This book will provide you with the skills you’ll need to plan, deploy, and manage VMware vSphere infrastructures. Starting with an introduction to vCenter Server and managing single and multiple ESXi servers, you’ll learn the basics of vSphere’s architecture of virtualization, hypervisors, and virtual infrastructure, and discover how to create and manage virtual machines. You’ll learn network management using inbuilt vSphere operations and network virtualization using VMware NSX technology, along with virtual storage in a vSphere environment. You’ll go on to implement and configure VSAN with vSphere and discover the advanced operations that can be performed with virtual machines. By the end of this book, you will have explored critical components in vSphere—HA, FT, and DRS security of vSphere architecture, and some vSphere 6.0 new features.

Who this book is written for
This book is intended for virtualization administrators who want to learn VMware vSphere quickly. It is assumed that you have some basic knowledge of virtualization and the vSphere environment.

What you will learn from this book
- Explore a multiple-host virtualization environment with ESXi and vCenter Server
- Create and manage virtual machines
- Create and configure vNetwork Switches to manage your virtual networks
- Build software-defined, performance-oriented shared storage and network topologies with VSAN and NSX
- Discover features such as vMotion, Storage vMotion, snapshots, templates, and cloning
- Familiarize yourself with vSphere High Availability, Fault Tolerance, DRS, and Update management
- Discover some of the newly added vSphere 6.0 features

Foreword by Brad Hedlund, Engineering Architect, Network Virtualization VMware, Inc.
In this package, you will find:

- The author's biography
- A preview chapter from the book, Chapter 3 'Creating Virtual Machines'
- A synopsis of the book’s content
- More information on VMware vSphere Essentials

About the Authors

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You can check out his personal blog about various IT topics at http://www.stankowic-development.net.
VMware vSphere Essentials

If you ask me what has been the biggest innovation in the last 10 years in IT, I'd answer—virtualization. In comparison with legacy infrastructure designs, this has enabled IT administrators to serve applications and workloads more cost-effectively. Fulfilling flexible IT requirements was never this easy before.

VMware acts as a global player in this market; they have introduced numerous innovations in the last few years and given virtualization an enormous push. VMware dominates the server as well as the desktop virtualization market. As a result, most of the major data centers are using rock-solid VMware products to suit their customers' infrastructure needs.

This book is an introduction for those who are looking forward to benefit from the proven vSphere infrastructure. You will learn how vSphere products can assist you to implement a dynamic and scalable virtual infrastructure while reducing your infrastructure costs.

So, are you ready for the takeoff?

What This Book Covers

Chapter 1, Introduction to VMware vSphere, introduces the book by covering all the essential basics including the vSphere architecture and how it differs from its competitor's products. You will also get to know about all the major components of virtual infrastructures, such as virtual machines, CPUs, memory, networks, and storage.

Chapter 2, VMware vCenter Server, will introduce the vCenter Server product family and the benefits of using them. You will learn how to install, configure, and use vCenter Server to manage your virtual infrastructure.

Chapter 3, Creating Virtual Machines, covers elementary tasks that include provisioning, configuring, and using virtual machines, clones, and templates. It is designed as a step-by-step guide for new users.

Chapter 4, Managing Virtual Network, demonstrates networking concepts for virtual infrastructures, it specifically introduces virtual switches, port groups, VLANs, and advanced technologies such as load balancing.

Chapter 5, Network Virtualization with VMware NSX, focuses on VMware's most recent technology for automating network deployment and configuration tasks. By the end of this chapter, you will learn how NSX is able to address large virtual infrastructure needs and how you can deploy NSX.
Chapter 6, Managing Virtual Storage, covers essential storage concepts, such as configuring, managing, and using VMFS and NFS data stores. To top it off, the chapter also includes implementing backup and recovery using the example of vSphere Data Protection.

