

Introduction to Data Center Modules

- Capex reduction of 50% by using vmware virtualization
- BDE - big data extensions
- Data-center virtualization provides Application and Hardware consolidation.
- Without vSphere, there will be an increase in downtime and cpu usage
- Data center virtualization reduces the number of physical hardware and allows virtual machines to access the same hardware.
- Reduces capital and operating costs, increases productivity and responsiveness

Reduce Capital and Operating Costs - Server consolidation, get more out of your hardware and lower capital and operating costs.

Deliver High Application Availability - availability and fault tolerance, if a node or server fails, all vms restart or are continued on another machine with no downtime or data loss

Improve Business Continuity - survive disaster, if one occurs, move a vm from one server to another in a different location without data loss

Increase Productivity - streamlined and automated management tasks

Improve Responsiveness - scale rapidly, deploy desktops, applications, and servers.

Bare-Metal Backup - take an image of a vm while it is running, allows you to recover to it if needed after a patch or other software upgrade

- Increase hardware on vm without powering off
- Decreasing hardware requires vm power off

Benefits of Virtual Machines

Multiple applications on each Host - encapsulate entire machine, many applications and OS

Maximum Host Utilization, Minimum Host count - use physical machine to full capacity

Faster and Easier Provisioning of Applications and Resources - transfer while running with vmotion and virtualize business crit apps to reduce costs, improve perform, reliability, and scalability

Hypervisor - Vmware Operating system that functions as the application layer between the hardware and virtual machines. Allows multiple virtual machines to access the same hardware.

Types of Hypervisor

Bare Metal - on premises, installed on physical device without OS. ie. VMWare ESXi

Hosted - hosted hypervisors as an application on top of a pre-existing OS. ie. VMWare Workstation.

SDDC - *Software Defined Data Center*, accelerates shift to cloud computing for existing data centers.

- VMware 6.0 provides
 - Live workload migrations
 - Data center maintenance
 - Zero application downtime

3 Editions of VMWare:

1. VMWare vSphere Standard
2. VMWare vSphere Enterprise
3. VMWare vSphere Enterprise +

vSphere 6.0 features and benefits:

1. Improves Utilization
2. Provides automation
3. Maximizes uptime
4. Reduces downtime
 - Reduces cap ex by upto 70%
 - Reduces operational expenses by upto 30% for each application on vSphere

Components of VMWare vSphere

Component layers of vSphere 6.0 Architecture:

Interface Layer

Clients - vSphere client and web client allow users to manage vsphere data center

Management Layer

vSphere Center - provides single point of control for a vSphere data center: access control, performance monitoring, configuration,
ie. *vCenter Server* and *vRealize Operations*

Virtualization Layer

Application Services - provide availability, security, and scalability of applications,
ie. high availability fault tolerance, vMotion
ie. Storage vMotion DRS

Infrastructure Services - services to provide abstract, aggregate, and allocate hardware or infrastructure resources

ie. Compute, Storage, Network

ie. Hypervisor BDE, Thin Provisioning, Distributed Switch

- 64 Hosts limit in a vSphere Center
- 8000 VMs limit in a vSphere Center
- 128 vCPUs per VM
- 4TB of RAM per VM

vSphere components:

- **Compute** - 64 Hosts, 8k vms per cluster (vSphere Center), rapid clone/deploy vms
- **Storage** -
 - Fibre Channel Storage Area Network (FCSAN)
 - Internal Small Computer System Interface (iSCSI)
 - Network Attached Storage arrays (NAS)
 - Storage Policy-Based Management (SPBM) - allows common management across storage tiers and dynamic storage classes of service automation
- **Networking** - supports Network I/O and multicast snooping, provides dedicated default gateway for vMotion traffic
- **Availability** - provides non-disruptive live migration of workload across distributed switches and servers. Savings of 95% in time and resources.
- **Management** - vSphere Content library and vSphere web client. vRealize provides operations management across all vSphere platforms (on-prem and hosted).
- Maximum vSphere ESXi 6 host configurations:
 - 480 physical CPUs
 - 12TB of RAM
 - 2048 VMs

vCenter Features:

- **Certificate Management** - enables services to use the same certificate - issued by VMWare Certificate Authority (VMCA) as a root cert (CA) so all certs are signed.
- **Alarms and Alerts** - notifications for events, set conditions, or state of object. Can trigger automated actions.
- **Monitoring Features** - monitor virtual environment, provides charts, reports, log files
- **Template Management** - Content library for vm templates, ISOs, images, & scripts. Can be shared with any ESXi host within a vCenter cluster.
- **Linked Mode Deployment** - enables common inventory view across multiple instances of vCenter. Replicates licenses, permissions, and roles.

Storage Protocols

Fibre Channel (FC) - primarily used for SAN, commonly used for vmfs datastores and boot LUNs for ESXi.

Fibre Channel over Ethernet (FCoE) - allows FC storage traffic and network traffic over the same ethernet infrastructure.

iSCSI - uses ethernet, can run long distance, used for vmfs datastores and thin provisioning on iSCSI LUNs. can use independent, dependent, or software iSCSI initiators.

