Introduction to Virtualization

From NDG In partnership with VMware IT Academy
www.vmware.com/go/academy

vmware IT ACADEMY

NDG

Why learn virtualization?

vmware IT ACADEMY

NDG

- Modern computing is more efficient due to virtualization
- Virtualization can be used for mobile, personal and cloud computing
- You can also use virtualization in your personal life

vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

Course Sections Covered

- Module 2 – Introduction to Virtualization
- Module 3 – The Hypervisor
- Module 4 – The Data Center
- Module 5 – The Virtual Data Center
- Module 6 – VMware Virtualization Solutions

Content will cover :

- Understand the benefits of virtualization
- Be able to describe virtualization, virtual machines and hypervisors
- Describe typical data center components that are virtualized
- Become familiar with VMware technology popular in industry

© Network Development Group reserved for use with NDG.tech/vmware content

Why virtualization?

- Have you ever wished you could clone yourself?
- If you could, would you be more efficient? Would you do more?
- Virtualization enables computers to be more efficient in a similar fashion
- Computers that use virtualization optimize the available compute resources

vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

What is virtualization?

Hardware and Software

- Do you use a smartphone, laptop or home computer?
- Smartphones, laptops or home computers are hardware
- Similar to how your brain controls your actions, software controls hardware
- There are different types of software that control computer actions

vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

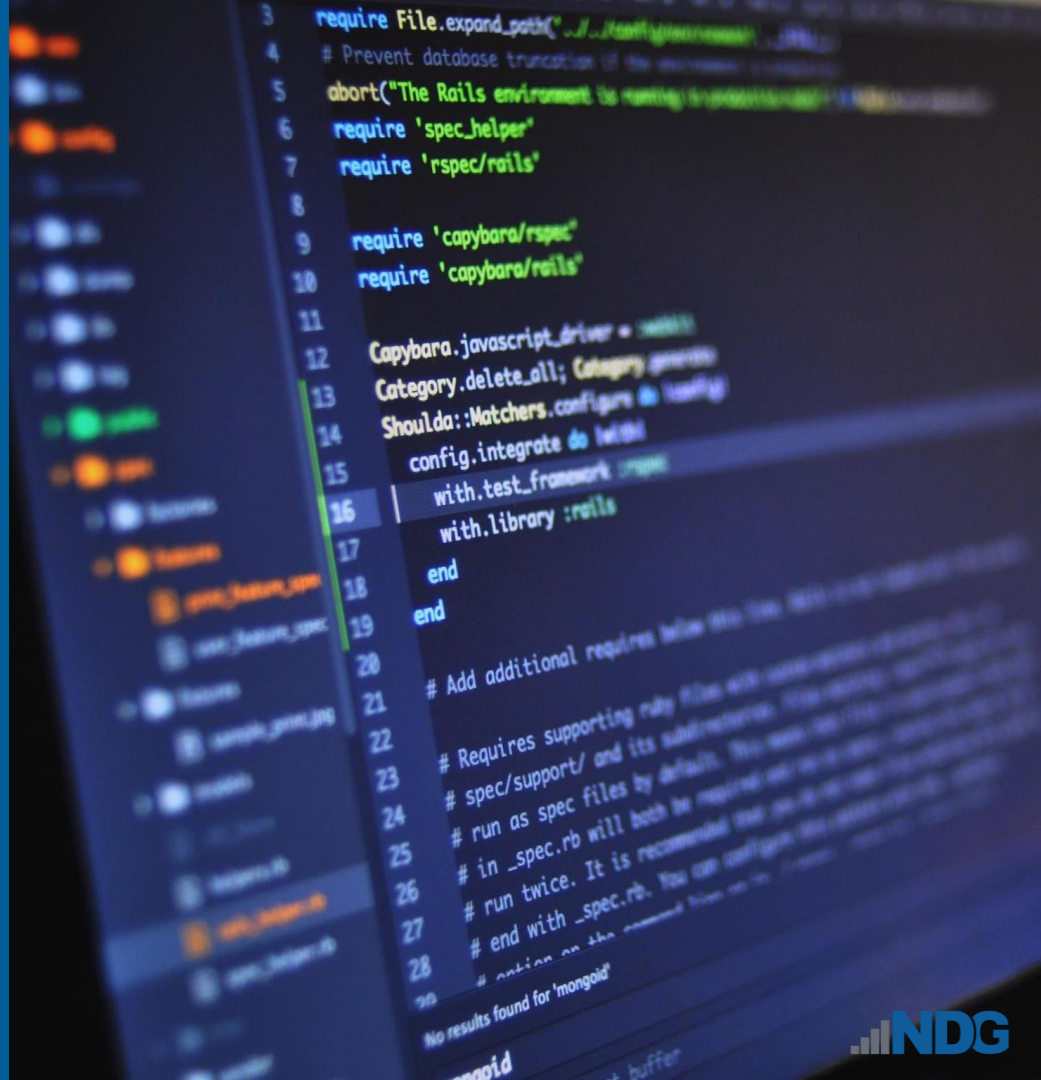
Hardware

Processor	- Also called CPU (Central Processing Unit)
RAM	- Random Access Memory
Read-Only Memory	- Non-volatile memory that stores BIOS *BIOS is type of software responsible for turning on (booting) computer
Motherboard	- Printed Circuit Board (PCB) that holds processor, RAM, ROM, network and Input/Output (I/O) and other components.
Chipset	- Collection of microchips on motherboard that manage specific functions.
Storage	- A persistent (non-volatile) storage device such as a Hard Drive Disk or Solid State Drive

© Network Development Group reserved for use with NDG.tech/vmware content

Software

- System software is necessary for hardware to function
- Operating system controls the hardware
- Application software tells your system to execute a task you want

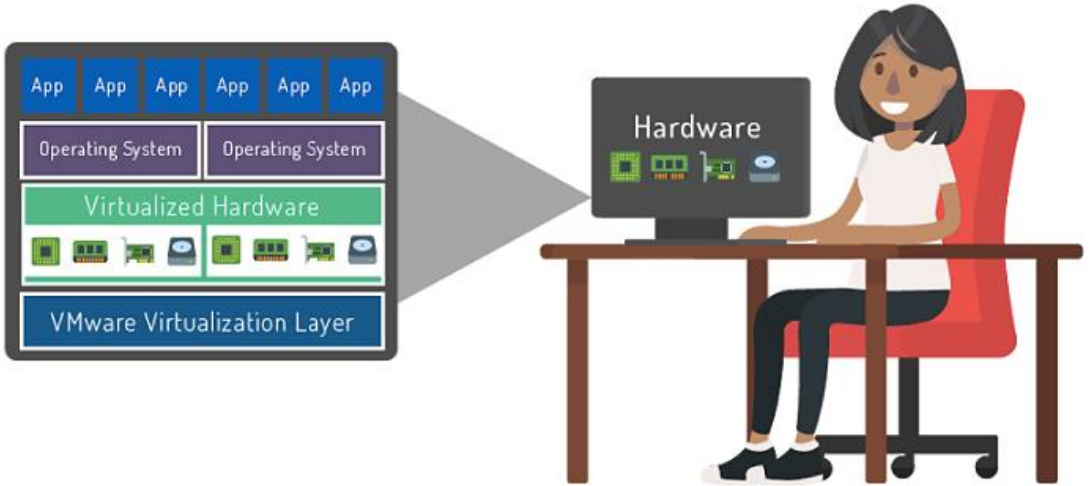


vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

Now that you are aware of the roles of hardware and software, the concept of virtualization will be easier to grasp. Virtualization is the "layer" of technology that goes between the physical hardware of a device and the operating system to create one or more copies of the device.