Chapter 7, Working with VSAN, introduces a cost-effective and efficient way to provide high-performance storage to virtual infrastructures. Especially in combination with storage policies, VSAN is able to address the most workload's requirements.

Chapter 8, Managing Virtual Machines, demonstrates various advanced virtual machine tasks that include taking snapshots and migrating and upgrading virtual machines.

Chapter 9, Resource Management and Performance Monitoring, focuses on several ways to optimize a virtual infrastructure's resources. It is designed as a step-by-step guide that will explain how you can implement resource pools, limitations, reservations, and alarms.

Chapter 10, Incorporating vSphere High Availability, Fault Tolerance, and DRS, covers major technologies to fulfill workload's availability requirements. You will also learn how to enable automatic load balancing of computing and storage resources using vSphere DRS and vSphere Storage DRS.

Chapter 11, Securing and Updating vSphere, introduces techniques to secure virtual infrastructures such as firewalls, security profiles, and vCloud Networking and Security. It also demonstrates how you can implement patch management using vSphere Update Manager.

Chapter 12, vSphere 6.0 Overview, talks about the most recent VMware product update. The chapter is a deep-dive into all technical difference in comparison with vSphere 5.5, such as virtual hardware versions, NVIDIA GRID vCPU, vCloud Air Disaster Recovery, and VSAN All-Flash.
Creating Virtual Machines

In the previous chapter, we discussed about vCenter Server and how it acts as the centralized management console for the vSphere environment. It is established that vCenter is used to manage multiple ESXi hosts and virtual machines from a centralized location. It is accessed using the vSphere legacy client or vSphere Web Client.

In this chapter, we will cover basic operations with a virtual machine, such as creation, provisioning, guest operating system installation, and creating clones/templates. This chapter will cover the following topics and act as a step by step guide to perform the listed operations with virtual machines:

- Overview of virtual machines
- Creating a virtual machine
- Creating a virtual machine using an OVF template
- Thick and Thin Provisioning of virtual disks
- Installing a guest operating system
- Creating templates and clones

Overview of virtual machines

Before we dive into operations that can be performed on virtual machines, let us first take an overview about virtual machines and the files that they are made up of. The generic definition of a virtual machine states that it is a mediation to the host CPU’s hardware virtualization features. A virtual machine is a software implementation of a computer machine. Note that it is not emulation, as an emulator would also emulate the complete CPU, which is not applicable to vSphere. A virtual machine executes the processes in the same way a physical computer does. It provides a complete set of system platform on which an operating system and a set of applications can run.
Creating Virtual Machines

However, as per VMware, a virtual Machine is a set of virtual hardware and features (in software format), in which a supported guest operating system and its applications can run. It is a set of discrete files. When a virtual machine is created, it creates with itself, a set of files which are used for specific purposes.

We will now discuss more about the set of particular files.

Virtual machine files

Whenever a virtual machine is created, a set of files is created during the process. Some of the files are created when the virtual machine is powered on, and some are created when a particular function is being called upon the machine. But each of these files has a significant role to play in the smooth operations/functioning of the virtual machine.

Following table shows the set of files created for a virtual machine named **VM** as an example:

