Virtual Machine Management

Module 7
Importance

You must perform many cumbersome tasks when using physical machines. For example, you must move server storage from one storage array to another, deploy servers with the same configuration, and dynamically add resources.

The ability to clone and deploy virtual machines from a template enables you to capture the state of a problematic virtual machine or deploy a virtual machine from a preconfigured standard.

VMware vSphere® enables you to migrate virtual machines and virtual machine disks from one VMware vSphere® ESXi™ host to another while the virtual machines are running.
Module Lessons

Lesson 1: Creating Templates and Clones
Lesson 2: Modifying Virtual Machines
Lesson 3: Migrating Virtual Machines
Lesson 4: Creating Virtual Machine Snapshots
Lesson 5: Creating a vApp and Removing a Virtual Machine
Lesson 1: Creating Templates and Clones
Learner Objectives

After this lesson, you should be able to do the following:

- Create a template.
- Deploy a virtual machine from a template.
- Clone a virtual machine.
- Enable guest operating system customization by VMware® vCenter Server™.
A template is a master copy of a virtual machine. It is used to create and provision new virtual machines.

The template is an image that typically includes a guest operating system, a set of applications, and a specific virtual machine configuration.
Creating a Template

Clone the virtual machine to a template.
- The virtual machine can be powered on or powered off.

Convert the virtual machine to a template.
- The virtual machine must be powered off.

Clone a template.
- Select the template in inventory first.
Two ways to view templates:

- Use the VMs and Templates inventory view.
- Use the **Virtual Machines** tab in the Hosts and Clusters inventory view.
Deploying a Virtual Machine from Template

To deploy a virtual machine, you must provide such information as the virtual machine name, inventory location, host, datastore, and guest operating system customization data.

![Diagram showing VM deployment from template](image-url)
Updating a Template

To update a template:

1. Convert the template to a virtual machine.
2. Place the virtual machine on an isolated network to prevent user access.
3. Make appropriate changes to the virtual machine.
4. Convert the virtual machine to a template.
Cloning is an alternative to deploying a virtual machine.

A clone is an exact copy of the virtual machine.

The virtual machine being cloned can be powered on or powered off.
Customizing the Guest Operating System

VMware® recommends customization of a clone’s guest operating system to prevent software and network conflicts.

During cloning or deploying from template, you can run the Guest Customization wizard.

- You can create a specification that you can use to prepare the guest operating systems of virtual machines.
- Specifications can be stored in the database.
- You can edit specifications in the Customization Specifications Manager.
Virtual machine deployment is allowed across datacenters.

- Clone a virtual machine from one datacenter to another.
- Deploy from a template in one datacenter to a virtual machine in a different datacenter.
In this lab, you will deploy a virtual machine from a template and clone a virtual machine.

1. Copy Sysprep files to the vCenter Server instance.
2. Create a template.
3. Create customization specifications.
4. Deploy a virtual machine from a template.
5. Clone a virtual machine that is powered on.
Review of Learner Objectives

You should be able to do the following:

- Create a template.
- Deploy a virtual machine from a template.
- Clone a virtual machine.
- Enable guest operating system customization by vCenter Server.
Lesson 2: Modifying Virtual Machines
Learner Objectives

After this lesson, you should be able to do the following:

- Describe virtual machine settings and options.
- Add a hot-pluggable device.
- Dynamically increase the size of a virtual disk.
- Add a raw device mapping (RDM) to a virtual machine.
Modifying Virtual Machine Settings

You can modify a virtual machine’s configuration in its Properties dialog box:

- Add virtual hardware.
  Some hardware can be added while the virtual machine is powered on.
- Remove virtual hardware.
- Set virtual machine options.
- Control a virtual machine’s CPU and memory resources.
- Create an RDM.
Hot-Pluggable Devices

Examples of hot-pluggable devices: USB controllers, Ethernet adapters, and hard disk devices.

