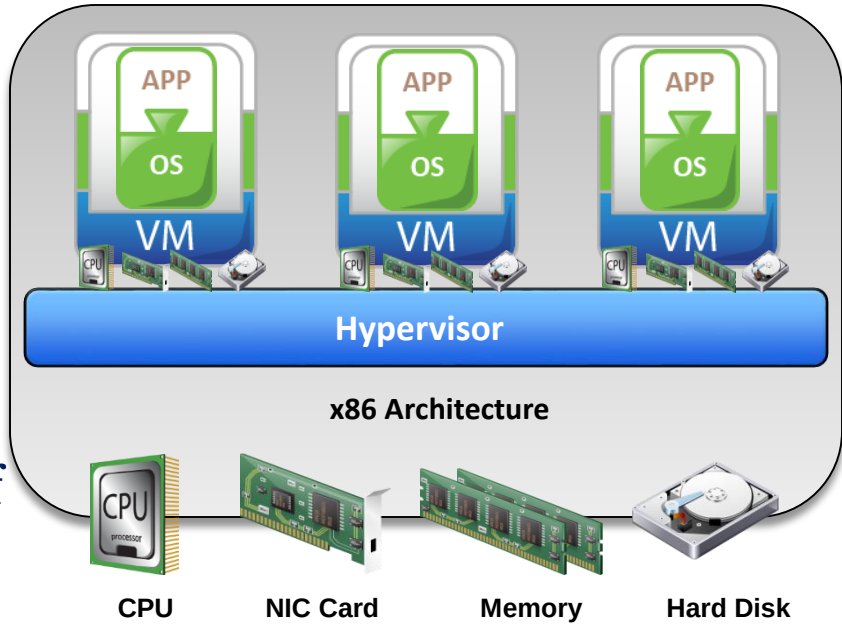


Hardware Assisted Virtualization

- Achieved by using hypervisor-aware CPU to handle privileged instructions
  - Reduces virtualization overhead caused due to full and paravirtualization
  - CPU and Memory virtualization support is provided in hardware
- Enabled by AMD-V and Intel VT technologies in the x86 processor architecture

Virtual Machine

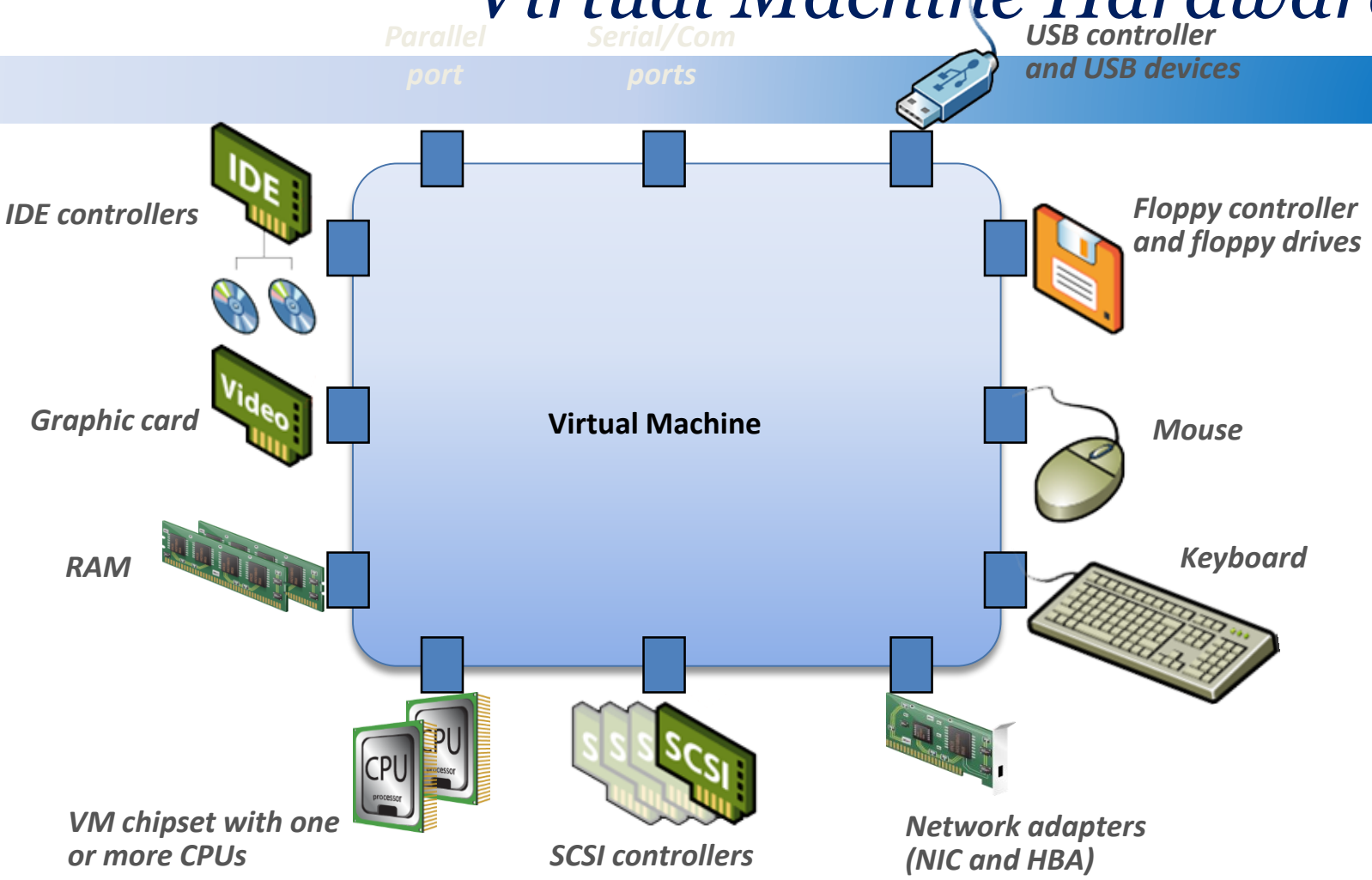
- From a user's perspective, a logical compute system
  - Runs an operating system (OS) and application like a physical machine
  - Contains virtual components such as CPU, RAM, disk, and NIC
- From a hypervisor's perspective
  - Virtual machine (VM) is a discrete set of files such as configuration file, virtual disk files, virtual BIOS file, VM swap file, and log file



