Cloud Computing
NETW 1009
Introduction to Containers

Cloud Computing NETW 1009
Dr.-Ing. Maggie Mashaly
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Introduction to Containers

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Today we will cover

- Introduction to Containerization
- Introduction to Docker
- Introduction to Kubernetes

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Containerization

Encapsulating or packaging up software code and all its dependencies so that it can run uniformly and consistently on any infrastructure.

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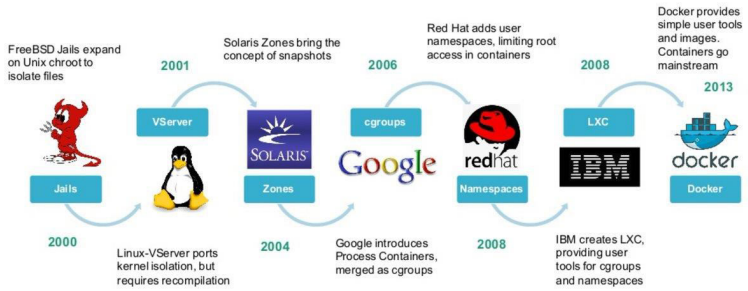
History



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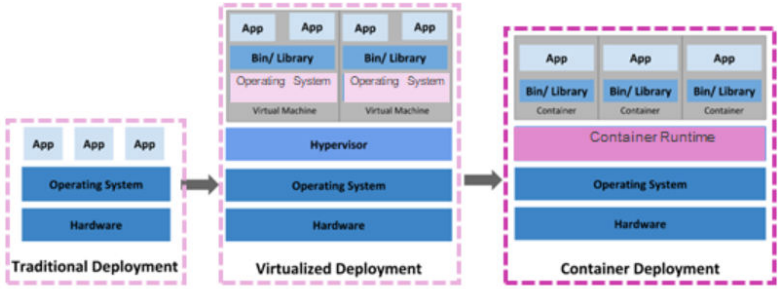
Container Architecture



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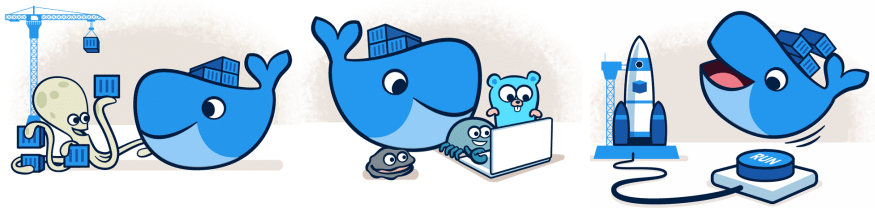
Docker



Create Share Run

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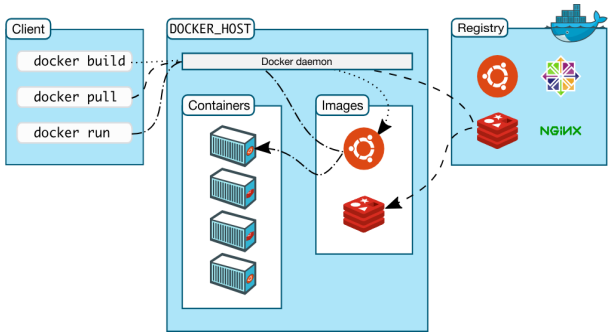
Docker Architecture



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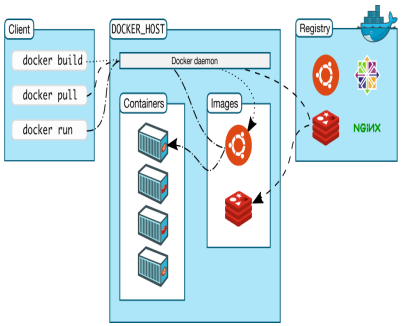
Docker Engine
1. Docker Daemon

Docker Engine is a client-server application with these main components:

1. Docker Daemon

The Daemon is responsible for creating, running, distributing and managing the Docker objects (images, containers, network and volumes). It can communicate with other Daemons to manage docker services

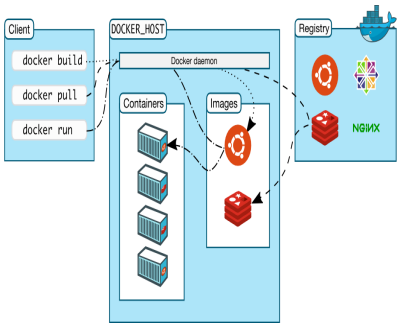


Docker Engine
2. Docker Client

The docker client command line is the primary way to communicate with the docker

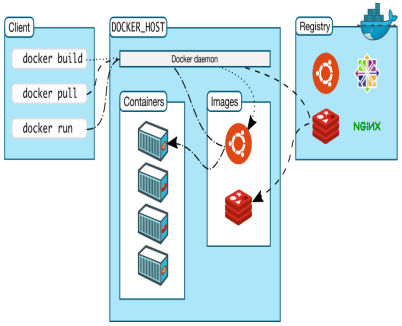
REST API for clients communication with the daemon

The Daemon and the docker client could reside and run on the same device or reside on different devices and use REST APIs to connect and communicate.



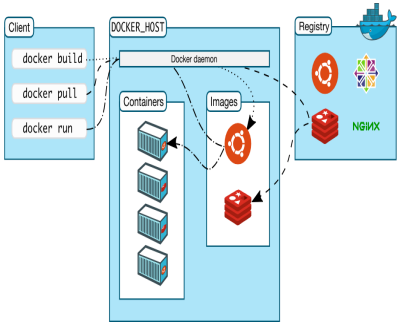
Docker Engine
3. Docker Desktop

Docker Desktop is an easy-to-install application for your Mac or Windows environment that enables you to build and share containerized applications and microservices

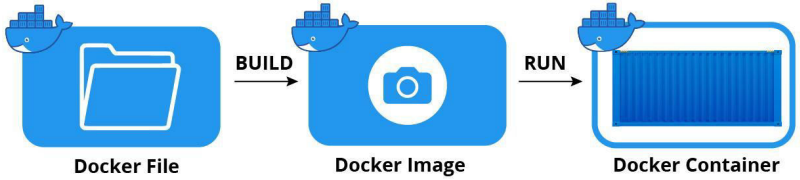


Docker Engine
4. Docker Registry

Docker Registry stores Docker images. Docker Hub is a public registry that anyone can use, and Docker is configured to look for images on Docker Hub by default. You can even run your own private registry



Docker Objects
1. Docker Images



A Docker image is made up of a collection of files that bundle together all the essentials – such as **installations**, **application code**, and **dependencies** – required to configure a fully operational container environment.