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

What is a VM?

- Virtualization creates virtual hardware by cloning physical hardware
- The hypervisor uses virtual hardware to create a virtual machine (VM)
- A VM is a set of files
- With a hypervisor and VMs, one computer can run multiple OS simultaneously

vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

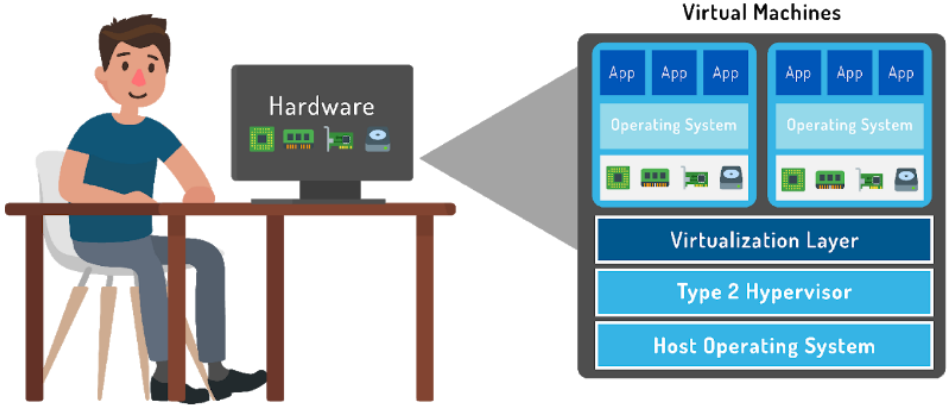
NDG

The Hypervisor

vmware
IT ACADEMY

NDG

What is a Hypervisor?



- Software installed on top of hardware that created virtualization layer
- Hosts VMs
- Type 1 Hypervisor – Bare metal hypervisor (VMware ESXi)
- Type 2 Hypervisor – Hosted hypervisor (VMware Workstation)

vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

Virtual Machine Files

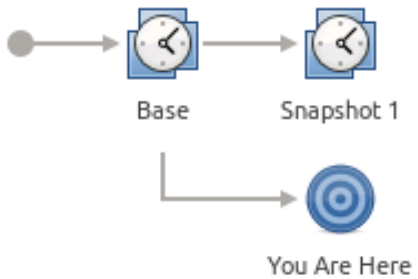
- VMs can be exported and moved to other hosts
- Files are created by the hypervisor and stored in a directory
- Example VM files:

File Type	File Name	Description
Log File	<vmname>.log	Keeps a log of VM activity
Disk File	<vmname>.vmdk	Stores content of VM's disk drive
Snapshot Files	<vmname>.vmsd and <vmname>.vmsn	Stores information about VM snapshots (saved VM state)
Configuration File	<vmname>.vmx	Stores information about VM name, BIOS, guest OS, and memory

© Network Development Group reserved for use with NDG.tech/vmware content

What is a snapshot?

- Working on a VM and need to save progress or state
- Snapshots are saved as files in the VM folder (`<vmname>.vmx`)
- What is saved by a snapshot?
  - State of VM disks
  - Contents of VM memory
  - VM settings



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

The Data Center

vmware IT ACADEMY

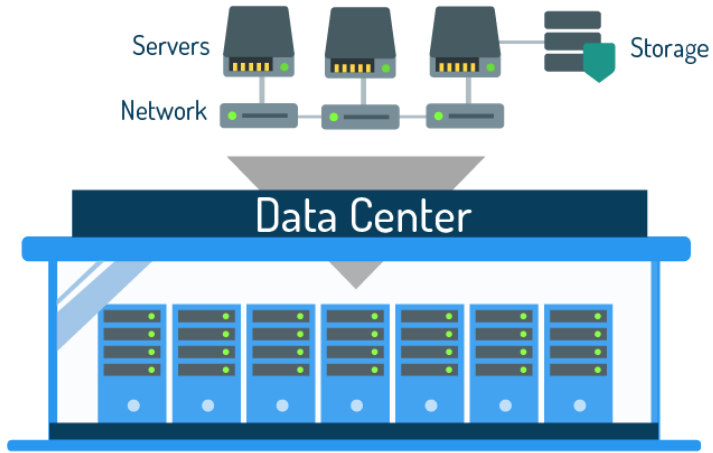
NDG

What is a Data Center?

- **Hardware** infrastructure that supports virtualization

- Focus is on processing large amounts of data

- What are the three main components?
  - Compute
  - Storage
  - Networks



© Network Development Group reserved for use with NDG.tech/vmware content

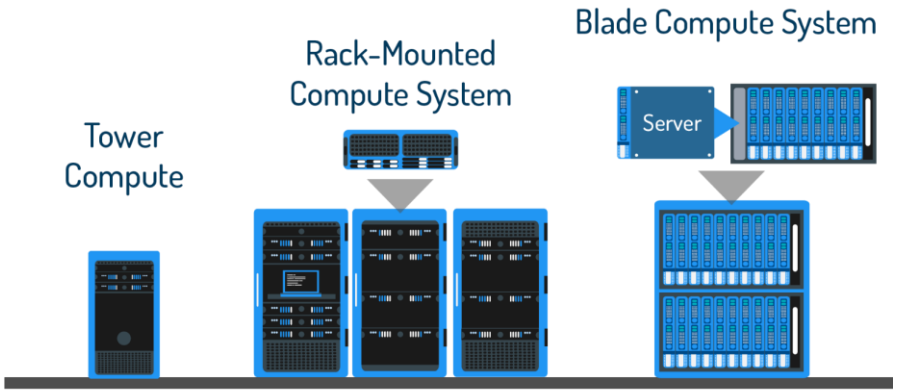
Compute Systems

- Hardware and operating system software that runs applications

- Difference between a PC and a server
  - PCs have user-friendly interface while servers focus on running programs

