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# **Subject: Principles of Virtualisation**

**Module Number: 4.0**

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**Module Name: Features of vSphere and NSX**

# Features of vSphere and NSX

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## **AIM:**

To understand the role of Vsphere and NSX .



## Objectives:

The Objectives of this module is to:

- Understand Fundamentals of Vsphere Hypervisor and its components

# Features of vSphere and NSX

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## Outcomes:

At the end of this module, you are expected to:

- Define Vsphere, its versions and NSX.

## Content:

- vSphere Resource Management Features
- vMotion
- Key features of vMotion
- Distributed resource scheduler
- Additional VMware DRS features
- Storage DRS
- vSphere data Protection
- High Availability
- Fault Tolerance

# vSphere Resource Management Features

- vMotion
- Distributed Resource Scheduler (DRS)
- Distributed Power Management (DPM)
- Storage vMotion
- Storage DRS
- Storage I/O Control
- Network I/O Control



- VMware vMotion enables the live migration of running virtual machines from one physical server to another with zero downtime, continuous service availability, and complete transaction integrity. vMotion is a key enabling technology for creating the dynamic, automated, and self optimizing data center.

## Benefits of vMotion

- Continuously and automatically allocate virtual machines within resource pools.
- Improve availability by conducting maintenance without disrupting business operations.

# How is VMware VMotion Used?

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VMotion allows users to:

- Automatically optimise and allocate entire pools of resources for maximum hardware utilisation, flexibility and availability.
- Perform hardware maintenance without scheduled downtime.
- Proactively migrate virtual machines away from failing or underperforming servers.



# How Does VMotion work?

- Live migration of a virtual machine from one physical server to another with VMotion is enabled by three underlying technologies. First, the entire state of a virtual machine is encapsulated by a set of files stored on shared storage such as Fibre Channel or iSCSI Storage Area Network (SAN) or Network Attached Storage (NAS).
- VMware's clustered Virtual Machine File System (VMFS) allows multiple installations of ESX Server to access the same virtual machine files concurrently. Second, the active memory and precise execution state of the virtual machine is rapidly transferred over a high-speed network, allowing the virtual machine to instantaneously switch from running on the source ESX Server to the destination ESX Server.

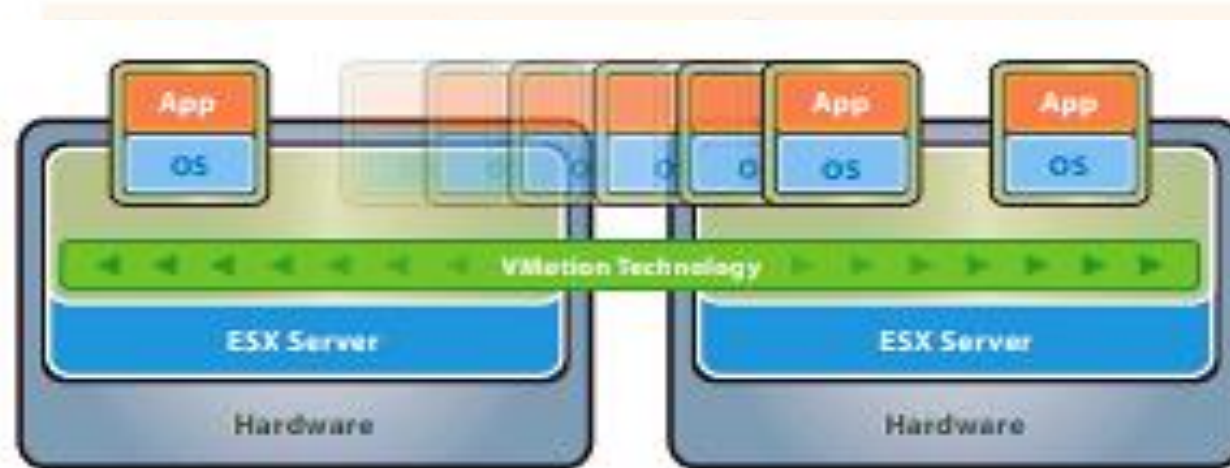
# How Does VMotion work?

- VMotion keeps the transfer period imperceptible to users by keeping track of on-going memory transactions in a bitmap. Once the entire memory and system state have been copied over to the target ESX Server, VMotion suspends the source virtual machine, copies the bitmap to the target ESX Server, and resumes the virtual machine on the target ESX Server.
- This entire process takes less than two seconds on a Gigabit Ethernet network. Third, the networks being used by the virtual machine are also virtualised by the underlying ESX Server, ensuring that even after the migration, the virtual machine network identity and network connections are preserved.