You can also add CPU and memory while the virtual machine is powered on.
Creating an RDM

To create an RDM:

- Edit settings to modify the virtual machine configuration.
- Click the **Add** button to add a device.
- Click **Hard Disk**.
- Select **Raw Device Mappings** and complete the Add Hardware wizard information by defining the following items:
  - **Target LUN** – LUN that the RDM will map to
  - **Mapped datastore** – Store the RDM file with the virtual machine or on a different datastore.
  - **Compatibility mode**
  - **Virtual Device Node**
Dynamically Increasing a Virtual Disk’s Size

Increases the size of the existing virtual disk file

Dynamically increase a virtual disk from, for example, 2GB to 20GB.
If you create a virtual disk in thin format, you can later inflate it to its full size.

To inflate a thin-provisioned disk:

- Right-click the virtual machine’s .vmdk file and select Inflate.
Virtual Machine Options

- VM display name
- .vmx file location
- VM directory
- guest operating system type
Options: VMware Tools

Customize power button actions.

When to run VMware Tools scripts

Update checks and time sync.
Advanced options rarely have to be set.

- **Delay power on:**
  - Whenever the virtual machine is powered on or reset, delay the boot for the following number of milliseconds: 0

- **Boot into BIOS:**
  - The next time the virtual machine boots, force entry into the BIOS setup screen.

- **Retry after failed boot:**
  - When the virtual machine fails to find boot device, automatically retry boot after 10 seconds.
In this lab, you will modify a virtual machine’s hardware and add a raw LUN to a virtual machine.

1. Increase the size of a VMDK file.
2. Adjust memory allocation on a virtual machine.
3. Rename a virtual machine in the vCenter Server inventory.
4. Add a raw LUN to a virtual machine and verify that the guest operating system can see it.
5. Expand a thin-provisioned virtual disk.
Review of Learner Objectives

You should be able to do the following:

- Describe virtual machine settings and options.
- Add a hot-pluggable device.
- Dynamically increase the size of a virtual disk.
- Add an RDM to a virtual machine.
Lesson 3:
Migrating Virtual Machines
After this lesson, you should be able to do the following:

- Describe the types of migration.
- Explain the importance of VMware vSphere® vMotion®.
- Identify vMotion requirements (virtual machine, host).
- Verify vMotion requirements (CPU constraints and guidelines).
- Perform a vMotion migration.
- Perform a VMware vSphere® Storage vMotion® migration.
- Perform an Enhanced vMotion migration.
Migrating Virtual Machines

Migration – Moving a virtual machine from one host or datastore to another. Types of migrations:

- Cold – Migrate a virtual machine that is powered off.
- Suspended – Migrate a virtual machine that is suspended.
- vMotion – Migrate a virtual machine that is powered on.
- Storage vMotion – Migrate a virtual machine’s files, while the virtual machine is powered on, to a different datastore.

Concurrent migrations are possible:

- A maximum of eight simultaneous vMotion, cloning, deployment, or Storage vMotion accesses to a single VMware vSphere® VMFS-5 datastore is supported.
## Comparison of Migration Types

<table>
<thead>
<tr>
<th>Migration type</th>
<th>Virtual machine power state</th>
<th>Change host/datastore?</th>
<th>Across virtual datacenters?</th>
<th>Shared storage required?</th>
<th>CPU compatibility?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold</td>
<td>Off</td>
<td>Host or datastore or both</td>
<td>Yes</td>
<td>No</td>
<td>Different CPU families allowed</td>
</tr>
<tr>
<td>Suspended</td>
<td>Suspended</td>
<td>Host or datastore or both</td>
<td>Yes</td>
<td>No</td>
<td>Must meet CPU compatibility requirements</td>
</tr>
<tr>
<td>vMotion</td>
<td>On</td>
<td>Host</td>
<td>No</td>
<td>Yes</td>
<td>Must meet CPU compatibility requirements</td>
</tr>
<tr>
<td>Storage vMotion</td>
<td>On</td>
<td>Datastore</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Enhanced vMotion</td>
<td>On</td>
<td>Both</td>
<td>No</td>
<td>No</td>
<td>Must meet CPU compatibility requirements</td>
</tr>
</tbody>
</table>
A vMotion migration moves a powered-on virtual machine from one host to another.