- Types of servers:
  - Tower
  - Blade server
  - Rack-mounted server

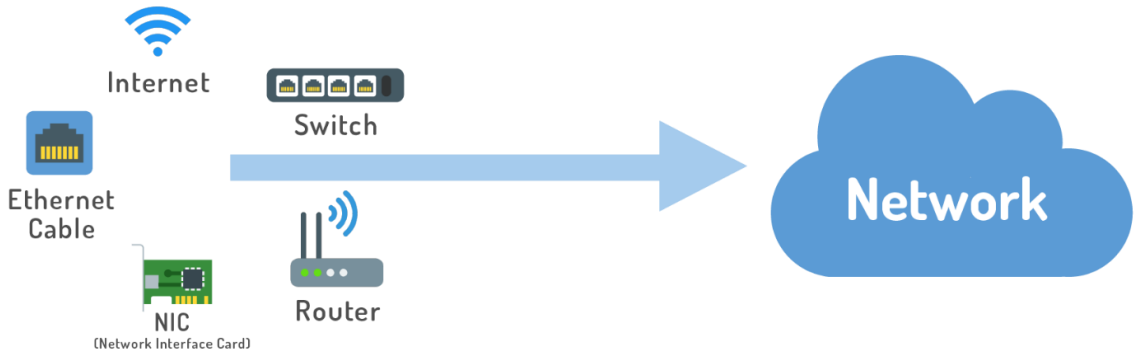
- What is the architecture of a server?



© Network Development Group reserved for use with NDG.tech/vmware content

Networks

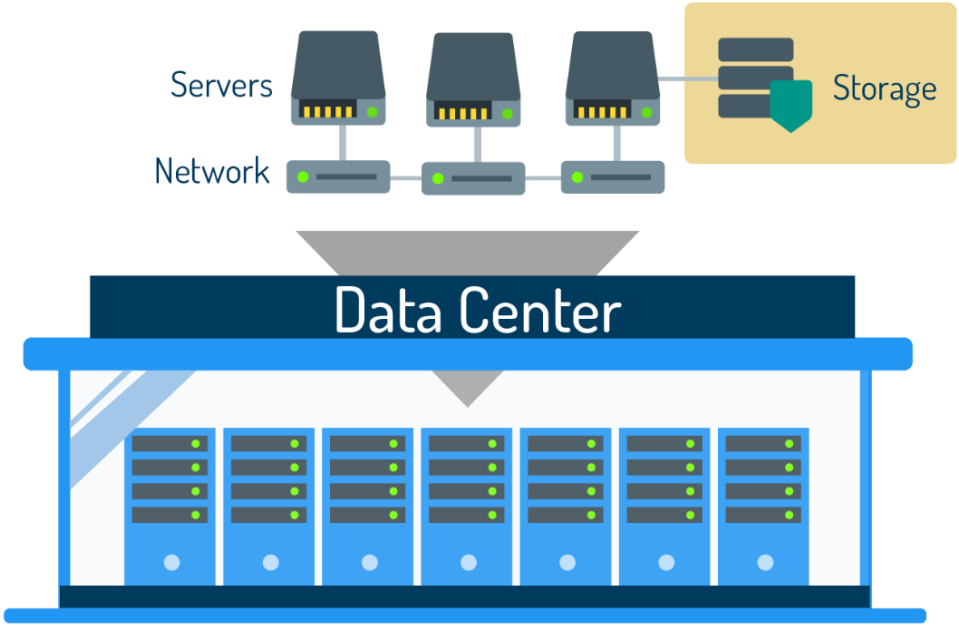
- Transfer data across the data center so devices can communicate
- What type of hardware is used for networking?



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Storage

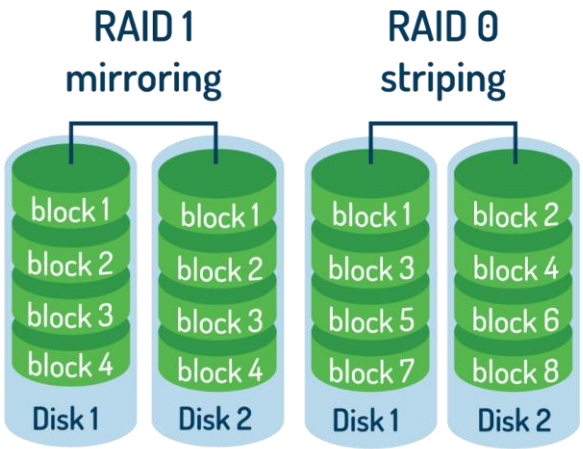
- Data center storage should have two features: **availability** and **redundancy**



© Network Development Group reserved for use with NDG.tech/vmware content

Storage - RAID

- **R**edundant **A**rray of **I**ndependent **D**isks
- Hard drives linked together to create a large volume of **redundant** storage
- What are the three methods of writing to RAID?
  - Mirroring
  - Striping
  - Parity
- What do the RAID numbers mean (i.e., 0, 1, 5)?

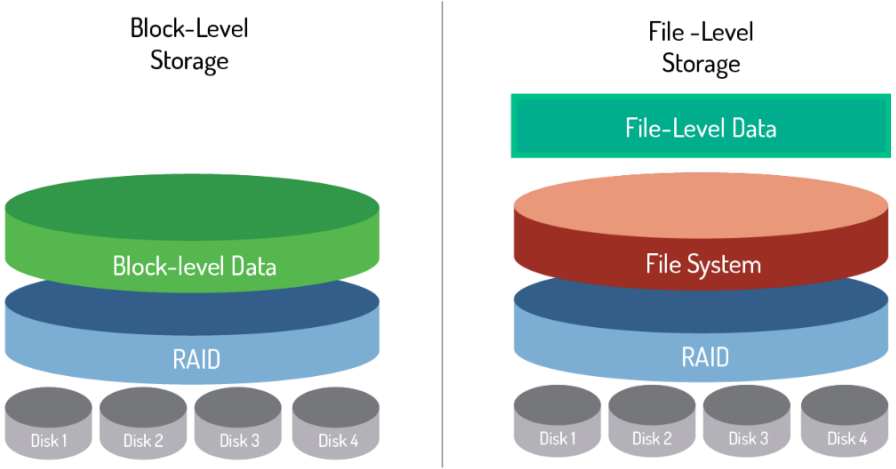


© Network Development Group reserved for use with NDG.tech/vmware content

Storage - Block vs. File Level

- **Block-Level Storage** – Data is written to and accessed from storage volumes (blocks)

- **File-Level Storage** – Data is written to disks but accessed from default file system



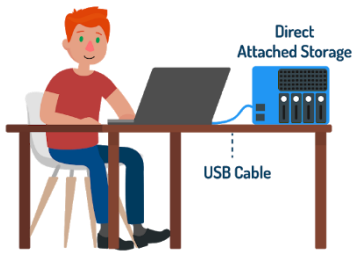
vmware IT ACADEMY

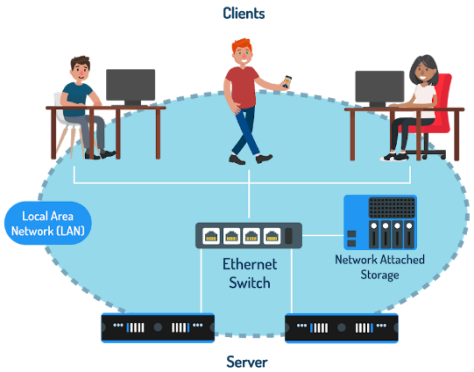
© Network Development Group reserved for use with NDG.tech/vmware content