A Docker image by can be created through one of two methods:

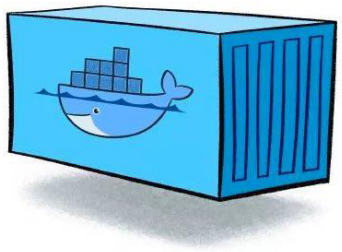
Interactive or **Dockerfile**

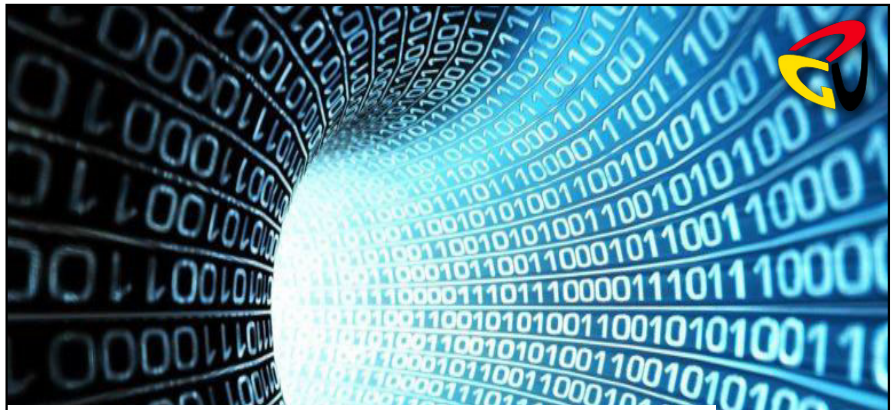
Docker Objects
2. Docker Containers

Container is a runnable instance of an image.

A container is defined by its image as well as any configuration options you provide to it when you create or start it.

When a container is removed, any changes to its state that are not stored in persistent storage disappear

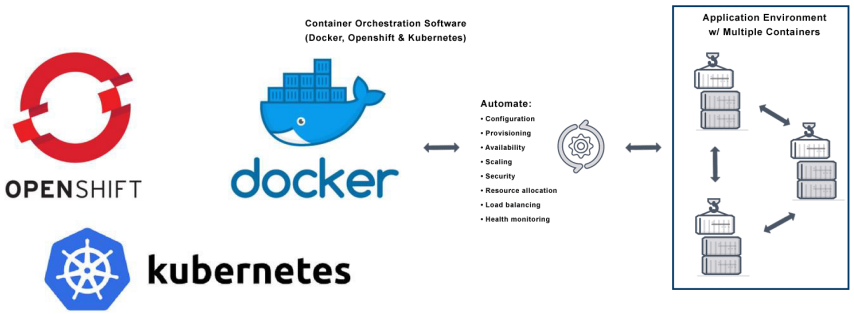




Container Orchestration

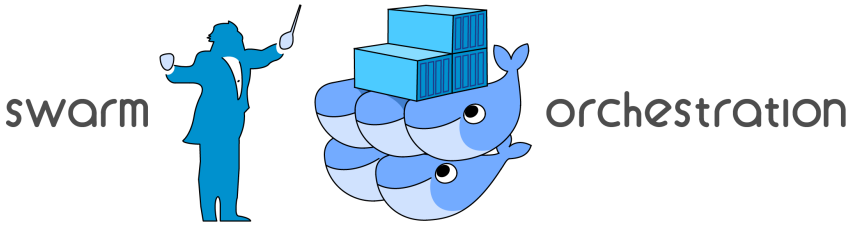
Container Orchestration

- Container orchestration is the automation of much of the operational effort required to run containerized workloads and services. This includes a wide range of things software teams need to manage a container's lifecycle, including provisioning, deployment, scaling (up and down), networking, load balancing and more



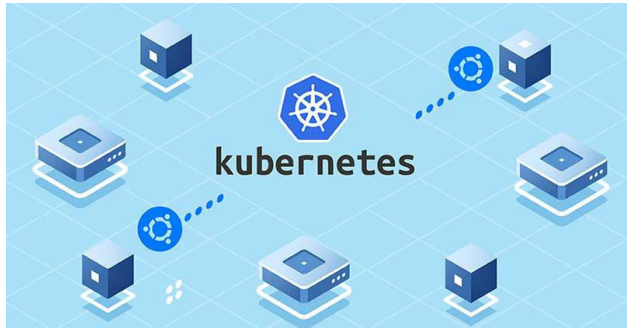
Docker Swarm

Docker Swarm, is the platform's own container orchestration tool that can automatically start Docker containers.



Kubernetes (K8s)

Kubernetes is a popular open source platform for container orchestration. It enables developers to easily build containerized applications and services, as well as scale, schedule and monitor those containers.



Kubernetes Architecture

A Kubernetes cluster consists of at least one control plane and at least one worker node (typically a physical or virtual server).

The smallest unit of execution for an application running in Kubernetes is the Kubernetes Pod, which consists of one or more containers.

Kubernetes Pods run on worker nodes.

.

Kubernetes AND/OR Docker

VS

kubernetes

Reference:

Thanks!

Any questions?

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Yomna youmna.atef@guc.edu.eg

Cloud Computing NETW 1009 Tutorial 7

Today's Agenda

- Recap
- ESXi Configuration
- vCenter
- Management
- Deploying
- Demo
- Lab 5

1. Recap

2. ESXi Configuration

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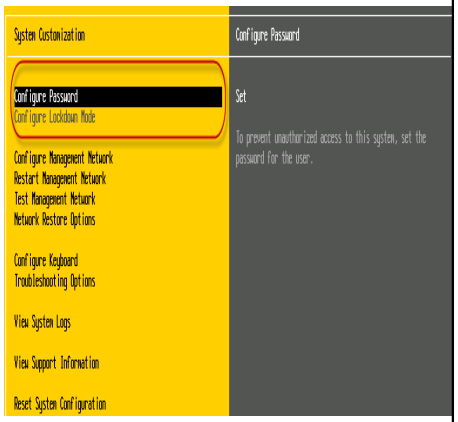
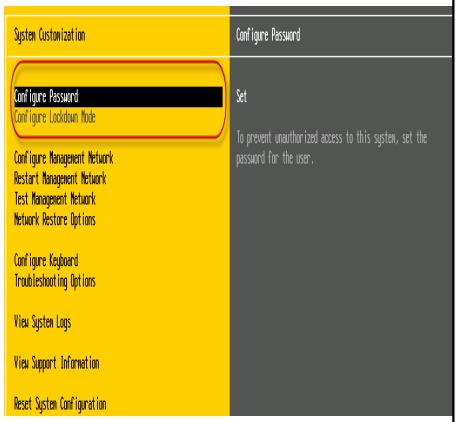
Basic Configurations