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# How Does VMotion work?

- VMotion manages the virtual MAC address as part of the process. Once the destination machine is activated, VMotion pings the network router to ensure that it is aware of the new physical location of the virtual MAC address. Since the migration of a virtual machine with VMotion preserves the precise execution state, the network identity, and the active network connections, the result is zero downtime and no disruption to users.



# Key Features of VMotion

- **Reliability:** Proven by thousands of customers in production environments since 2004, VMotion continues to set the standard for the most dependable live migration capabilities.
- **Performance:** Perform live migrations with downtime unnoticeable to the end-users. Optimal use of CPU and network resources ensures that the live migrations occur quickly and efficiently.
- **Interoperability:** Migrate virtual machines running any operating system across any type of hardware and storage supported by VMware ESX Server.
  - » **Support for Fibre Channel SAN-:** Implement live migration of virtual machines utilising a wide range of up to 4GB Fibre Channel SAN storage systems.

# Key Features of VMotion

- » **New - NAS and iSCSI SAN support:** Implement live migration of virtual machines with lower-cost, more easily managed shared storage.
- » **New - Customisable CPU compatibility settings-:** Ensure that virtual machines can be migrated across different versions of hardware. Enable virtual machines to benefit from the latest CPU innovations.
- **Manageability**
  - » **Migration wizard:** Quickly identify the best destination for a virtual machine using real-time information provided by migration wizard.

# Key Features of VMotion

- » **Multiple concurrent migrations:** Perform multiple concurrent migrations to continuously optimise virtual machine placement across the entire IT environment.
- » **Priority levels:** Assign a priority to each live migration operation to ensure that the most important virtual machines always have access to the resources they need.
- » **Scheduled migration tasks:** Automate migrations to happen at pre-defined times and without an administrator's presence.
- » **Migration audit trail:** Maintain a detailed record of migration operations, including date/time and the administrators responsible for initiating them.

- VMware DRS (Distributed Resource Scheduler) is a utility that balances computing workloads with available resources in a virtualised environment. The utility is part of a virtualisation suite called VMware Infrastructure 3.
- With VMware DRS, users define the rules for the allocation of physical resources among virtual machines (VMs). The utility can be configured for manual or automatic control. VMware resource pools can be easily added, removed or reorganised. If desired, resource pools can be isolated between different business units. If the workload on one or more virtual machines drastically changes, VMware DRS redistributes the virtual machines among the physical servers. If the overall workload decreases, some of the physical servers can be temporarily powered-down and the workload consolidated.

# Additional VMware DRS features

- Dedicated infrastructures for individual business units.
- Centralised control of hardware parameters.
- Continuous monitoring of hardware utilisation.
- Optimization of the use of hardware resources as conditions change.
- Prioritization of resources according to application importance.
- Downtime-free server maintenance.
- Continuous monitoring for automatic energy optimization.
- Reduced power and cooling costs -- as much as 20% -- during low utilisation periods.



- VMware DRS runs within the VMware vCenter Server to automatically balance the memory load on all virtual machines within a cluster. DRS intelligently allocates resources and can be configured to automatically take care of workload migration (with VMotion) or assign migrations based on rules defined by an administrator.
- Using resource pools that combine multiple host resources into one, DRS enables optimal workload distribution on virtual machines based on business needs and changing priorities. DRS migrates VMs based on the availability and utilization of CPU and memory resources.
- When an increased VM load is encountered, DRS evaluates its priority against resource allocation rules and redistributes VMs so that capacity is dedicated to the highest-priority applications.

# Distributed Power Management (DPM)

- DPM is a DRS "extension" that helps to save power (so we can be "green"). It recommends powering off or on ESX hosts when either CPU or memory resource utilisation decreases or increases. VMware DPM also takes into consideration VMware HA settings or user-specified constraints.
- It means that, if our HA tolerates one host failure, DPM will leave at least two ESXi hosts powered on. How does DPM contact with ESXi host? It uses wake-on-LAN (WoL) packets or these out-of-band methods: Intelligent Platform Management Interface (IPMI) or HP Integrated Lights-Out (iLO) technology. When DPM powers off ESXi host, that host is marked as *Standby* (standby mode).