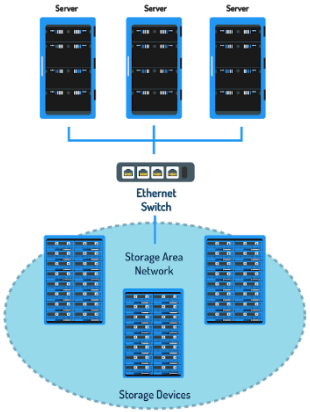
NDG

Storage – Types of Data Center Storage

- **DAS** – Storage device is directly attached to a server (block-level)
- **NAS** – Storage device is attached to a network, servers on the network can access device (file-level)
- **SAN** – Clustered storage devices on their own network that servers can connect to (block-level)







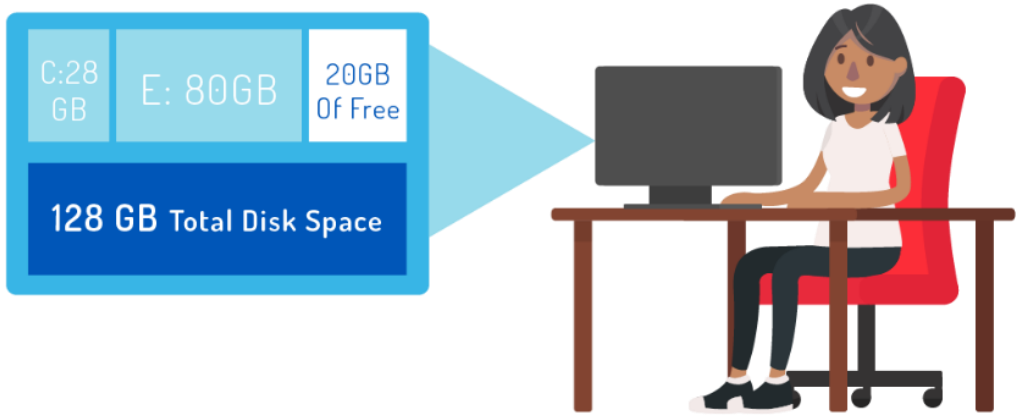
© Network Development Group reserved for use with NDG.tech/vmware content

Protocol	Application
SCSI (Internet Small Computer System Interface	Medium-sized blade servers, Enterprise servers, DAS
FC (Fiber Channel)	Enterprise servers, SAN
FCoE (Fiber Channel over Ethernet)	Enterprise servers, SAN
iSCSI (Internet Small Computer System Interface)	Enterprise servers, NAS

© Network Development Group reserved for use with NDG.tech/vmware content

Storage Provisioning

- **Thick provisioning:** Disk space is strategically pre-allocated to a server, or a VM. This means that the logical space provided by partitioning is equal to the amount of actual physical space set aside on the physical disk.



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Virtual Data Center

vmware IT ACADEMY

NDG

Benefits of a Virtual Data Center

- Data centers use a lot of hardware and virtualization makes hardware more efficient
- Increased computing resources results in higher **availability** of applications
- Less labor needed to monitor data center (administrator can monitor from desk using a program)
- **Software-defined data center (SDDC):** Hypervisor pools physical data center resources into a virtual data center

© Network Development Group reserved for use with NDG.tech/vmware content

What is vSphere?

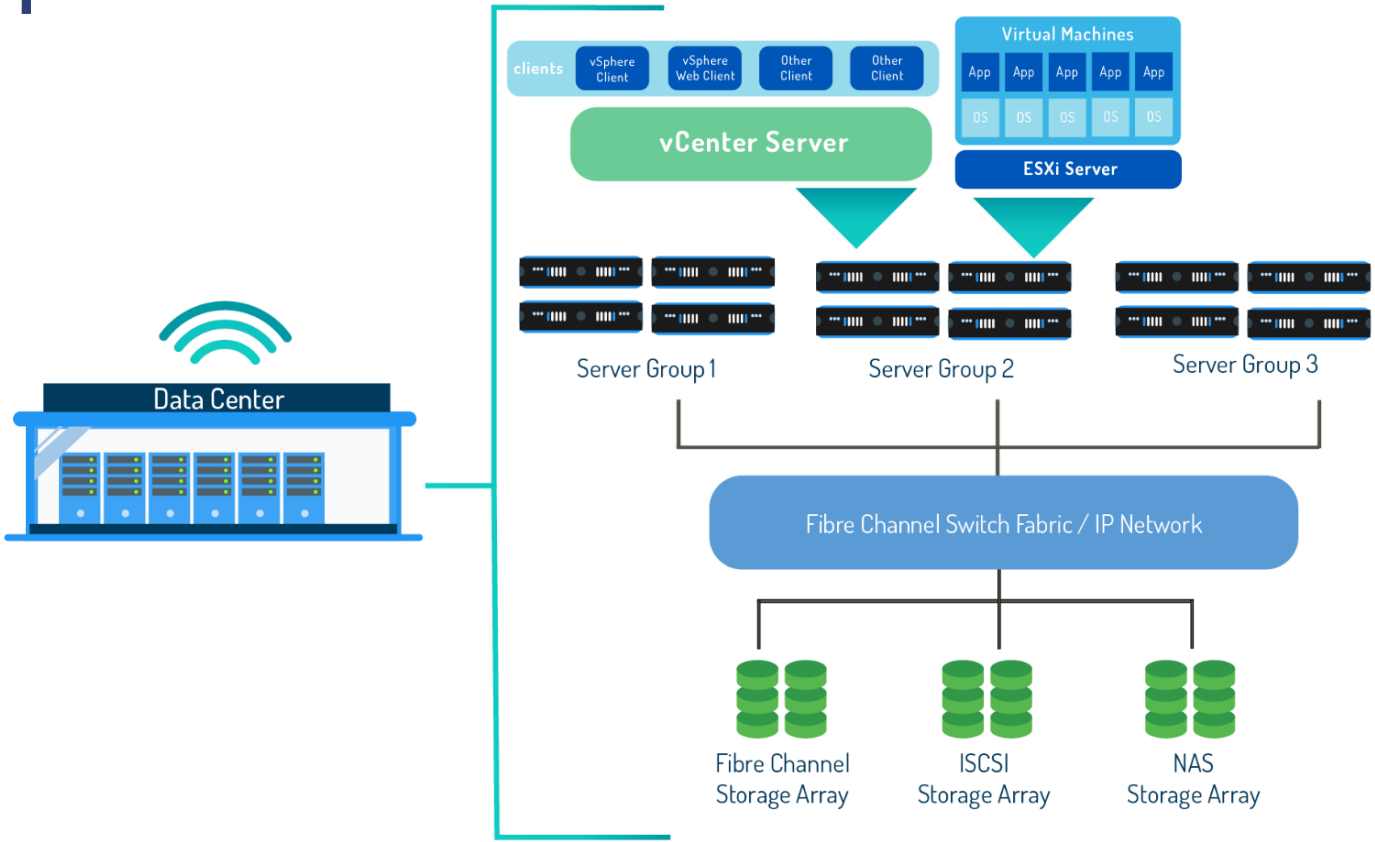
- Suite of virtualization technology designed for larger enterprise data center management