vMotion can be used to:

- Improve overall hardware utilization
- Enable continued virtual machine operation while accommodating scheduled hardware downtime
- Enable vSphere Distributed Resource Scheduler (DRS) to balance virtual machines across hosts
How vMotion Migration Works

VM A (network = Production)

vMotion network

Production network

memory bitmap

esx02

virtual disk and config files

shared storage

memory

VM A (network = Production)
A virtual machine must meet the following requirements:

- A virtual machine must not have a connection to an internal standard virtual switch (vSwitch with zero uplink adapters).
- A virtual machine must not have a connection to a virtual device (such as a CD-ROM or floppy drive) with a local image mounted.
- A virtual machine must not have CPU affinity configured.
- If the virtual machine’s swap file is not accessible to the destination host, vMotion must be able to create a swap file accessible to the destination host before migration can begin.
- If a virtual machine uses an RDM, the RDM must be accessible by the destination host.
Host Requirements for vMotion Migration

Source and destination hosts must have:

- Visibility to all storage (Fibre Channel, iSCSI, or NAS) used by the virtual machine:
  - 128 concurrent vMotion migrations per VMFS datastore

- At least a Gigabit Ethernet (GigE) network:
  - Four concurrent vMotion migrations on a 1Gbps network
  - Eight concurrent vMotion migrations on a 10Gbps network

- Identically named port groups connected to the same physical networks

- Compatible CPUs:
  - CPU feature sets of both the source and destination host must be compatible.
  - Some features can be hidden by using Enhanced vMotion Compatibility (EVC) or compatibility masks.
## CPU Constraints on vMotion Migration

<table>
<thead>
<tr>
<th>CPU characteristics</th>
<th>Exact match required?</th>
<th>Why or why not?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock speeds, cache sizes, hyperthreading, and number of cores</td>
<td>No</td>
<td>Virtualized away by the VMkernel</td>
</tr>
<tr>
<td>Manufacturer <em>(Intel or AMD)</em> Family <em>(P4, Opteron)</em></td>
<td>Yes</td>
<td>Instruction sets contain many small differences.</td>
</tr>
<tr>
<td>Presence or absence of SSE3, SSSE3, or SSE4.1 instructions</td>
<td>Yes</td>
<td>Multimedia instructions usable directly by applications</td>
</tr>
<tr>
<td>Virtualization hardware assist</td>
<td>For 32-bit VMs: No</td>
<td>Virtualized away by the VMkernel</td>
</tr>
<tr>
<td></td>
<td>For 64-bit VMs on Intel: Yes</td>
<td>The VMware Intel 64-bit implementation leverages VT.</td>
</tr>
<tr>
<td>Execution-disable (NX/XD bit)</td>
<td>Yes (but customizable)</td>
<td>Guest operating system relies on NX/XD bit if detected.</td>
</tr>
</tbody>
</table>
Choose between NX/XD security features or broadest vMotion compatibility.

For future CPU features, edit mask at the bit level.
Identifying CPU Characteristics

To identify CPU characteristics, use the server and CPU specifications, or use the VMware CPU identification utility.
Verifying vMotion Layout: Virtual Machine Map
Checking vMotion Errors

The virtual machine has CPU and/or memory affinities configured, which is preventing vMotion.
Storage vMotion enables you to:

- Perform storage maintenance and reconfiguration
- Redistribute storage load
- Evacuate physical storage soon to be retired
- Perform storage tiering
- Upgrade ESXi hosts without virtual machine downtime

Storage vMotion is independent of storage type.