- Direct Console User Interface (DCUI) press F2 to start customizing system settings.
- Root Password
- Host name,IP,IPv6 Subnet Mask, Default Gateway, and DNS servers.
- Configure VLAN settings
- Set custom DNS suffixes
- Restart and test the management Network



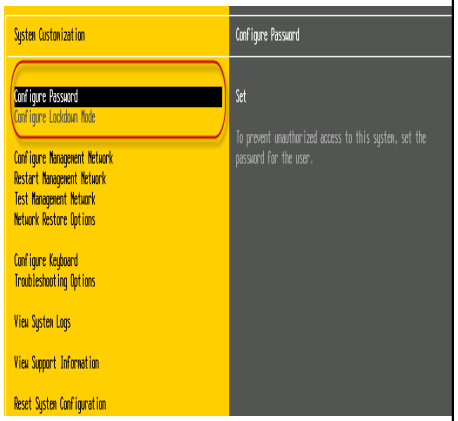
Basic Configurations

- Direct Console User Interface (DCUI) press F2 to start customizing system settings.
- Show System Logs
- Troubleshoot system
- Reset Configuration
- Configure Keyboard
- Lockdown mode
- SSH Access



Basic Configurations

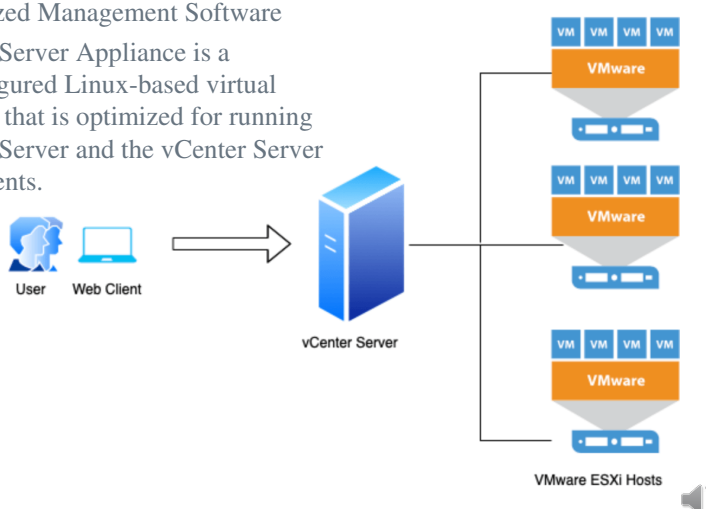
- Network Time Protocol (NTP)
- Client Server Model
  - Accurate performance graphs
  - Accurate time stamps in log messages
  - virtual machines can synchronize with host



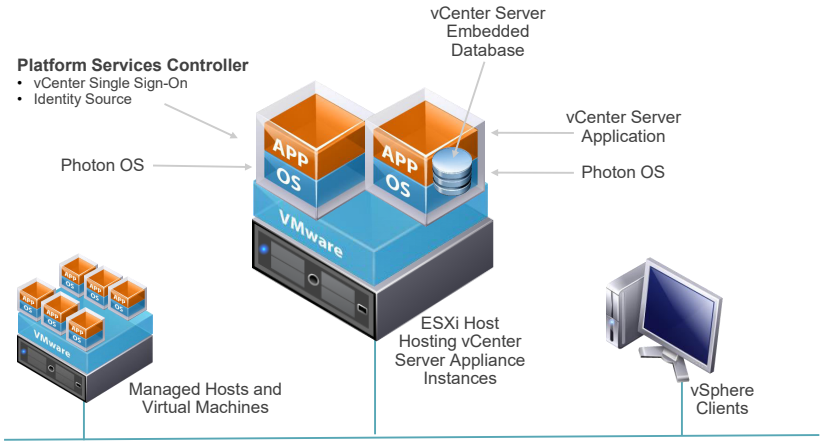
3. vCenter

vCenter

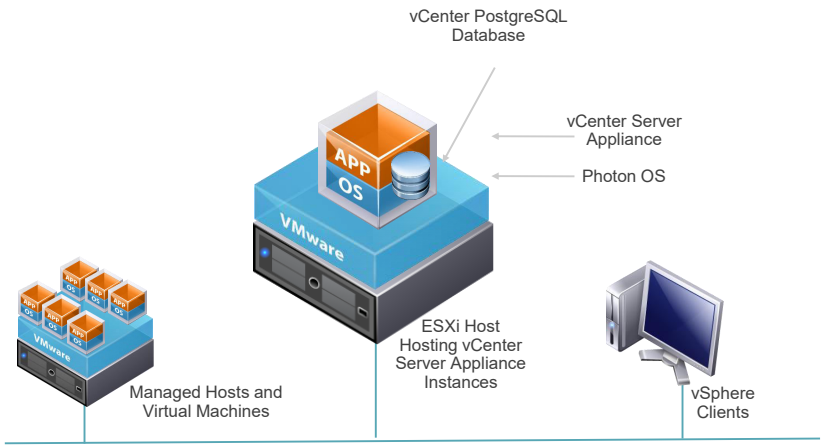
- Centralized Management Software
- vCenter Server Appliance is a preconfigured Linux-based virtual machine that is optimized for running vCenter Server and the vCenter Server components.



vCenter Architecture (till 6.7)