- vSphere virtualization tools include:
    - **ESXi**: Type 1 Hypervisor
    - **vCenter**: Management software (installed on management server)
    -

vSphere Client: Program that controls host servers and VMs

© Network Development Group reserved for use with NDG.tech/vmware content

vSphere



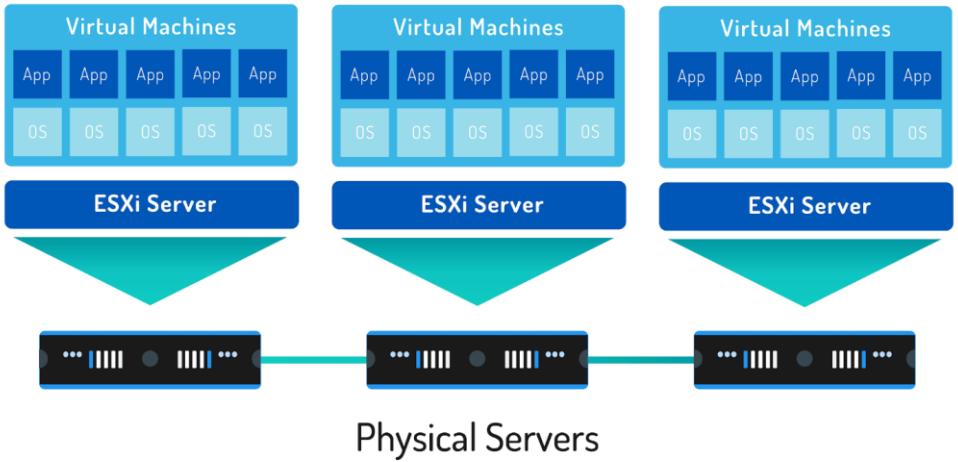
© Network Development Group reserved for use with NDG.tech/vmware content

What is ESXi?

- ESXi is VMware's Type 1 hypervisor software installed directly on the physical server and creates the virtual layer

- Components of ESXi:
  - Unix Microkernel
  - VMware Kernel

(VMkernel)



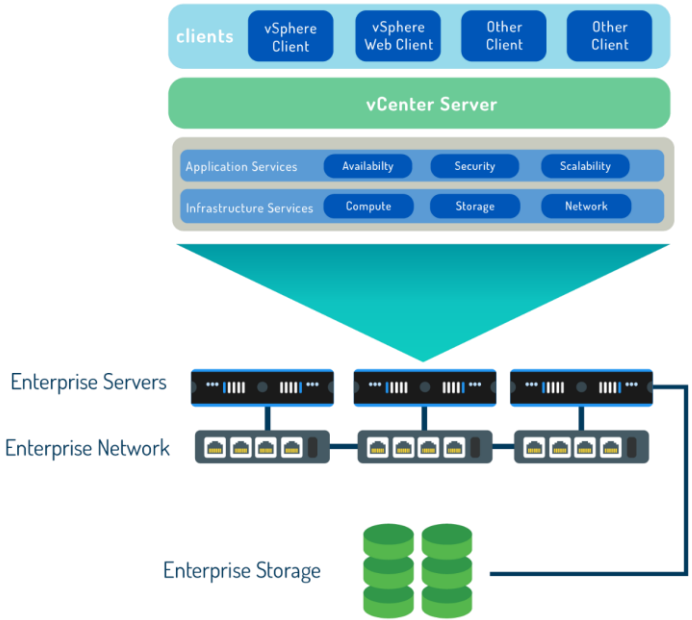
vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

vCenter and vSphere Client

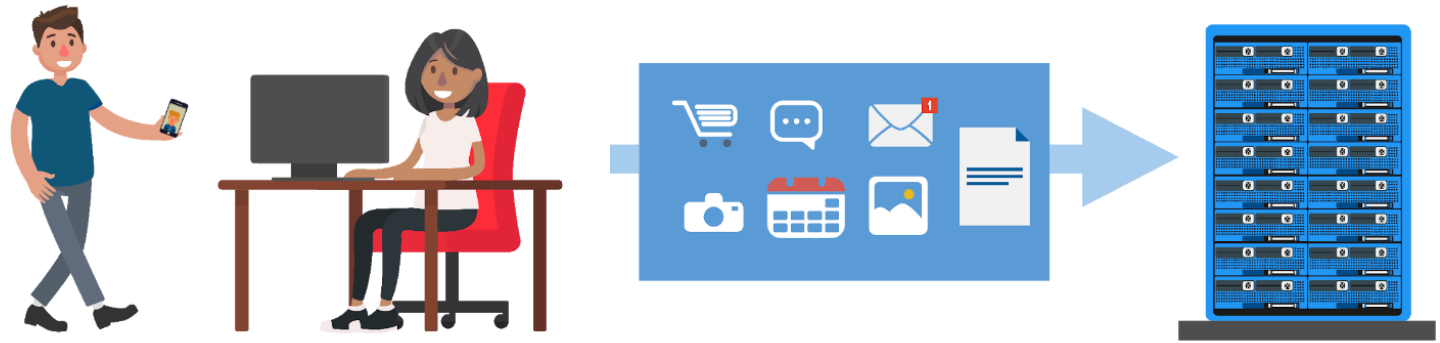
- **vCenter**: Software installed on a dedicated server to manage ESXi servers and other components of a virtualized data center
- **vSphere Client**: Program with a graphical user interface (GUI) that allows data center administrators to connect to vCenter and ESXi remotely



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Server Virtualization

- Results in increased efficiency of data center servers because multiple VMs can be hosted on one server
- Computing resources can be distributed to customers using less hardware