- Source and destination can be different storage types.
Storage vMotion in Action

1. Initiate storage migration.

2. Use the VMkernel data mover or VMware vSphere® Storage APIs - Array Integration (VAAI) to copy data.

3. Start a new virtual machine process.

4. Mirror I/O calls to file blocks that have already been copied to virtual disk on the destination datastore.

5. Cut over to the destination VM process to begin accessing the virtual disk copy.
Storage vMotion performs up to 4 parallel disk migrations per Storage vMotion operation.

- In previous versions, Storage vMotion used to copy virtual disks serially.
- Limit of two concurrent Storage vMotion operations per host.
Storage vMotion Guidelines and Limitations

Guidelines:
- Plan and coordinate with administrators.
- Perform during off-peak hours.
- Ensure that the host has access both to source datastores and target datastores.

Limitations:
- Virtual machine disks must be in persistent mode or be RDMs.
Enhanced vMotion

- Combine vMotion and Storage vMotion into a single operation
- Migrate between hosts and clusters without shared storage
Enhanced vMotion is only available in the vSphere Web Client.

- Change host: Move the virtual machine to another host.
- Change datastore: Move the virtual machine's storage to another datastore.
- Change both host and datastore: Move the virtual machine to another host and move its storage to another datastore. The virtual machine must be powered off to change the VM's host and datastore.

Windows vSphere Client vs vSphere Web Client
Enhanced vMotion Considerations

Single Migration to Change Both Host and Datastore

- Hosts must be managed by the same vCenter Server instance.
- Hosts must be part of the same Datacenter.
- Hosts must be on the same layer-2 network (and same switch if VDS is used).

Operational Considerations:

- Enhanced vMotion is a manual process:
  - DRS and SDRS do not leverage enhanced vMotion.
- Maximum of 2 concurrent Enhanced vMotions per host:
  - Enhanced vMotions count when considering concurrent limitations for both vMotion and Storage vMotion.
- Enhanced vMotion leverages multi-NIC when available.
In this lab, you will use vMotion and Storage vMotion to migrate virtual machines.

- Migrate virtual machine files with Storage vMotion.
- Create a virtual switch and a VMkernel port group for vMotion migration.
- Verify that your ESXi host meets vMotion requirements.
- Verify that your virtual machines meet vMotion requirements.
- Perform a vMotion migration of a virtual machine on a shared datastore.
- Perform a vMotion migration to a private datastore.
- Prepare for the next lab.
Review of Learner Objectives

You should be able to do the following:

- Describe the types of migration.
- Explain the importance of vMotion.
- Identify vMotion requirements (virtual machine, host).
- Verify vMotion requirements (CPU constraints and guidelines).
- Perform a vMotion migration.
- Perform a Storage vMotion migration.
- Perform an Enhanced vMotion Migration.
Lesson 4:
Creating Virtual Machine Snapshots
Learner Objectives

After this lesson, you should be able to do the following:

- Take a snapshot of a virtual machine and manage multiple snapshots.
- Delete virtual machine snapshots.
- Consolidate snapshots.
Virtual Machine Snapshots

Snapshots enable you to preserve the state of the virtual machine so that you can return to the same state repeatedly.

For example, if you make changes while testing software, snapshots enable you to back out of those changes.
A snapshot consists of a set of files: the memory state file (.vmsn), the description file (−00000#.vmdk), and the delta file (−00000#-delta.vmdk).

The snapshot list file (.vmsd) keeps track of the virtual machine’s snapshots.
You can take a snapshot while a virtual machine is powered on, powered off, or suspended.