<table>
<thead>
<tr>
<th>File extension</th>
<th>File name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.vmx</td>
<td>VM.vmx</td>
<td>Virtual machine configuration file</td>
</tr>
<tr>
<td>.nvram</td>
<td>VM.nvram</td>
<td>VM's virtual BIOS configuration and NVRAM state</td>
</tr>
<tr>
<td>.vmdk</td>
<td>VM.vmdk</td>
<td>VM's disk descriptor file</td>
</tr>
<tr>
<td>-Flat.vmdk</td>
<td>VM-flat.vmdk</td>
<td>VM's actual data (storage) file (OS/application, data)</td>
</tr>
<tr>
<td>.vswp</td>
<td>VM.vswp</td>
<td>VM's swap file (similar to Swap files in Linux)</td>
</tr>
<tr>
<td>.vmsd</td>
<td>VM.vmsd</td>
<td>VM's snapshot manager file</td>
</tr>
<tr>
<td>.vmsn</td>
<td>VM.vmsn</td>
<td>VM's snapshot state file</td>
</tr>
<tr>
<td>-00000#.vmdk</td>
<td>VM-000001.vmdk</td>
<td>VM's snapshot disk descriptor file</td>
</tr>
<tr>
<td>-00000#-delta.vmdk</td>
<td>VM-000001-flat.vmdk</td>
<td>Snapshot disk data file</td>
</tr>
<tr>
<td>vmware.log</td>
<td>vmware.log</td>
<td>Log file for every virtual machine; older logs are kept and renamed (vmware.log.1, vmware.log.2,...)</td>
</tr>
<tr>
<td>.rdm</td>
<td>VM.rdm</td>
<td>Raw device mapping file</td>
</tr>
<tr>
<td>.vmss</td>
<td>VM.vmss</td>
<td>Virtual machine state file</td>
</tr>
</tbody>
</table>
The following screenshot displays the virtual machine files for Windows 7:

<table>
<thead>
<tr>
<th>Name</th>
<th>Size</th>
<th>Modified</th>
<th>Type</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 7.vmdk</td>
<td>41.943,040 KB</td>
<td>5/19/15, 10:39...</td>
<td>Virtual Disk</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vmdk</td>
</tr>
<tr>
<td>Windows 7.vmx</td>
<td>2.8 KB</td>
<td>5/19/15, 10:39...</td>
<td>Virtual Machine</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vmx</td>
</tr>
<tr>
<td>Windows 7.vmem</td>
<td>2.75 KB</td>
<td>5/19/15, 10:39...</td>
<td>File</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vmem</td>
</tr>
<tr>
<td>Windows 7.vmem.lic</td>
<td>0 KB</td>
<td>5/19/15, 10:39...</td>
<td>File</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vmem.lic</td>
</tr>
<tr>
<td>vms-Windows 7-3816206861-1.vswap</td>
<td>194,569 KB</td>
<td>5/19/15, 10:39...</td>
<td>File</td>
<td>[ESX04_VMs] Windows 7/vms-Windows 7-3816206861-1.vswap</td>
</tr>
<tr>
<td>Windows 7.vram</td>
<td>8.48 KB</td>
<td>5/19/15, 10:39...</td>
<td>Non-volatile Memory File</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vram</td>
</tr>
<tr>
<td>Windows 7-e370661.vswap</td>
<td>2,057,102 KB</td>
<td>5/19/15, 10:39...</td>
<td>File</td>
<td>[ESX04_VMs] Windows 7/Windows 7-e370661.vswap</td>
</tr>
<tr>
<td>vmmware.log</td>
<td>117.21 KB</td>
<td>5/19/15, 10:39...</td>
<td>VM Log File</td>
<td>[ESX04_VMs] Windows 7/vmmware.log</td>
</tr>
<tr>
<td>Windows 7.vmsd</td>
<td>0 KB</td>
<td>5/19/15, 10:39...</td>
<td>File</td>
<td>[ESX04_VMs] Windows 7/Windows 7.vmsd</td>
</tr>
</tbody>
</table>

### Virtual hardware versions

A virtual machine is created on the basis of a set of virtual hardware and features called virtual hardware (often also called vHW or VMHW version). During deployment of a virtual machine using the custom wizard, it is possible to specify a particular vHW version. Depending on the virtual machine's guest operating system, it might be necessary to choose a specific version.