Virtual Machine Files

File name	Description
Virtual BIOS File	• Stores the state of the virtual machine's (VM's) BIOS
Virtual Swap File	• Is a VM's paging file which backs up the VM RAM contents • The file exists only when VM is running
Virtual Disk File	• Stores the contents of the VM's disk drive • Appears like a physical disk drive to VM • VM can have multiple disk drives
Log File	• Keeps a log of VM activity • Is useful for troubleshooting
Virtual Configuration File	• Stores the configuration information chosen during VM creation • Includes information such as number of CPUs, memory, number and type of network adaptors, and disk types

Virtual Machine Hardware



VM Hardware Components

Virtual Hardware	Description
vCPU	• Virtual machine (VM) can be configured with one or more virtual CPUs • Number of CPUs allocated to a VM can be changed
vRAM	• Amount of memory presented to the guest operating system (OS) • Memory size can be changed based on requirement
Virtual Disk	• Stores VM's OS and application data • A VM should have at least one virtual disk
vNIC	• Enables a VM to connect to other physical and virtual machines
Virtual DVD/CD-ROM Drive	• It maps a VM's DVD/CD-ROM drive to either a physical drive or an .iso file
Virtual Floppy Drive	• It maps a VM's floppy drive to either a physical drive or an .flp file
Virtual SCSI Controller	• VM uses virtual SCSI controller to access virtual disk
Virtual USB Controller	• Maps VM's USB controller to the physical USB controller

Virtual Machine Console

- Provides mouse, keyboard, and screen functionality
- Sends power changes (on/off) to the virtual machine (VM)
- Allows access to BIOS of the VM
- Typically used for virtual hardware configuration and troubleshooting issues

Resource Management

Resource management

A process of allocating resources from physical machine or clustered physical machines to virtual machines (VMs) to optimize the utilization of resources.

- Goals of resource management
  - *Controls utilization of resources*
  - *Prevents VMs from monopolizing resources*
  - *Allocates resources based on relative priority of VMs*
- Resources must be pooled to manage them centrally

Resource Pool

Resource pool

It is a logical abstraction of aggregated physical resources that are managed centrally.

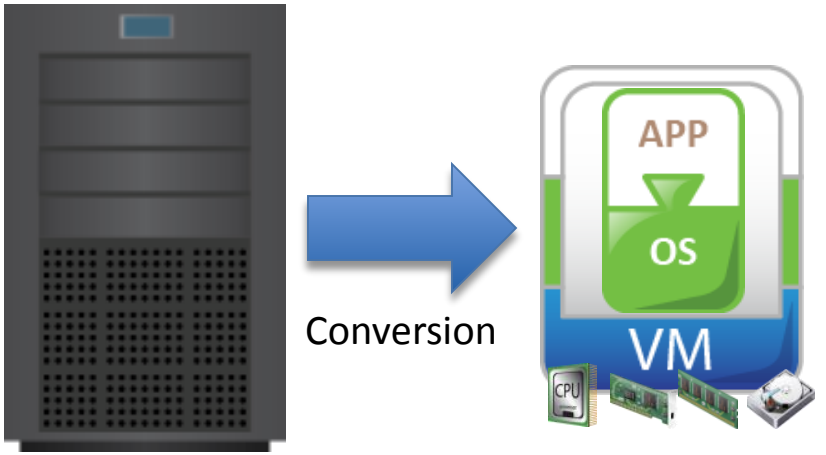
- Created from a physical machine or cluster
- Administrators may create child resource pool or virtual machine (VM) from the parent resource pool
- Reservation, limit, and share are used to control the resources consumed by resource pools or VMs

Physical to Virtual Machine (P2V) Conversion

P2V Conversion

It is a process through which physical machines are converted into virtual machines (VMs).

- Clones data from physical machine's disk to VM disk
- Performs system reconfiguration of the destination VM such as:
  - Change IP address and computer name
  - Install required device drivers to enable the VM to boot



Conversion Options

- Hot conversion
  - *Occurs while physical machine is running*
  - *Performs synchronization*
    - *Copies blocks that were changed during the initial cloning period*
  - *Performs power off at source and power on at target virtual machine (VM)*
  - *Changes IP address and machine name of the selected machine, if both machines must co-exist on the same network*
- Cold conversion
  - *Occurs while physical machine is not running OS and application*
  - *Boots the physical machine using converter boot CD*
  - *Creates consistent copy of the physical machine*