A snapshot captures the state of the virtual machine:
- Memory state, settings state, and disk state

Snapshots are not backups.
Managing Snapshots

The Snapshot Manager enables you to review all snapshots for the active virtual machine and act on them directly:

- Revert to (Go to) a snapshot.
- Delete one or all snapshots.
Deleting a Virtual Machine Snapshot (1)

- base disk (5GB) + snap01 data
- snap01 delta (1GB)
- snap02 delta (2GB)
Deleting a Virtual Machine Snapshot (2)

- base disk (5GB)
- snap01 delta (1GB) + snap02 delta (2GB)
- snap02 delta (2GB)
Deleting a Virtual Machine Snapshot (3)

- base disk (5GB)
- snap01 delta (1GB)
- snap02 delta (2GB)

You are here.
Deleting All Virtual Machine Snapshots

base disk (5GB) + snap01/02 data

snap01 delta (1GB)

snap02 delta (2GB)

You are here.
What is snapshot consolidation?

- A method used to commit a chain of snapshots to the original virtual machine when the Snapshot Manager shows that no snapshots exist, but the delta files still remain on the datastore.

Snapshot consolidation is intended to resolve known issues with snapshot management:

- The snapshot descriptor file is committed correctly, but the Snapshot Manager incorrectly shows that all the snapshots are deleted.
- The snapshot files (-delta.vmdk) are still part of the virtual machine.
- Snapshot files continue to expand until the virtual machine runs out of datastore space.
Discovering When to Consolidate

The Snapshot Manager displays no snapshots. But a warning on the Summary tab of the virtual machine notifies the user that a consolidation is required.
Performing Snapshot Consolidation

Select Consolidate to reconcile snapshots.

Any snapshots found are committed to the virtual machine.
Removing a Virtual Machine

Two ways to remove a virtual machine:

- Remove a virtual machine from the inventory:
  - This type of removal registers the virtual machine.
  - The virtual machine’s files remain on the disk.
  - The virtual machine can later be registered (added) to the inventory.

- Delete a virtual machine from disk.
  - The virtual machine is removed from the inventory, and its files are permanently deleted from the disk.
In this lab, you will perform several virtual machine management tasks.

1. Unregister a virtual machine in the vCenter Server inventory.
2. Register a virtual machine in the vCenter Server inventory.
3. Unregister and delete virtual machines from disk.
4. Take snapshots of a virtual machine.
5. Revert to a snapshot.
6. Delete an individual snapshot.
7. Use the **Delete All** button in Snapshot Manager.
Review of Learner Objectives

You should be able to do the following:

- Take a snapshot of a virtual machine and manage multiple snapshots.
- Delete virtual machine snapshots.
- Consolidate snapshots.
Lesson 5: Creating a vApp and Removing a Virtual Machine
Learner Objectives

After this lesson, you should be able to do the following:

- Describe a vSphere vApp.
- Build a vApp.
- Use a vApp to manage virtual machines.
- Remove a virtual machine from the vCenter Server inventory.
- Remove a virtual machine completely from disk.
Managing Virtual Machines with a vApp

A vApp:
- Is a container for one or more virtual machines
- Can be used to package and manage related applications
- Is an object in the vCenter Server inventory
vApp Characteristics

You can configure a vApp:

- CPU and memory allocation
- IP allocation policy
- Advanced settings

You can also configure the virtual machine startup and shutdown order.
In this lab, you will perform vApp management tasks.

1. Create a vApp.
Review of Learner Objectives

You should be able to do the following:

- Describe a vApp.
- Build a vApp.
- Use a vApp to manage virtual machines.
- Remove a virtual machine from the vCenter Server inventory.
- Remove a virtual machine completely from disk.
vCenter Server provides useful features for provisioning virtual machines, such as templates and cloning.

Deploying virtual machines from a template enables you to create many virtual machines easily and quickly.

vMotion can be used to move virtual machines while they are powered on.

Storage vMotion can be used to move virtual machines from one datastore to another.

Enhanced vMotion enables live virtual machine migration when shared storage is not available.

Virtual machine snapshots enable you to preserve the state of the virtual machine so that you can return to the same state repeatedly.

A vApp is a container for one or more virtual machines. The vApp can be used to package and manage related applications.