The following table shows major differences between the last three virtual hardware versions:

<table>
<thead>
<tr>
<th></th>
<th>vSphere 5.1</th>
<th>vSphere 5.5</th>
<th>vSphere 6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum vHW</td>
<td>Version 9</td>
<td>Version 10</td>
<td>Version 11</td>
</tr>
<tr>
<td>Virtual CPUs</td>
<td>64</td>
<td></td>
<td>128</td>
</tr>
<tr>
<td>Virtual RAM</td>
<td>1 TB</td>
<td></td>
<td>4 TB</td>
</tr>
<tr>
<td>vDisk size</td>
<td>2 TB</td>
<td>62 TB</td>
<td></td>
</tr>
<tr>
<td>SCSI adapters / targets</td>
<td>4 / 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SATA adapters / targets</td>
<td>Not supported</td>
<td>4 / 30</td>
<td></td>
</tr>
<tr>
<td>Nvidia vGPU</td>
<td>Not supported</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Parallel / Serial ports</td>
<td>3 / 4</td>
<td></td>
<td>3 / 32</td>
</tr>
</tbody>
</table>
Some guest operating systems require a newer virtual hardware version. VMware offers a very comprehensive list of supported guest operating systems at


The oldest virtual hardware version, supported on all vSphere releases mentioned above, is vHW 4 (ESXi 3.x). It is possible to upgrade a virtual machine's vHW version. Note that this process cannot be undone. Make sure to create a backup of the virtual machine and check in advance whether the guest operating system is supported on the new vHW release. Once updated, a downgrade is not possible. The vSphere legacy client is not supported to add new features that came with vHW release 9 or higher (for example, USB 3.0 xHCI controllers), but it is possible to edit previously supported features. It is a common practice to use vSphere Web Client for virtual machines with vHW version 9 or higher.

Creating a virtual machine

An administrator can create a virtual machine using many different methods. In this chapter, we will cover how an administrator can create virtual machines manually. The two methods which we will discuss are:

- Creating a virtual machine using the New Virtual Machine Wizard
- Importing a virtual appliance

Creating a new virtual machine using the wizard

An Administrator can open New Virtual Machine Wizard using the vSphere legacy client or vSphere Web Client, to create a virtual machine. Creating a virtual machine using the wizard is very simple; once the wizard is open, you just have to feed the right information to it and the virtual machine is created.

The following steps need to be performed in each scenario:

- **Creating through a vSphere legacy client**: Right-click the ESXi host in the inventory and select New Virtual Machine
- **Creating through vSphere Web Client**: From the data center or host in the inventory, right-click the Action menu and click New Virtual Machine
The following screenshot shows the menu item in vSphere Web Client for creating new virtual machines.

Once the **New Virtual Machine Wizard** starts, the administrator can choose between a **Typical** and **Custom** configuration to create a virtual machine. However, you do not get this option if you are using vSphere Web Client to create the new virtual machine by using the wizard.
Creating Virtual Machines

Regardless of the location from where the administrator is trying to create the virtual machine, the following information has to be provided:

- The virtual machine's name
- The data store on which to store the virtual machine files
- The guest operating system which will be installed
- The number of NICs and the virtual network to connect to
- Virtual disk provisioning type

If the user selects to create the virtual machine with the Custom configuration, the following additional information is required:

- Virtual machine hardware version (version 10 being the latest)
- Number of CPUs and cores per CPU
- Size of the memory
- SCSI controller type
- Whether to create a disk, use an existing disk, create a RDM, or use no disk
- Whether to store the virtual machine disk (vmdk) with the virtual machine files or on a separate data store.
- Mode-Independent (persistent disk or nonpersistent disk)

The persistent disk commits the changes immediately and permanently when any data is written to it. The nonpersistent disk discards the changes when a virtual machine is powered off.

Regardless of the configuration type selected, the administrator can attach an ISO image to the virtual CD/DVD drive after the virtual machine is created.