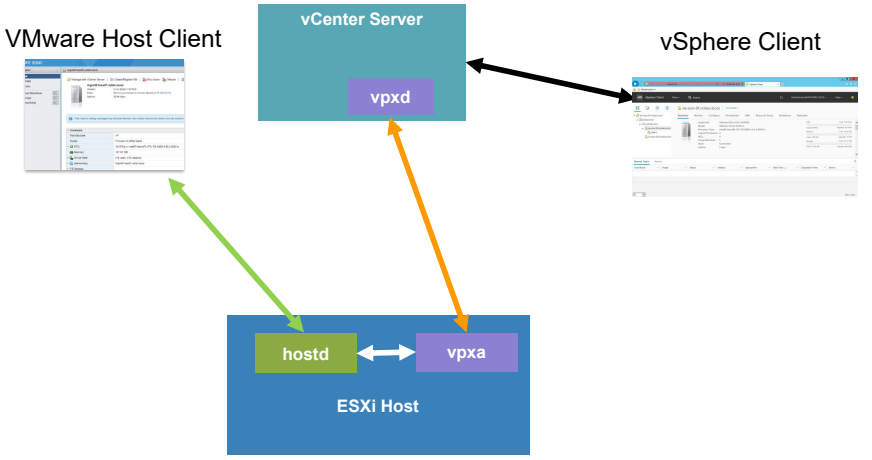
vCenter Architecture



vCenter Architecture

- vSphere Client
- vCenter database
- Managed hosts

vCenter



vCenter Services

- vSphere Update Manager
- VMware vSphere® Auto Deploy™
- VMware vSphere® ESXi™ Dump Collector

4. Management

System Limitation

	vCenter Server Appliance 8
Host per vCenter server	2500
Powered on vms per vCenter server	40000
Hosts per cluster	96
VMs per Cluster	8000

vCenter Single Sign On

- Uses Secure Token Mechanism
- After connecting to vCenter Server, authenticated users can view all vCenter Server instances or other vSphere objects for which their role gives them privileges. No further authentication is required.

Enhanced Link Mode

- **Enables:**
  - The log in to all linked vCenter Server systems using a single user name and password.
  - Viewing and searching the inventories of all linked vCenter Server systems
  - Roles, permission, licenses, tags, and policies are replicated across linked vCenter Server systems.
- To join vCenter Server systems in Enhanced Linked Mode, connect them to the same vCenter Single Sign-On domain.
- Can be created only at the installation/deployment phase.

vCenter Server APIs

Key use case:

- VM automation
- Development
- vCenter Server Appliance services health check

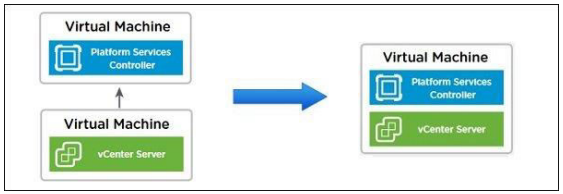
Benefits:

- Reduces API development complexity and time
- Access through modern automation and development processes for consistency and repeatability
- Simplified API model
- Single point of access for all API samples

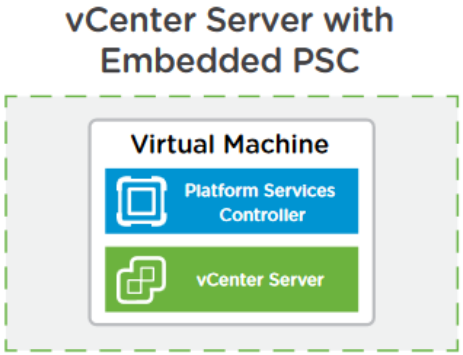
5.1 Deployment DEPRECIATED starting vSphere 7

Deployment Options

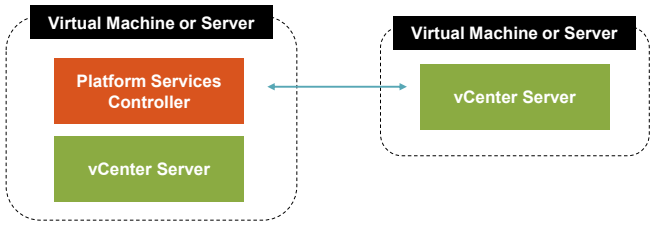
- vCenter Server Appliance is a preconfigured Linux-based virtual machine
- You can download the vCenter Server Appliance ISO file and run the installer. Native installers for Windows, Linux, and macOS are available.
- vCenter Server Appliance can be configured in the following ways:
  - As an embedded system with an internal Platform Services Controller instance
  - As a distributed system with an external Platform Services Controller instance



Embedded Platform Services Controller (THE ONLY OPTION VALID NOW)



External vCenter Server System Linked to an Embedded vCenter Server System

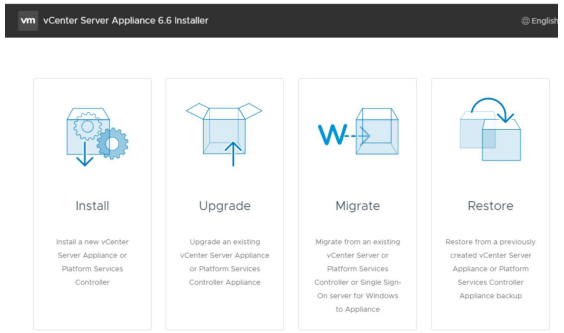


5.2 Deployment

Pre-requisites

- Verify that all systems requirements are met.
- You must provide the fully qualified domain name (FQDN) or the static IP of the host machine on which you are performing the install or upgrade.
- VMware recommends using the FQDN.
- Get a FQDN and IP address to assign to the vCenter Server appliance
- You must ensure that clocks on all machines on the vSphere network are synchronized.

GUI Installer



6.
Lab 5

Thanks!

Any questions?

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Cloud Computing
NETW 1009
Tutorial 10

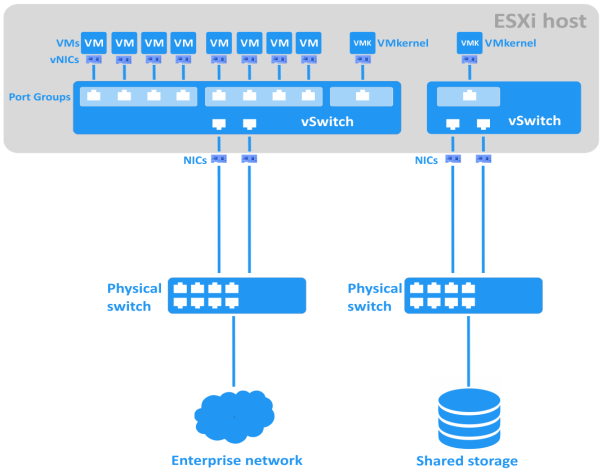
Today's Agenda

- Recap
- Virtual Network
- Virtual Switch
  - Standard vSwitch
  - Distributed vSwitch
- Configuring vSwitch