# DPM configuration steps

Before enabling Power Management for hosts in a vSphere cluster, you need to know username and password, IP and MAC Address of the iLO interface. Then, please follow the below steps:

- Browse to each host in the vSphere Web Client.
- Click the **Manage** tab and click **Settings**.
- Under **System**, click **Power Management**.
- Click **Edit**.
- Enter the username, password, IP and MAC of iLO

# Enabling DPM

- Click on vSphere Cluster in the vSphere Web Client.
- Click the **Manage** tab and click **Settings**.
- Under **Services**, click **vSphere DRS**.
- Click **Edit**.
- Check *Turn ON vSphere DRS* (1) and set up DRS Automation Level (2) and Migration Threshold (3)
- Set up Power Management Automation Level (4) and DPM Threshold (5).

- Storage vMotion is a component of VMware vSphere that allows the live migration of a running Virtual Machine's (VM) file system from one storage system to another, with no downtime for the VM or service disruption for end users.
- This migration occurs while maintaining data integrity. Storage vMotion is included in the Standard, Enterprise Plus and Platinum editions of vSphere. VMware vCenter is also required.
- Storage vMotion is the companion feature to vSphere's vMotion capability, which allows virtual machines to be moved from one physical server to another. Working in cycle, these two vMotion processes ensure that virtual machines are mobile without endangering their operational or data consistency.

# How Storage vMotion works

- VMware Storage vMotion begins the process by copying the VM's metadata, found in its home directory, to the alternate storage location. Next, the software copies the VM's disk file (Virtual Machine Disk File or VMDK) to the new location using vSphere's Changed Block Tracking (CBT) functionality to preserve data integrity while the replication occurs.
- CBT module is queried again for a second copy to the new location, but this time only the blocks that have changed since the initial replication was started are copied. This second step persists until both copies are in sync. The VM is then suspended and pointed to the new location of its virtual disk image. Before VMware ESX resumes the VM, the last of the changed regions of the source disk is replicated to the target and the source home directory and disks are removed.

# How Storage vMotion works

The entire process is unnoticeable to the VM and to end-users, although depending on the size of the VMDK and other factors, it can take some time to complete and may have an effect on performance. A Storage vMotion operation may also require significant network resources which can also affect other VMs using the same network.



Storage DRS is an intelligent vCenter Server feature for efficiently managing VMFS and NFS storage, similar to DRS which optimises the performance and resources of your vSphere cluster. Storage DRS revolves around two storage metrics, Space and IO. Yes, Storage DRS fully supports VMFS and NFS datastore. However, it does not allow adding NFS datastore and VMFS datastore into same datastore cluster.



- **Resource aggregation:** It enables to group multiple datastores into a single flexible pool of storage called a Datastore Cluster (aka Storage DRS POD).
- **Initial placement:** This feature takes care of disk placement for operations such as Create a virtual machine, add disk, clone, relocate.
- **Load balancing based on Space and IO:** Storage DRS dynamically balance the Storage DRS cluster imbalance based on Space and IO threshold set. Default space threshold per datastore is 80% and the default IO latency threshold is 15ms.
- **Datastore maintenance mode:** This feature helps when an admin wants to do maintenance activity on storage. Similar to host maintenance mode, Storage DRS will store vMotion all the virtual machine files.
- **Inter/Intra VM Affinity rules:** As the name states, we can have affinity/anti-affinity rules between virtual machines or VMDKs.

- Storage I/O Control (SIOC), a feature that was introduced in vSphere 4.1, provides a fine-grained storage control mechanism which dynamically allocates portions of hosts' I/O queues to VMs whose data is located on the same datastore. This dynamic allocation is based on shares that an administrator assigns to the VMs.
- Using SIOC, vSphere administrators can allocate more shares to the VM that is running a high priority application, which ensures that the application can maintain a higher level of performance during peak load periods. SIOC is enhanced in vSphere 5.0 to include support for NFS datastores.

- VMware vSphere Network I/O Control (NIOC) is a feature that allows an administrator to prioritise bandwidth for different network resource pools on a vNetwork Distributed Switch (vDS).
- When enabled, Network NIOC categorises traffic into network resource pools, which use resource allocation policies to control bandwidth for various traffic types. By default, a share's value of 50 is given to each pool, except for VM traffic, which gets a default of 100.
- The administrator can adjust the value of the share to each pool to determine how much bandwidth a pool gets to fulfil specific service levels. Pools with higher share number receives more physical network resources.