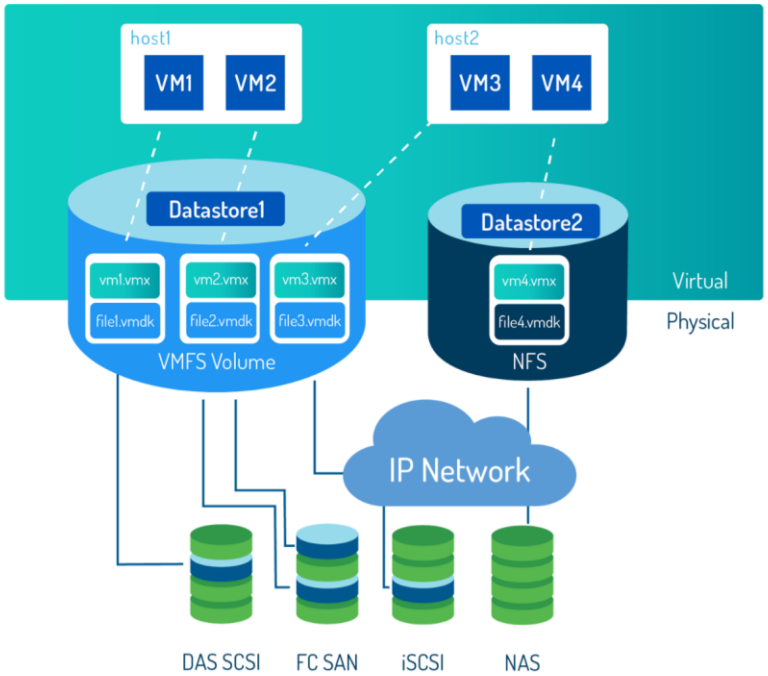


© Network Development Group reserved for use with NDG.tech/vmware content

Storage Virtualization

- Storage capacity is pooled and distributed to the VMs
  - Physical storage devices are partitioned into logical storage (**LUNs**)
  - LUNs are used to create a **datastore**

- How do VMs access data center storage?
  - VMs are stored as VMDK (*.vmdk*) files on datastore
  - VM configuration files (VM settings) are stored as VMX (*.vmx*) files



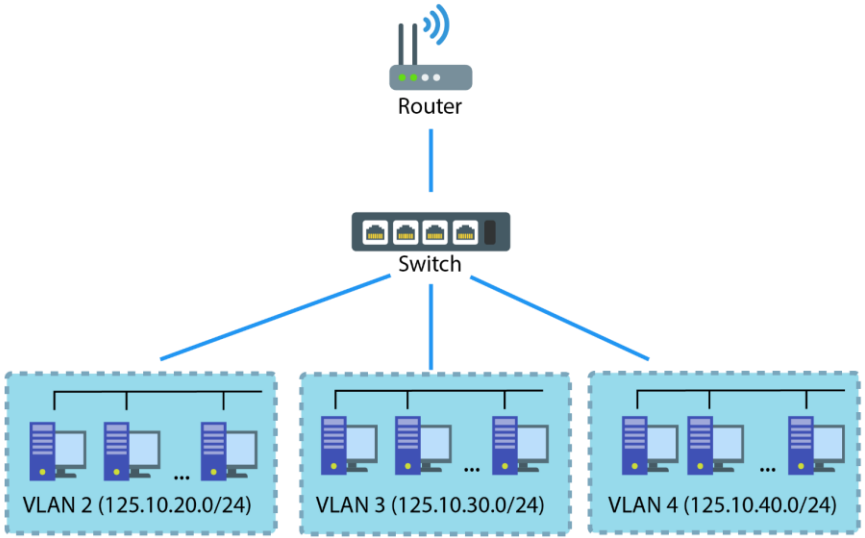
© Network Development Group reserved for use with NDG.tech/vmware content

Network Virtualization

- Physical components that make up the physical network are virtualized to create a *virtual network*

- What is a vSwitch?
  - Virtual switch that virtual devices can connect to in order to communicate with each other

- What is a vLAN?
  - Virtual Local Area Network that is segmented into groups of ports isolated from one another, creating different network *segments*



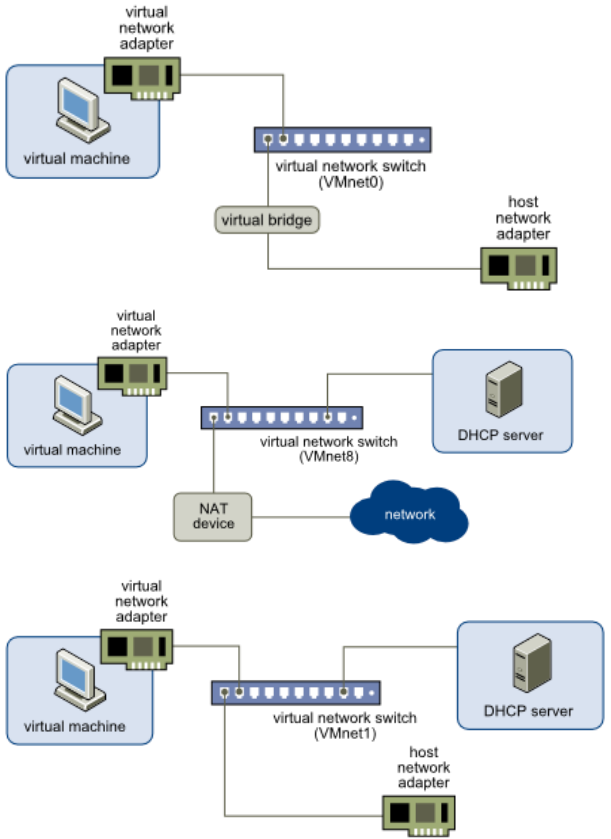
© Network Development Group reserved for use with NDG.tech/vmware content

Types of Virtual Networks

- **Bridged Network**: The host server and the VM are connected to the same network, and the host shares its IP address with the VM

- **NAT**: VMs use an IP translated from the host's IP (using NAT device) and communicate on a private network set up on the host computer

- **Host-only Network**: VMs use a private network but do not have translated IP addresses to connect to external network, therefore can only communicate to other VMs on the isolated host network



© Network Development Group reserved for use with NDG.tech/vmware content

Application and Desktop Virtualization

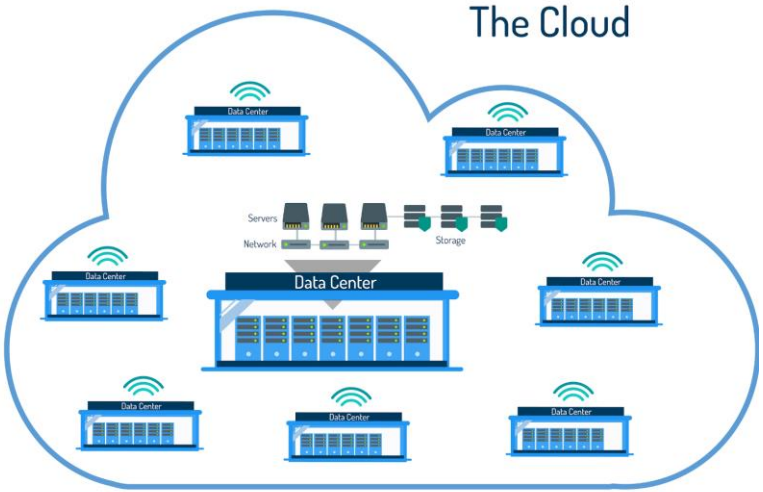
- Why use virtualized applications?
  - Some applications have specific system requirements
  - VMware **Thinapp** creates a packaged virtual app, that contains the program and system requirements, and delivers it to the end-user