1.
Recap

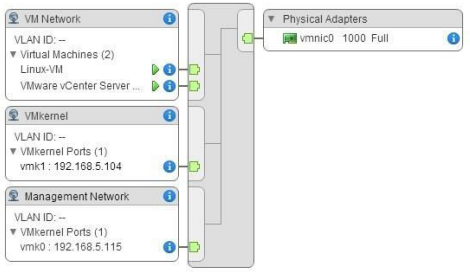
2.
Virtual Network

Virtual Switch

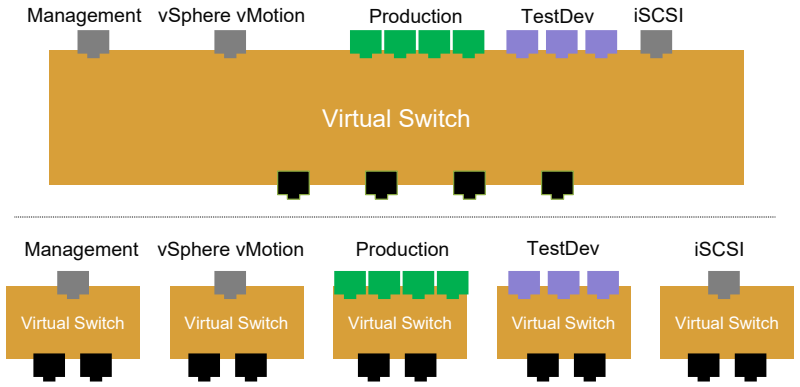


Virtual Switch

- Virtual switches provide the connectivity between virtual machines on the same host or on different hosts. Virtual switches also support VMkernel network access for remote host management, vSphere vMotion migration, iSCSI, and NFS.
- A virtual switch has specific connection types:
  - Virtual machine port groups
  - VMkernel port: For IP storage, vSphere vMotion migration, VMware vSphere® Fault Tolerance, vSAN,and the ESXi management network
  - Uplink ports



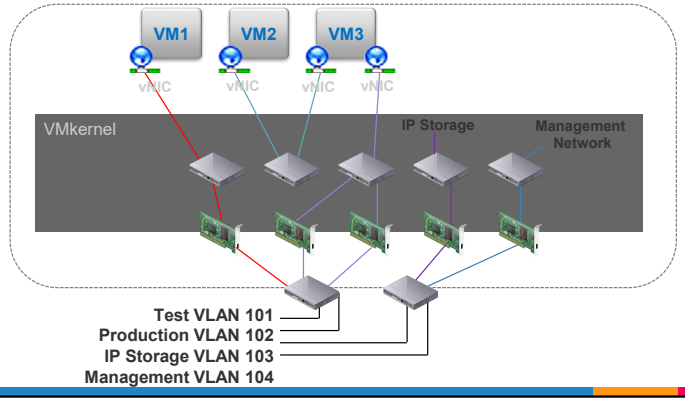
Virtual Network



3.1
Standard vSwitch

Standard vSwitch

- A standard switch provides connections for virtual machines to communicate with one another, whether they are on the same host or on different hosts.

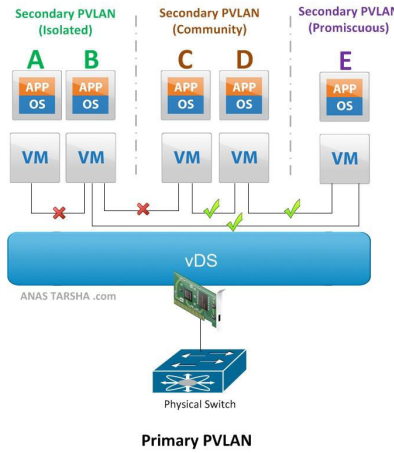


VLANS

VLANS offer:

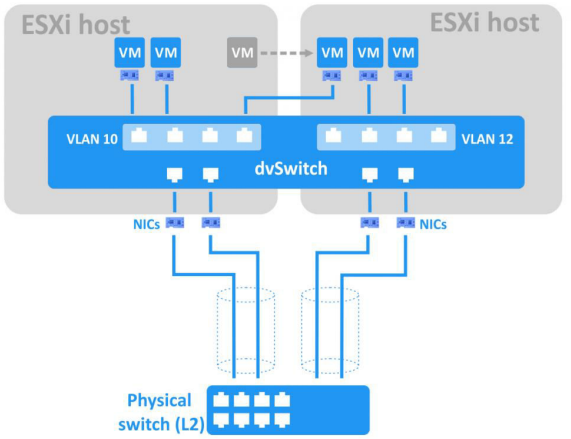
- Creation of logical networks that are not based on the physical topology
- Improved performance by confining broadcast traffic to a subset of ports on a switch
- Cost savings by partitioning the network without overhead of deploying new routers

- The ESXi host provides VLAN support through virtual switch tagging using the 802.1Q tagging
- The VMkernel takes care of all tagging and untagging as the packets pass through the virtual switch.



3.2
Distributed vSwitch

Distributed vSwitch



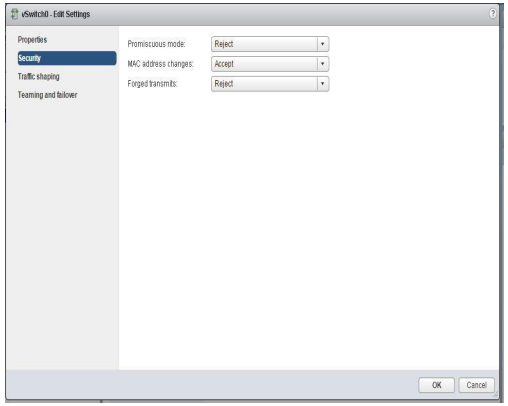
Standard vs Distributed

Feature	Standard Switch	Distributed Switch
Layer 2 switch	✓	✓
VLAN segmentation	✓	✓
IPv6 support	✓	✓
802.1Q tagging	✓	✓
NIC teaming	✓	✓
Outbound traffic shaping	✓	✓
Inbound traffic shaping		✓
VM network port block		✓
Private VLANs		✓
Load-based teaming		✓
Data center-level management		✓
vSphere vMotion migration over a network		✓
Per-port policy settings		✓
Port state monitoring		✓
NetFlow		✓
Port mirroring		