Network File System (NFS) - IP-based file sharing protocol used by Network-Attached Storage (NAS). Cannot initialize or format NAS target remotely, NAS Server responsible for data storage locations.

Local Storage - Internal HDD within the ESXi host, or direct attached storage without network access. Requires a compatible Host Bus Adapter on the host and is considered virtual storage.

Virtual Volumes (VVOL) - virtualizes SAN/NAS arrays, automates tasks, provides finer control for admins. Eliminate need to provision LUNs or volumes per host. SPBM works with virtual volumes.

Datstores

Logical Unit Number (LUN) - Logical Unit Number, VMFS partition where virtual machines are stored. vSphere client shows a LUN as a datastore.

VMFS Datastore - high performance file system designed for VMs. can span several physical storage extents, SAN LUNs and local.

NFS Datastore - works the same as vmfs datastores. Max size dependent on nfs server.

Virtual SAN Datastore - Abstracts physical hardware resources into logical pools of capacity. can be configured as needed, without disruption, and doesn't require formatting.

Virtual SAN

Features:

- Not included with vSphere and is a separate paid offering
- Enable on existing clusters, even if they are not identical
- Cluster can have no local disks
- Works with storage policies
- Pools server attached HDDs and SSDs to create a distributed shared datastore.

Types:

Hybrid - uses HDDs and SSDs. Flash is used as read/cache write buffer, magnetic provide persistence

All-Flash Storage - Flash is used as read/cache write buffer, ssds provide persistence and fast response times.

Storage Policy-Based Management (SPBM) - works with virtual volumes, dynamic resource allocation and management. Can specify prereqs for an individual VM to match service levels required by applications.

Networking Features

- Works similar to physical networks
- vSphere uses virtual NICS and virtual Switches

- vSphere uses NSX as the network virtualization platform for SDDC
- Network and security services can attach to vms through policies

Virtual LANs - provide logical separation of the network traffic.

Traffic Shaping - restrict inbound/outbound bandwidth of vms.

Port Mirroring - mirror total VM traffic, troubleshooting or IDS

Quality of Service (QoS) and Differentiated Services Code Point (DSCP) - allows prioritization of network traffic.

NetFlow -Monitoring tool and captures metadata.

Cisco Discovery Protocol (CDP) and Link Layer Discovery Protocol (LLDP) - used to discover neighboring physical network switches and discover misconfigs.

Virtual Switches - Maintain MAC address port forwarding table

Standard Switch

- Can bridge traffic internally.
- bridge multiple network adapters to combine bandwidth/load balance/redundancy
- Default ports are 120

Distributed Switch

- Centralized interface to configure, monitor, administer vm access switching for entire datacenter
- Enhanced network monitoring/troubleshooting
- Centralized on vCenter Server system

NSX

VMWare NSX - handles data across virtual switches without interacting with physical

Logical Switching - spin out Level 2 (layer 2 OSI) virtual switches.

Logical Routing - handles east-west traffic in a DC.

Logical Firewall - distributed kernel-enabled firewall with monitoring

Logical Load Balancer - distribution of workload across servers and high-availability applications

Logical VPN -

- SSL VPN-Plus: access to private corporate applications
- IP Sec VPN: site-to-site connectivity between NSX and remote sites
- L2 VPN: extend datacenter, allow vms to retain connectivity across geo boundaries

Resource Management

vMotion - allows to migrate a vm from one host to another without downtime. Can move datastore and execution states.

Cross vSwitch - migrate vm across different virtual switches.

Cross vCenter - migrate vm from 1 host on a vCenter to another host on another vCenter

Long Distance vMotion - migrate across a WAN, must be 150ms RTT or less.

Distributed Resource Scheduler (DRS) - aggregates computing capacity across collection of servers.

- Able to apply hardware resources by Policy
- Prioritize resources by application
- May distribute VMS to other hosts based on load.
- Conduct zero downtime server maintenance
- Reduce power consumption by 20%
- Could be used for offsite disaster recovery

Distributed Power Management (DPM) -

- feature of DRS.
- Can power hosts on/off and migrate vms across hosts to reduce power consumption and meet demand.

Storage vMotion -

- migrate a vm from one datastore to another while running with zero downtime.
- Proactive storage migration
- Improve vm performance
- Easy monitoring

Storage DRS -

- Smart vm placement and load balancing based on I/O and space capacity.
- Keeps storage devices balanced
- Monitors the storage habits
- Manual mode - makes recommendations that an admin must approve.
- Fully automated - makes decisions to lower I/O latency across VMs

Storage I/O Control (SIOC) -

- provides storage I/O performance isolation for VMs
- Prioritize resource allocation during high demand
- Mitigate performance loss of critical workloads due to high congestion

Network I/O Control (NIOC) -

- Allows prioritizing network traffic over virtual switches
- Uses QoS
- Enforces bandwidth limits
- Provides load-based teaming

Availability Features

- vSphere Data Protection - disk-based backup, local data protection and offsite, managed through vSphere web client
 - Agents that enable application-consistent backup
 - Restore replication data back to source or target