- What is desktop virtualization?
  - Designed to solve computing resource issues faced by the mobile workforce (workers that need computing without the hardware)
  - VMware **Horizon** takes the resources needed to create a desktop environment from data centers and delivers it to the end-user's device

© Network Development Group reserved for use with NDG.tech/vmware content

The Cloud

- Cloud computing is the delivery of shared computing resources (software and/or data) on-demand through the internet



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Convergence

- **Convergence**: Moving from a traditional hardware-based server model to a virtual data center

- Two strategies:
  - **Containment**: Not deploying any existing applications for customers on virtual servers. Maintain applications running on the hardware-based data center.
  - **Consolidation**: Moving applications that are running in the old hardware-based data center model using VMware P2V technology

© Network Development Group reserved for use with NDG.tech/vmware content

VMware Solutions

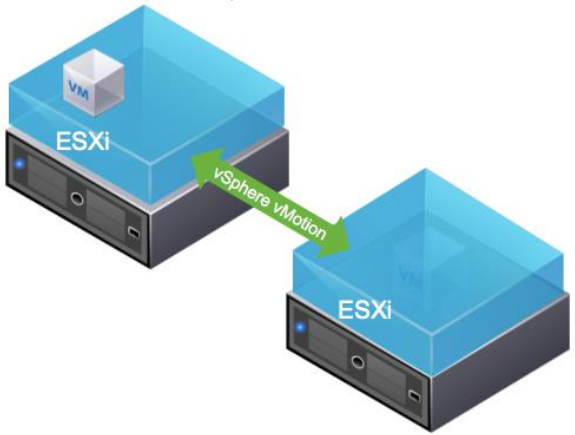
vmware IT ACADEMY

NDG

vMotion

- Move running virtual machines from one ESXi host to another ESXi host without service interruption (live migration)

- Increases **availability** of data and computing resources

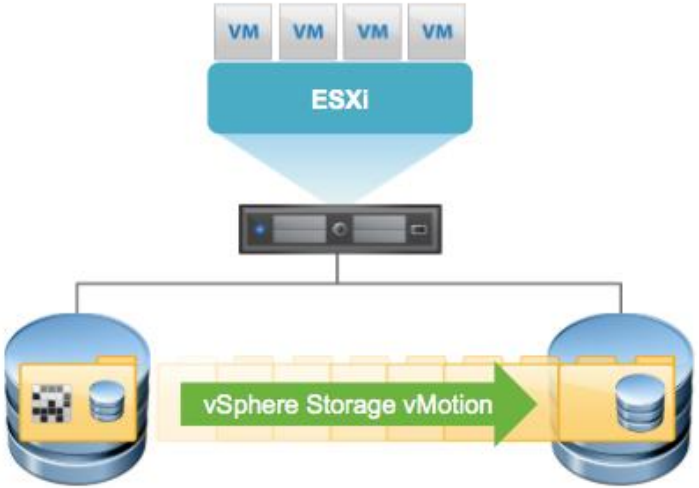


vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Storage vMotion

- Move the disks and configuration files of a running virtual machine from one datastore to another datastore without service interruption

- Increases **availability** of storage



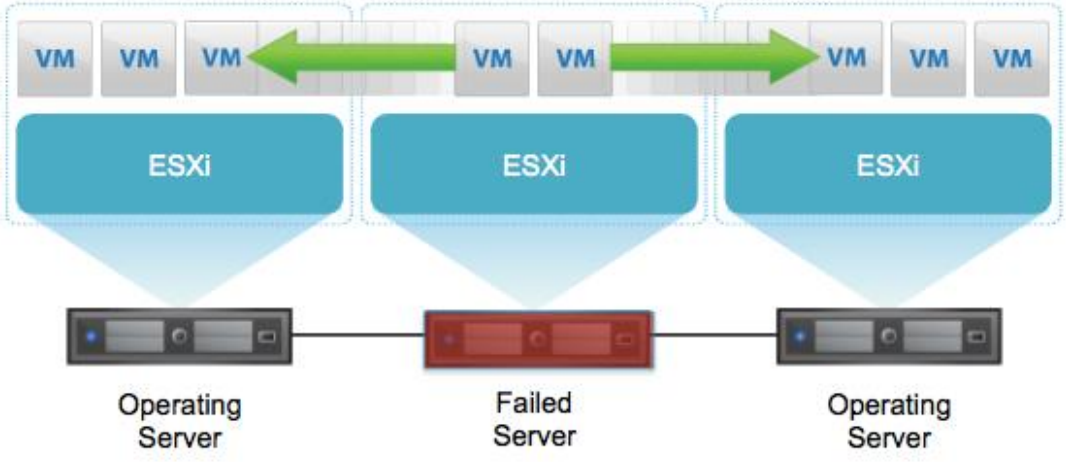
vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

High Availability (HA)

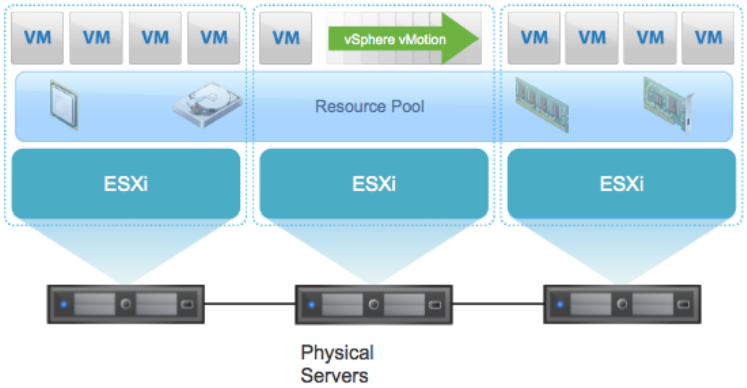
- Pools servers (hosts) and the VMs that reside on them in a cluster so that in the event of a failure, the virtual machines on a failed host are restarted on alternate hosts



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Distributed Resource Scheduler (DRS)