4.
Configuring vSwitch

Policies

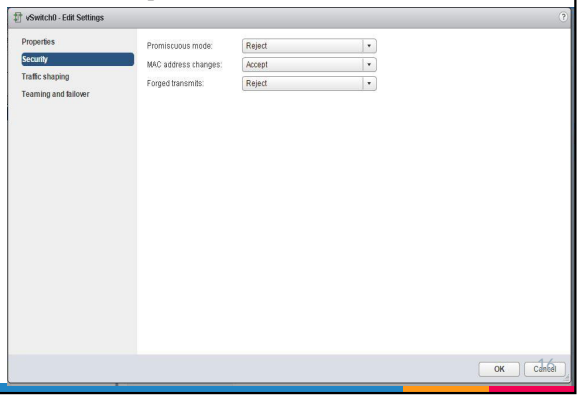
- Available network policies:
  - Security
  - Traffic shaping
  - NIC teaming and failover
- Policies are defined at the following levels:
  - Standard switch level
  - Port group level



Security Polices

The network security policy contains the following exceptions:

- **Promiscuous mode**: The default is Reject.
- **MAC address changes**: The default is Accept.
- **Forged transmits**: The default is Accept.



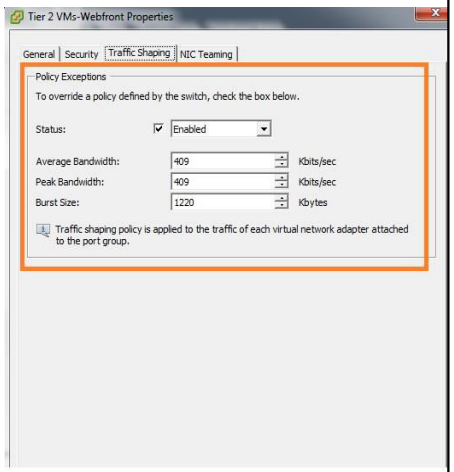
Security Polices Guidelines

- Set **Promiscuous mode** to **Accept** to use an application in a virtual machine that analyzes or sniffs packets, such as a network-based intrusion detection system.
- Set **MAC Address Changes** and **Forged Transmits** to **Reject** to help protect against certain attacks launched by a rogue guest operating system.
- Leave **MAC Address Changes** and **Forged Transmits** at their default values (**Accept**) if your applications change the mapped MAC address, as do some guest operating system-based firewalls.

Traffic Shaping Polices

A virtual machine's network bandwidth can be controlled by enabling the network traffic shaper. The network traffic shaper, when used on a standard switch, shapes only outbound network traffic. To control inbound traffic, use a load-balancing system or turn on rate-limiting features on your physical router.

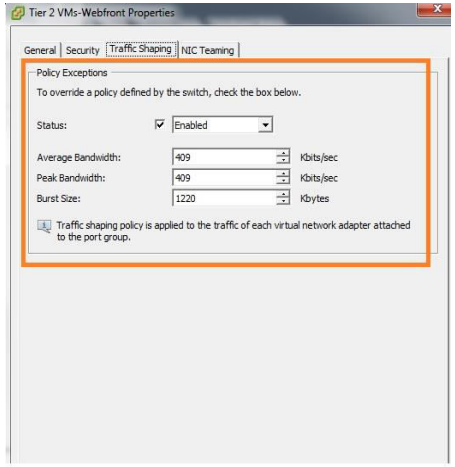
- **Average bandwidth** (Kbps): Establishes the number of kilobits per second to allow across a port, averaged over time. The average bandwidth is the allowed average load.
- **Peak bandwidth** (Kbps): The maximum number of kilobits per second to allow across a port when it is sending a burst of traffic. This number tops the bandwidth that is used by a port whenever the port is using the burst bonus that is configured using the Burst size parameter.



Traffic Shaping Polices

- **Burst size** (KB): The maximum number of kilobytes to allow in a burst.

▷ Network traffic shaping is off by default.



5.
Lab 10

*Open HOL – Virtualization 101 Lab

*Follow the guide (223-338)

Cloud Computing
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Tutorial 12

Cloud Computing NETW 1009
Tutorial 12
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Eng. Yomna Atef

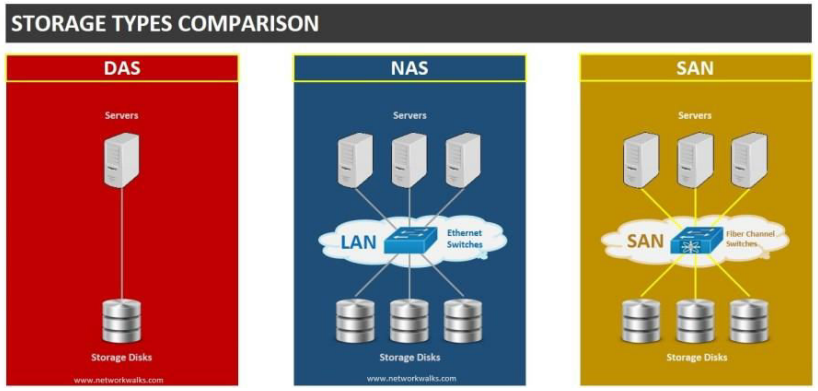
Today's Agenda

- Recap
- FC SAN
- Topology
- Case Study
- Zoning
- Case Study

1. Recap

2. Storage Recap

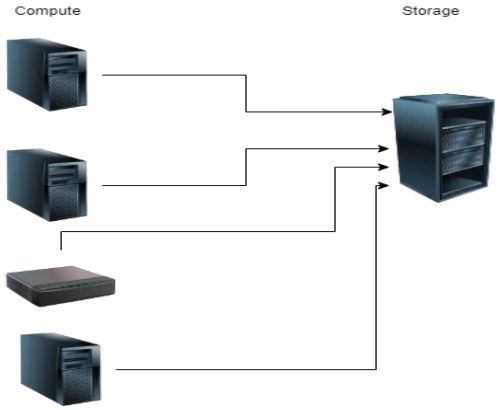
DAS/NAS/SAN



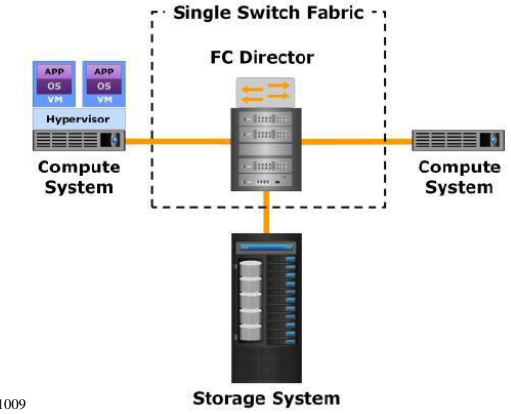
3.
FC SAN

3.
Topologies

Why NOT Direct Attachment?