Importing an OVF file

An administrator can deploy virtual appliances using a Open Virtualization Format (OVF) template. A virtual appliance is basically one or multiple preconfigured virtual machines. It includes a preinstalled guest operating system and other software. The administrator doesn't need to install any operating system on the new virtual machine as it is already installed and is ready to use. A virtual appliance is designed for a specific purpose, for example, to provide a secure web browser, a firewall, backup server, or recovery utility. In the previous chapter, we learned that vCenter Server Appliance is also deployed using an OVF template.
A virtual appliance can be added, removed, or imported to vCenter Server or an
ESXi host inventory. Virtual appliances are deployed as an OVF template. OVF is
a platform-independent, efficient, extensible, and open platform for distributing
virtual appliances. OVF templates are in compressed format and are easy to
download. Virtual appliances can also be imported from VMware Virtual Appliance
Marketplace at

https://solutionexchange.vmware.com/store/category_groups/virtual-
appliances.

The vSphere Web Client validates an OVF file before importing it and ensures that
it is compatible with the destination server on which it will be imported. If the
appliance is not compatible with the server, then it cannot be imported.

To import a virtual appliance, perform the following steps:

1. Select the host or cluster in the inventory, select the **Actions** menu, and click
   **Deploy OVF Template**....
2. Point to the OVF file from where the virtual appliance will be imported.
3. Enter a VM name and select the data store the template will be deployed on.
4. Some OVF templates require additional information like network settings. If
   applicable, enter them.
5. Review and acknowledge the configuration.

The following screenshots shows the menu item in vSphere Web Client for
deploying OVF templates:
Creating Virtual Machines

Thick and thin provisioning of virtual disks

Virtual disk provisioning is the process of managing storage space by allocating storage space on "as and when needed" basis. This simplifies storage administration by meeting capacity allocation on request. When creating a virtual disk for the virtual machine, there are three disk types available:

- **Thick Provision Lazy-Zeroed**: When this option is selected, a virtual disk is created in a default thick format. If we create a 20 GB disk with this type, then 20 GB space is reserved for the virtual disk. However, the data on the physical device is not erased during the creation process; instead it is zeroed (erased) out on demand later during write operations on unused blocks inside the virtual machine.

- **Thick Provision Eager-Zeroed**: When this option is selected, the complete space is allocated to the virtual disk during the time of creation. In contrast to Lazy-Zeroed, the data remaining on the physical device is zeroed out during the creation process. Thick Provisioned Eager zeroed supports clustering features like fault tolerance and offers the best I/O performance.

- **Thin Provision**: This format is used to save storage space. An administrator can provision as much datastore space as the disk would require; however, the thin disk starts small at first and uses as much disk as it requires for its operations, and rest of the disk space is unconsumed. Note that over-allocating datastores requires a higher level of management and alerting, to ensure not filling up a LUN. If a datastore containing a virtual machine's virtual disk has no remaining storage capacity, the virtual machine will be paused to avoid data corruption. Thin Provision is often used along with **Virtual Desktop Infrastructure (VDI)** setups and Linked Clones, as the high amount of virtual machines share virtual disk blocks to reduce storage needs.

Installing a guest operating system

Installing a guest operating system is the same as installing the operating system in a physical machine. To install a guest operating system, perform the following steps:

1. Connect to the virtual machine using the console tab.

2. The administrator can attach the ISO image on to the virtual CD/DVD drive, or directly connect to the physical ESXi host's CD/DVD drive. It is also possible to pass through the CD/DVD drive of the computer accessing the virtual machine's console.

3. Install the operating system.
Customizing the guest operating system

Whether cloning a virtual machine or deploying a virtual machine from a template, an administrator can customize its guest operating system to change certain properties, such as the following:

- Hostname
- License information
- Network settings

Customizing the guest operating system can help prevent the software and network conflict, which occurs when the virtual machines with identical configuration are created. The conflicts can be due to similar hostnames or IP addresses.

Administrator can create the customization specifications in Customization Specification Manager. These customization specifications are stored in the vCenter Server database. During cloning or deploying, the administrator can select the specification to be applied to the virtual machine.