- Can restore vms, start OS'es, and check for vmware tools heartbeats to verify running
- High Availability
 - In physical server failure, vms are auto restarted on other servers with spare capacity
 - OS failure, vms are auto restarted
 - Monitors vmware heartbeats to determine failure
 - Can select availability for types of vms
- Faults Tolerance
 - Traffic between hosts that run primary and secondary virtual machines
 - Creates a log step of vms and applications to restore in the case of failure
 - Auto triggers failover in an outage event
 - Supports 4 vcpus, and 64gb of mem
 - Integrated with vSphere
 - Fault tolerance logging recommends a dedicated 10GB NIC on each host for this feature
 - Requires a secondary vm to remain in lock-step with primary vm
- vSphere Replication
 - Replicates vms within the same sites or cross sites
 - Managed using vSphere web client
 - Max 24 recovery points
 - Separate traffic by using Network I/O or configuring on a separate network.

Data Center Virtualization

- vSphere with Operations Management
 - Provides common service catalog for Infrastructure and applications
 - Performance/capacity monitoring
 - Reclaim overprovisioned space
 - Increase resource utilization
 - Eliminate need for scripts and spreadsheets
 - vSphere Operations Management Standard
 - Server consolidation, business continuity
 - vSphere Operations Management Enterprise
 - Resource load balancing
 - vSphere Operations Management Enterprise Plus
 - Enhanced application availability
 - AK - Acceleration Kits -
- vRealize Suite - cloud management platform
 - Extends to vmware vCloud Air, amazon, or openstack
 - vRealize automation

- Secure portal where users can request resources
 - Admins can request infrastructure and applications through the portal.
 - Simplified resource management
 - vRealize Operations
 - Provides unified reporting
 - Capacity reporting
 - Dashboard, alerts
 - Virtual Machine Architecture for vRealize:
 - User Interface - web app - apache tomcat
 - Collector - collects controller data
 - Controller - placing/mapping data on cluster
 - Analytics - caches and processes data
 - Persistence - writes data to disk
 - Databases - xml in vPostgres DB
 - vRealize Log Insight
 - Real-time log management
 - Allows advanced queries
- Software-Defined Storage Virtual SAN - matches storage and application need.
 - Runs on the same host
 - Works with storage policies
 - Integrates with vSphere web client
- Software-Defined Networking - NSX
 - Allows virtual networks across hosts
 - Create entire virtual networks to run in parallel with physical
 - On-demand resource allocation
- Big Data Extensions
 - Works with hadoop
 - Scale out hadoop virtually
 - Integrate with vCenter
- VMware Integrated OpenStack
 - Deployment using web client
 - Seamless upgrade/patch
 - Free to enterprise customers
- Cloud Services
 - vCloud Air - extension of SDDC
 - Offers networking layer between your data center and private cloud
 - Common management tools and automation
 - vCloud offers high availability and business continuity/disaster recovery for Applications, Servers, and Clusters
- EVO: RACK
 - Helps define and deploy SDDCs
 - Medium to large enterprises

- EVO: RAIL
 - Same as rack but with compliance certifications for financial, health, gov
 - Ideal for Virtual Desktops (VDI)

Scenarios

Availability Challenge: critical applications for clients, want zero downtime and avoid extended downtime. Disaster recovery off-site, backup uses too much bandwidth for backup

- Zero downtime -
 - Fault tolerance provides backups of vms that run in parallel
 - High availability provides uniform fail-over protection for hardware
- Disaster recovery off-site -
 - Replication provides asynchronous replication of datastores through a dedicated link.
- Backup uses too much bandwidth -
 - Data protection allows partial backups to only back up changes through Changed Block Tracking (CBT)

Scalability Challenge: Cut IT expenses, use resources in DR site, how to migrate vms to off-site datacenter,

- Migrate vms to off-site DR
 - vSphere 6.0 offers Long distance vMotion for long distances, up to 150ms RTT
- Reached maximum hosts per cluster (32 on vSpherer 5)
 - vSphere 6.0 offers 64 hosts per cluster.

Management Challenge: repositories across their global offices, license mismatch between used and purchased

- Repos are on individual vCenter servers
 - Content library will store OVF, ISO, or other file types
 - Can sync with publishers
- License management challenges
 - Platform services control feature for license inventory and management

Optimization Challenge: how to optimize infrastructure

- Optimize infrastructure
 - vRealize Operations Manager, automate tasks and monitor health.

Application Upgrade Challenge: search engine company wants to deliver better ads and get high click rates and site-time

- building user profiles from large volumes of data
 - vSphere 6.0 support BDE with hadoop to analyze data and target content for users

Cloud Challenge: Move to cloud

- Benefits to moving to cloud with VMware vCloud:
 - High availability

- Business Continuity/Disaster recovery
- Policy based provisioning
- Rules-based configuration
- Operational analytics
- Automated infrastructure costing and metering
- Self-Service provisioning
- Availability for live migration and long distance with vMotion