## NIOC resource pools include:

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1. Fault tolerance traffic
2. iSCSI traffic
3. vMotion traffic
4. Management traffic
5. vSphere Replication traffic
6. Network File System (NFS) traffic
7. Virtual Machine (VM) traffic
8. Host-based Replication (HBR) traffic
9. User-defined traffic

# vSphere Availability Features-:

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- vSphere Data Protection
- High Availability
- Fault Tolerance
- vSphere Replication



- vSphere Data Protection is a backup and recovery solution designed for vSphere environments. Powered by EMC Avamar, it provides agentless, image-level virtual-machine backups to disk. It also provides application-aware protection for business-critical Microsoft applications (such as Exchange, SQL Server and SharePoint) along with WAN-efficient, encrypted backup data replication.
- vSphere Data Protection is fully integrated with vCenter Server and vSphere Web Client.
- vSphere Data Protection can be deployed to Virtual Machine File System (VMFS), Network File System (NFS) and Virtual SAN datastores. Management of vSphere Data Protection is done using the vSphere Web Client. vSphere Data Protection is deployed as a virtual appliance with four processors (vCPUs) and at least 4GB of memory depending on the backup data capacity of the appliance.

- Several backup data capacity configurations are available ranging from .5TB to 8TB per vSphere Data Protection appliance. Capacity requirements are based on the number of protected virtual machines, data quantities, backup data retention periods and data change rates, all of which can vary considerably.



VMware vSphere High Availability delivers the availability required by most applications running in virtual machines, independent of the operating system and applications running in it. High Availability provides uniform, cost-effective failover protection against hardware and operating system outages within your virtualised IT environment. High Availability allows you to:

- Monitor VMware vSphere hosts and virtual machines to detect hardware and guest operating system failures.
- Restart virtual machines on other vSphere hosts in the cluster without manual intervention when a server outage is detected.
- Reduce application downtime by automatically restarting virtual machines upon detection of an operating system failure.



vSphere Fault Tolerance safeguards any virtual machine (with up to four virtual CPUs), including homegrown and custom applications that traditional high-availability products cannot protect. Key capabilities include the following:

- Compatible with all types of shared storage, including Fibre Channel, Internet Small Computer Systems Interface (iSCSI), Fibre Channel over Ethernet (FCoE) and Network-attached Storage (NAS).
- Compatible with all operating systems supported by vSphere.
- Works with existing VMware vSphere Distributed Resource Scheduler and VMware vSphere High Availability (HA) clusters for advanced load balancing and optimised initial placement of virtual machines.
- Contains a version-control mechanism that allows primary and secondary virtual machines to run on vSphere FT-compatible hosts at different, but compatible, patch levels.

- VMware vSphere Replication is an extension to VMware vCenter Server that provides hypervisor-based virtual machine replication and recovery.
- vSphere Replication replaces storage-based replication. It protects virtual machines from partial or complete site failures by replicating the virtual machines from a primary site to a secondary site.

vSphere Replication provides several benefits as compared to storage-based replication.

- Data protection at a lower cost per virtual machine
- A replication solution that allows flexibility in storage vendor selection at the primary and secondary sites.
- Overall lower cost per replication.

# vSphere Replication

- With vSphere Replication, you can replicate virtual machines from a primary datacenter to a secondary site quickly and efficiently. After you set up the replication infrastructure, you can choose the virtual machines to be replicated at a different Recovery Point Objective (RPO).
- You can configure all vSphere Replication features in the vSphere Web Client. You monitor the status of replication through the replication management and monitoring dashboard.

- NSX Data Center for vSphere is VMware's network virtualisation platform for the Software-Defined Data Center (SDDC), delivering networking and security features entirely in software, abstracted from the underlying physical infrastructure.
- In VMware's vision of Software-Defined Data Center, VMware NSX plays the role of virtualising the networking components. Thus, enabling creating multi-tier and complex networking programmatically in seconds.

**NSX Manager:** It is the centralised management plane. Upon deployment of NSX Manager, it installs some VIBs (VXLAN, Distributed Routing, Distributed Firewall and user world agent) on the host when host preparation is initiated.

**NSX vSwitch:** It is the software that operates in server hypervisors to form a software abstraction layer between servers and the physical network.

**NSX Controller:** It is a VM deployed by NSX Manager which acts as the Control Plane. NSX controller is the central control point for all logical switches within a network and maintains information of all virtual machines, hosts, logical switches, and VXLANs. The controller supports two new logical switch control plane modes; Unicast and Hybrid.

**NSX Edge:** NSX Edge provides network edge security and gateway services to isolate a virtualised network. You can install an NSX Edge either as a logical (distributed) router or as a service gateway. The NSX Edge gateway connects isolated, stub networks to shared (uplink) networks by providing common gateway services such as DHCP, VPN, NAT, dynamic routing, and Load Balancing. Common deployments of NSX Edge include in the DMZ, VPN Extranets, and multi-tenant cloud environments where the NSX Edge creates virtual boundaries for each tenant.