Implementing customization specifications is an advanced topic that depends on the guest operating system chosen by the user. VMware offers a great documentation about this feature, available at https://pubs.vmware.com/vsphere-51/index.jsp?topic=%2Fcom.vmware.vsphere.vm_admin.doc%2FGUID-EB5F090E-723C-4470-B640-50B35D1EC016.html

VMware Tools

VMware Tools VMware Tools is a set of special drivers and also utilities that enhance the performance of the operating system running inside the virtual machine.

Installing VMware Tools is not mandatory, but it is the best practice to install them in all the virtual machines. VMware Tools, when installed, provide the following benefits:

- Device drivers such as SVGA, network card, and Ballooning drivers for memory management and improved mouse performance
- Virtual machine heartbeat
- Time synchronization of the guest operating system with ESXi server
- Ability to shut down the virtual machine
- Additional performance monitoring options
Creating Virtual Machines

The VMware Tools installation process differs per guest operating system. For example, Windows systems will show a graphical installation wizard, while Linux systems will have a command line-interface setup utility, based on the Perl language.

To install VMware Tools, select the virtual machine from the inventory and right-click All vCenter Tasks | Guest Operating System | Install/Upgrade VMware Tools. For the vSphere legacy client, the user has to select Inventory | Virtual Machine | Guest | Install/Upgrade VMware Tools.

Creating templates and clones
A template is a master copy of a virtual machine. It is used to create and provision multiple other virtual machines of same type, including the same guest operating system and its configuration.

A template generally includes the following:

- A guest operating system
- A set of applications
- Virtual hardware configuration

Creating a template makes the provisioning of multiple virtual machines faster and easier. It is very easy to deploy virtual machines from a template, and it saves a lot of time which was otherwise used in installing the guest operating system and applications.

A template can be created in many ways:

- **Clone a Virtual Machine to Template**: The virtual machine's power status doesn't affect this process; it can be powered on or off. In this case, we will continue to have the original virtual machine, and a new template of the same virtual machine will also be created.

- **Convert a Virtual Machine to a Template**: The virtual machine should be powered off. In this case, the original virtual machine is no longer present and it is converted to a template.

- **Clone a Template**: In this, we duplicate an already created template. As a template is already in powered-off state, the cloned template will also be in the same state.
Deploying a virtual machine from a template

The following steps are required to deploy a virtual machine from a template:

1. Select the template in the **VMs and Templates** view.
2. Right-click the template and select **Deploy VM from this Template**.

The deploy template wizard will start and prompt for information related to virtual machine deployment.

The following screenshots shows the menu item in vSphere Web Client for deploying virtual machines from templates:

![vSphere Web Client screenshot showing Deploy VM from this Template option](image)

Cloning a virtual machine

Cloning a virtual machine is an alternative to deploying a virtual machine from a template. Cloning a virtual machine creates an exact copy of the virtual machine with same set of operating system, applications, and virtual hardware.

The virtual machine power state doesn't matter, that is, a virtual machine can be in powered on or powered off state.
Creating Virtual Machines

To clone a virtual machine, right-click Virtual machine in the inventory and select Clone to Virtual Machine... option. Refer to the following image:

Summary
In this chapter, we covered basic operations with a virtual machine, such as creation, provisioning, installation in VMs, creating clones/templates, and so on. We read and understood that there are multiple ways of creating a virtual machine and one can pick any of these as per his requirements. We also learned about various configuration parameters for a virtual machine, and how to provision a virtual machine. In addition, we learned about installing operating system on virtual machines and configuring it. The chapter also covered a step by step process of creating templates and clones.

In next chapter, we will cover network management in a VMware virtual infrastructure. We will cover and understand various virtual network components, virtual switches, and virtual ports. The following screenshots shows the menu item in vSphere Web Client for deploying virtual machines from templates.
Where to buy this book

You can buy VMware vSphere Essentials from the Packt Publishing website.
Alternatively, you can buy the book from Amazon, BN.com, Computer Manuals and most internet book retailers.

Click here for ordering and shipping details.