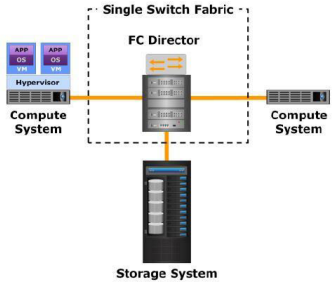


Single Switch

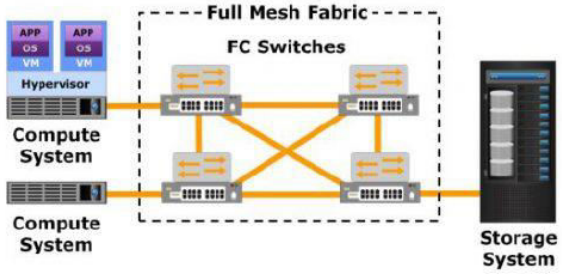


1. Single Switch

- Number of ISLs
- Port Utilization
- Simplicity
- Reliability
- Cost
- Scalability

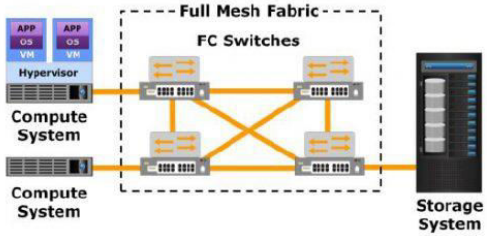


2.1 The Full Mesh

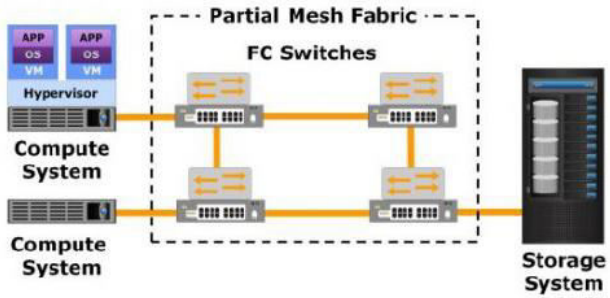


The Full Mesh

- Number of ISLs
- Port Utilization
- Simplicity
- Reliability
- Cost
- Scalability

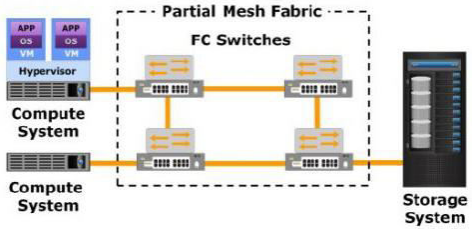


2.2 The Partial Mesh

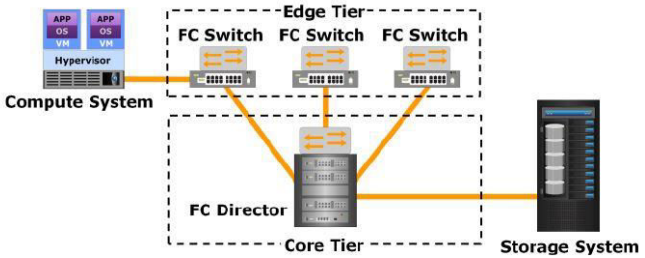


The Partial Mesh

- Number of ISLs
- Port Utilization
- Simplicity
- Reliability
- Cost
- Scalability

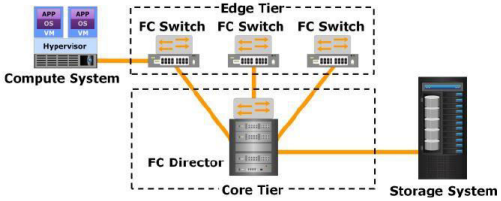


3. The Core Edge



The Core Edge

- Number of ISLs
- Port Utilization
- Simplicity
- Reliability
- Cost
- Scalability



4.
Case Study

Case

The IT infrastructure of an organization consists of three storage arrays direct-attached to a heterogeneous mix of **45 servers**. All servers are **dual-attached** to the arrays for high availability. Because each storage array has **32 front-end ports**, each could **support a maximum of 16 servers**. However, each existing storage array has the disk capacity to support a maximum of 32 servers. The organization plans to **purchase 45 more servers** to meet its growth requirements. If it continues using direct-attached storage, the organization needs to purchase additional storage arrays to connect these new servers. The organization realizes that its existing storage arrays are poorly utilized; therefore, it plans to implement FC SAN to overcome **the scalability and utilization challenges**. The organization uses **high-performance applications; therefore, it wants to minimize the hop count for the server's access to storage.**

Task

Propose a switched fabric topology to address organization's challenges and requirements. Justify your choice of the fabric topology. If 72-port switches are available for FC SAN implementation, determine the minimum number of switches required in the fabric.

Solution
1. Analyze

• **Single switch topology** not suitable for environment that requires high scalability.

• **Mesh topology** Full mesh topology is not suitable for environment that requires high scalability. Partial mesh, although, provides more scalability than full mesh, but several hops or ISLs may be required for the network traffic to reach its destination.

• **Core-Edge topology** Therefore, the recommended solution is core-edge topology. The core-edge topology provides higher scalability than mesh topology and provides one-hop storage access to all servers in the environment. Because of the deterministic pattern (from the edge to the core) of FC traffic movement, it is easy to calculate traffic load distribution across ISLs.

Core Edge

Consists of 2 tiers:

- Core Tier: Storage arrays (Targets) are connected to core switch/s / director/s (enhanced switch)

- Edge Tier: Computer systems / HBA / Servers (Initiators) are connected to edge switch/s

NOTE: The edge-tier switches are not connected to each other

ISL (inter switch links) Created to connect each edge switch to the core switch / director in the fabric

Solution
2. Design Edge

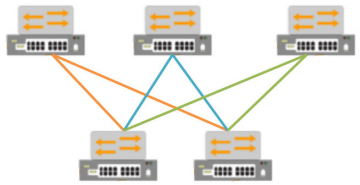
- Number of Servers = 45+45(new)=90
- Number of Ports needed(dual attached) = 90x2 = 180
- Each switch has 72 ports
- Number of switches needed = 180/72 = 3 switches (rounded up)
- The edge switches provide 3 switches x 72 ports each = 216 ports of which 180 ports will be used for server connectivity. Remaining 216 – 180 = 36 ports can be used for ISLs and future growth.