**Distributed Firewall:** NSX Distributed Firewall is a hypervisor kernel-embedded firewall that provides visibility and control for virtualised workloads and networks. You can create access control policies based on VMware vCenter objects like datacenters and clusters, virtual machine names and tags, network constructs such as IP/VLAN/VXLAN addresses, as well as user group identity from Active Directory.

## Summary

- Different aspect of vmware storages and High availability. There are lots of issues, which we have to understand while we deploy vmware.datacentre is vulnerable entity, so it is better to protect it and Find out all the loop holes of a data centre.
- NSX Distributed Firewall is a hypervisor kernel-embedded firewall that provides visibility and control for virtualised workloads and networks.
- NSX vSwitch is the software that operates in server hypervisors to form a software abstraction layer between servers and the physical network.
- In VMware's vision of Software-Defined Data Center, VMware NSX plays the role of virtualising the networking components. Thus, enabling creating multi-tier and complex networking programmatically in seconds.

## Self Assessment Questions

1. vSphere Platinum includes VMware AppDefense natively integrated into vCenter Server, so there are no agents to manage. State whether True or False.
  - a) True
  - b) False

**Answer: a**



## Self Assessment Questions

2. Which one of the following benefit is a characteristic of Persistent Memory (PMem) module?
- a) Super-fast performance
  - b) Low Price
  - c) Both a and b

**Answer: c**

## Self Assessment Questions

3. Which one of the following capability is supported by Instant Clone?
- a) vMotion
  - b) Distributed Resource Scheduler (DRS)
  - c) High Availability (HA)
  - d) All of the above

**Answer: d**

## Self Assessment Questions

4. Which one of the following is the maximum limit of VM configuration supported by vSphere 6.7?
- a) 128 vCPU, 4TB vRAM
  - b) 256 vCPU, 4TB vRAM
  - c) 128 vCPU, 6TB vRAM
  - d) 256 vCPU, 6TB Vram

**Answer: d**

## Assignment

**Q1.-** What are the basic differences between VMware and Hyper-v ?

**Q2.-** What is the hardware version used in VMware ESXi 6.5?

**Q3.-** What is the difference between the vSphere ESX and ESXi architectures?

# Features of vSphere and NSX

## Document link

Topic	URL	Notes
Availability Challenges	<a href="https://www.computerweekly.com/feature/VMware-five-biggest-challenges-of-server-virtualisation">https://www.computerweekly.com/feature/VMware-five-biggest-challenges-of-server-virtualisation</a>	Discuss challenges of vmware availability
Scalability Challenges	<a href="http://pages.cs.wisc.edu/~remzi/Classes/838/Spring2013/Papers/p95-sundararajan.pdf">http://pages.cs.wisc.edu/~remzi/Classes/838/Spring2013/Papers/p95-sundararajan.pdf</a>	Why scalable environment is vulnerable and need focus
Management Challenges	<a href="https://www.eginnovations.com/blog/top-5-monitoring-challenges-vmware-environments/">https://www.eginnovations.com/blog/top-5-monitoring-challenges-vmware-environments/</a>	Top-5 Performance Monitoring Challenges in VMware Environments

# Features of vSphere and NSX

## Ebook link

Ebook name	Chapter	Page No.	URL
vSphere Virtual Machine Administration	2-5	23-78	<a href="http://www.tu-varna.bg/tu-varnaknt/images/tutorials/vt/ve.pdf">http://www.tu-varna.bg/tu-varnaknt/images/tutorials/vt/ve.pdf</a>
Vmware vsphere 6.0 with vcentre server	1-5	45-90	<a href="https://ssl.www8.hp.com/de/de/pdf/virtuallisation_tcm_144_1147500.pdf">https://ssl.www8.hp.com/de/de/pdf/virtuallisation_tcm_144_1147500.pdf</a>

# Features of vSphere and NSX

## Video link

Topic	URL	Notes
Vmware Virtualization	<a href="https://youtu.be/6LDY9BatAQc">https://youtu.be/6LDY9BatAQc</a>	Basic of vmware
Container and VM	<a href="https://youtu.be/L1ie8negCjc">https://youtu.be/L1ie8negCjc</a>	Practical approach to create VM
Why use open stack for developer	<a href="https://youtu.be/Bk4NoUsikVA">https://youtu.be/Bk4NoUsikVA</a>	Part of Networking