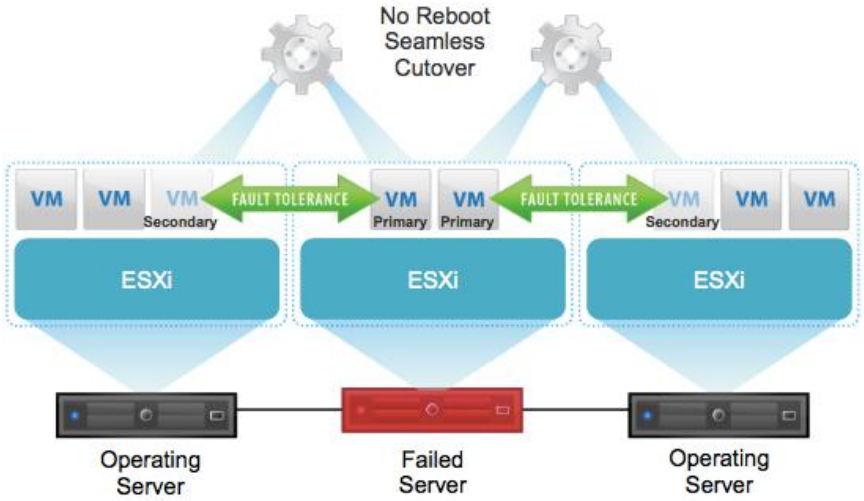
- What problem does DRS solve?
- HA clusters need to be monitored and managed. DRS implements a shared management interface so that the cluster's resources can be monitored and managed
- vSphere Storage Distributed Resource Scheduler provides the same solution for storage clusters



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

Fault Tolerance (FT)

- A secondary copy of that virtual machine and its files is created on another ESXi host and datastore
- Using FT, the transfer to a different server is seamless and will not be noticeable to the end-user

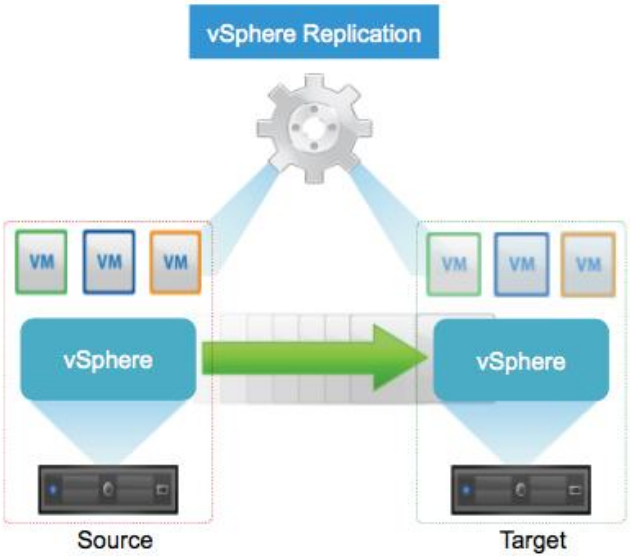


vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG

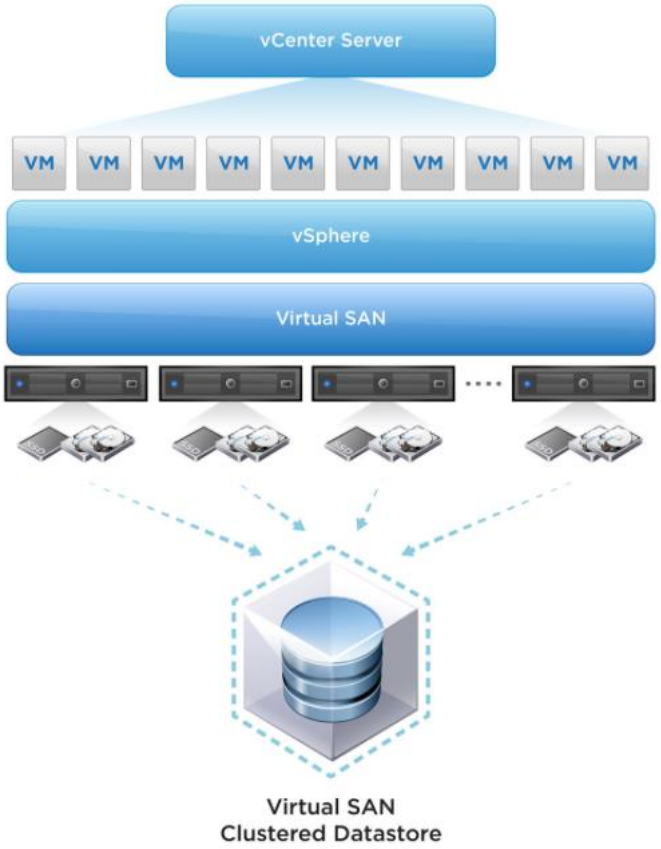
Replication

- vSphere Replication makes copies of VMs in a different physical location, useful for data protection and disaster recovery

- Works with vSphere Client to allow admins to monitor



vmware IT ACADEMY
© Network Development Group reserved for use with NDG.tech/vmware content
NDG



- VMware VSAN (Virtual Storage Area Network) virtualizes existing storage in data center servers

- Creates a **hyper-converged** infrastructure; integrated virtualized data center components from one vendor (i.e., VMware) (Do you recall what a converged infrastructure is?)

- Interacts with vSphere to create one layer of virtualization software, which is managed by the vCenter management layer

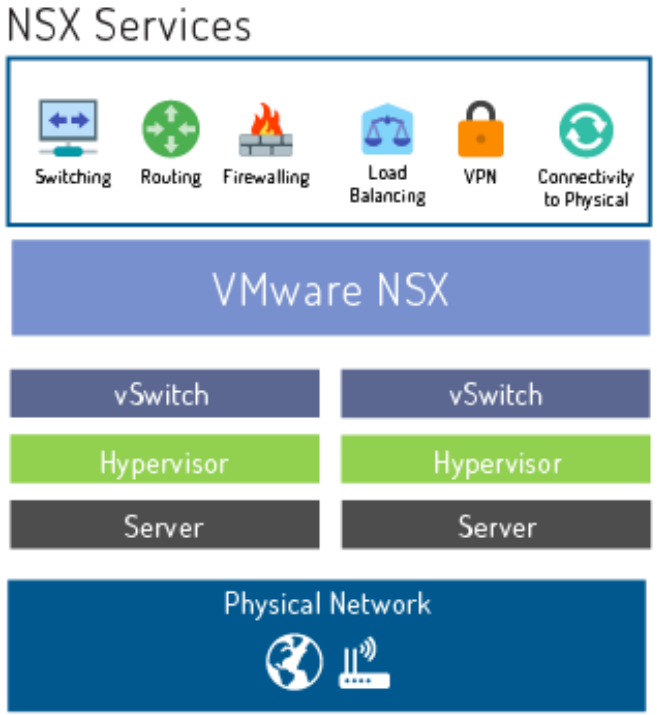
vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG

NSX

- Suite of virtualization solutions for data center networking
- VMware NSX creates a 'software network' on top of the physical network that can be divided up into many virtual networks
- Virtual networking components included



vmware IT ACADEMY

© Network Development Group reserved for use with NDG.tech/vmware content

NDG