Solution
2. Design Core

- Total number of array ports = 3 arrays × 32 ports = 96 ports
- Number of switches required at the core = 96 array ports/ 72 ports per switch = 1.3 ≈ 2 switches (Round up)
- The core switches provide 2 switches x 72 ports each = 144 ports of which 96 ports will be used for array connectivity. Remaining 144 - 96 = 48 ports can be used for ISLs and future growth.

Solution
3. Connecting Core Edge

- To connect the core tier with edge tier



Edge Tier

2 + 2 + 2 = 6 ports per each tier

Core Tier

Solution
4. Propose full solution

Number of edge switch ports used for connecting to core switches = 6, this is less than 36 the remaining edge switch ports.

Remaining now 36 - 6 = 30 ports can be used for future growth.

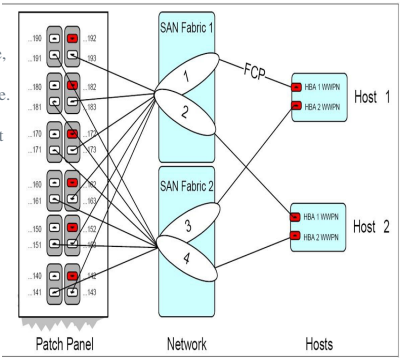
Number of core switch ports used for connecting to edge switches = 6, this is less than 48 the remaining core switch ports.

Remaining now 48 - 6 = 42 ports can be used for future growth.

5.
Zoning

Zoning Definition

- Zoning is an FC switch function that enables node ports within the fabric to be logically segmented into groups and communicate with each other within the group.
- Whenever a change takes place in the name server database, the fabric controller sends a Registered State Change Notification (RSCN) to all the nodes impacted by the change. If zoning is not configured, the fabric controller sends the RSCN to all the nodes in the fabric. Involving the nodes that are not impacted by the change increases the amount of fabric-management traffic
- In the presence of zoning, a fabric sends the RSCN to only those nodes in a zone where the change has occurred
- Zoning also provides access control, by allowing only the members in the same zone to establish communication with each other.
- Zone members, zones, and zone sets form the hierarchy defined in the zoning process.



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Zone Set

- A zone set is composed of a group of zones that can be activated or deactivated as a single entity in a fabric. Multiple zone sets may be defined in a fabric, but only one zone set can be active at a time.

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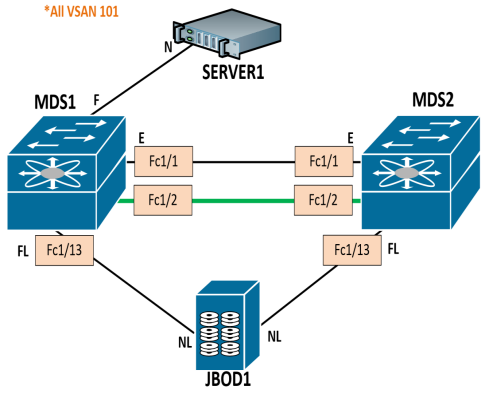
Addressing Ports

- WWN
  - WWNN
  - WWPN
- FCID
  - Domain ID
  - Area ID
  - Port ID



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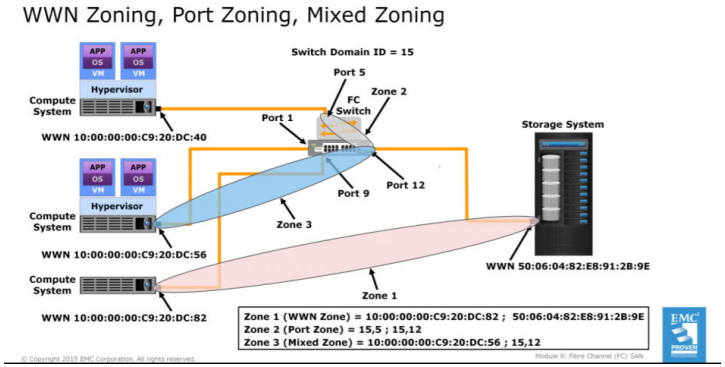
Types Of Zoning



6.
Case Study

Zoning example

The following output illustrates the FC addresses of some given initiators and targets , as well as the configuration of the FC switch connecting between them.

Initiator/Target	World Wide Port name (WWPN)	World Wide Node Name	FCID
HOST1_HBA0	10:00:00:90:FA:10:3D:60	20:00:00:90:FA:10:3D:60	0x150000
HOST2_HBA0	10:00:00:90:FA:1D:3D:60	20:00:00:90:1D:14:3D:60	0x290001
HOST3_HBA0	10:00:00:90:FA:13:3D:60	20:00:00:90:FA:13:3D:60	0x150002
VNX_SPA_0	50:06:01:6F:08:E0:02:22	50:06:01:60:88:E0:02:22	0x150004
VNX_SPA_1	50:06:01:6c:08:E0:02:22	50:06:01:60:88:E0:02:22	0x150006
VNX_SPB_1	50:06:01:64:88:E0:02:22	50:06:01:60:88:E0:02:22	0x290007

Task

Validate the output by checking the present mistakes and clearly stating their corrections

show zoneset active vsan 1-4093
zoneset name FABRICA vsan 3
zone name HOST1_HBA0_VNX_SPA_0 vsan 10
* fcid 0x150001 [pwwn 50:06:01:64:08:E0:02:22]
* fcid 0x150000 [pwwn 10:00:00:90:FA:14:3D:60]
zone name HOST2_HBA0_ VNX_SPA_1 vsan 3
* fcid 0x150006 [pwwn 50:06:01:6c:08:E0:02:22]
* fcid 0x290001 [pwwn 10:00:00:90:FA:1D:3D:60]
zone name HOST3_HBA0_ VNX_SPB_1 vsan 3
* fcid 0x290000 [pwwn 50:06:01:64:88:E0:02:22
* fcid 0x150002 [pwwn 10:00:00:90:FA:13:3D:60]
zoneset name FABRICB vsan 20
zone name HOST2_HBA0_ VNX_SPB_1 vsan 20
* fcid 0x290007 [pwwn 50:06:01:64:88:E0:02:22
*fcid 0x150002 [pwwn 10:00:00:90:FA:13:3D:60]

Thanks!

Any questions?

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