Configuring System Images

As a network professional in an enterprise environment, you have probably configured a reference computer, created an image, and used a distribution server to apply that image to your client computers. You should be familiar with the Sysprep tool and how you can remove hardware-specific information from an image. This chapter looks at recent developments and enhancements to the various tools you use in configuring *system images* (disk image files that include an operating system) and in particular the use of file-based Windows Image (WIM) images and the ImageX tool.

In previous Microsoft operating systems, the use of *virtual hard disks (VHDs)* containing system images was limited to virtualization and the facility was used with Hyper-V, Microsoft Virtual Server, and Microsoft Virtual PC software when implementing virtual machines. In Windows 7, this has been extended and you can create and use VHDs on hardware PCs that are not virtual machines. In Windows 7 Enterprise and Ultimate editions, you can boot from VHD, back up an entire system disk to VHD, and install a system image to VHD. This new operating system feature enables you to recover quickly from a catastrophic system disk failure and provides failover protection without needing to implement disk array systems.

This chapter looks at how you capture a system image and prepare it for distribution to other computers. It also looks at how to configure a VHD to hold a system image and how to enable a computer running Windows 7 Enterprise or Ultimate to boot from a VHD containing a system image. The chapter covers the various tools and methods you use to prepare system images for capture and to manage VHD files.

> *EXAM TIP*
>
> **The use of native VHDs on non-virtual computers is a new feature in Windows 7 and is likely to be tested in the 70-680 examination.**

Exam objectives in this chapter:
- Capture a system image.
- Configure a VHD.

Lessons in this chapter:

Before You Begin

To complete the exercises in the practices in this chapter, you need to have done the following:

- Installed Windows 7 on a stand-alone client PC as described in Chapter 1, "Install, Migrate, or Upgrade to Windows 7." You need Internet access to complete the exercises.
- Implemented a second hard disk on this computer to host the VHD you create (this is an option). You can use an internal disk if one is available, or an external hard disk such as a USB device. You should have at least 20 GB free space on this hard disk. This is not essential because you can create a VHD on the C: drive, but it makes your practice exercises more realistic.
- You need a USB flash drive (UFD) with 4 GB free memory.

> ### 🌐 *REAL WORLD*
>
> **Ian McLean**
>
> Setting up large numbers of computers has become much easier than it was 10 or even 5 years ago.
>
> I recall going from computer to computer, booting each with a floppy disk that implemented a subset of MS-DOS that permitted network access and file transfer (and very little else). Installation files and answer files were then downloaded to each client computer (often from a single and creakingly slow CD-ROM) and the operating system was installed. In those days, "hands-free" installation was a bit of a joke. I recall going around to several hundred computers in the middle of the night agreeing to licensing terms and conditions.
>
> Installing from captured images posed other difficulties. You typically needed to capture an image for each computer because of security ID (SID) considerations. This was OK for teaching networks where you could have images for each course, but it's not the way to install a few hundred new computers. Sysprep was one of the more welcome utilities when it was first introduced. Also, if you captured an image with time-critical information (for example passwords) and applied it at a later date you could hit trouble. I recall installing a computer as the domain controller for a Microsoft Official Course from an image and finding 1,000 passwords had expired. Also, if you imaged a computer and installed that image later, the security updates that had been issued in the meantime were not applied, leaving the computer vulnerable.

Now client computers can be installed from image files on a distribution server (much faster than downloading and running installation files). Images can be generalized with SIDs and computer names removed. You can add security updates, language packs, and applications to an image before you distribute it, and keep images up to date.

Administrators don't have easy lives. Nevertheless, I think it's a bit easier now than it used to be. Learn about the best ways to install large numbers of client computers. It will make one aspect of your job considerably less arduous. It won't do you any harm in your examinations, either!

Lesson 1: Capturing System Images

This lesson discusses how you prepare a system image for automated or manual capture and the use of Windows Image (WIM) files. It discusses the Windows Automated Installation Kit (Windows AIK), the Windows Preinstallation Environment (Windows PE), and the Sysprep command-line tool.

The lesson briefly discusses the Microsoft Deployment Toolkit (MDT) 2010 and the Deployment Image Servicing and Management (DISM) tool. However, Chapter 3, "Deploying System Images," describes in detail how you use DISM to amend system images and how you load and install MDT and use it to deploy a system image.

After this lesson, you will be able to:

- Download and use the Windows AIK. In particular, use the ImageX and Oscdimg tools to create system images and Windows System Image Manager (Windows SIM) to create an answer file that enables hands-free installation of a WIM image.
- Create a Windows PE boot disk, boot to Windows PE, and image a Windows 7 installation.
- Use the Sysprep utility to prepare a reference computer for imaging and understand the Windows Setup configuration passes.
- Understand the functions of the MDT tool and know that you can use Deployment Workbench to access MDT documentation and to access a checklist of tasks you must complete before deploying an operating system. Chapter 3 describes this tool in detail.

Estimated lesson time: 50 minutes

Installing and Using the Windows Automated Installation Toolkit

The *Windows Automated Installation Kit (Windows AIK)* is a collection of tools and documentation designed to help you deploy Microsoft Windows operating system images to target computers or to a VHD. You can use the Windows AIK to automate Windows 7 installations, capture Windows system images with ImageX, configure and modify images using DISM, create Windows PE images, and migrate user profiles and data with the User State Migration Tool (USMT).

The Windows AIK consists of a number of tools that enable you to configure various deployment options. Depending upon your requirements, you will use some or all of the resources available in the Windows AIK.

To install the Windows AIK, you first download the ISO image, burn it to a DVD-ROM, and then install from the DVD-ROM. At the time of this writing, you can download the Windows

AIK International Organization for Standardization (ISO) image by accessing *http://technet.microsoft.com/en-us/library/dd349343.aspx* and clicking the appropriate link.

Installing the Windows AIK from a DVD-ROM

You create an installation DVD-ROM by burning the downloaded ISO image to DVD-ROM. Right-click the ISO image file and click Burn Disk Image. To install Windows AIK from DVD-ROM, perform the following steps:

1. Insert the DVD-ROM. On the Welcome screen, click Windows AIK Setup.
2. On the Setup Wizard Welcome page, click Next.
3. Select the I Agree check box to accept the license terms. Click Next.
4. Click Next to accept the defaults on the Select Installation Folder page (unless you want to change the installation folder).
5. Click Next to start installation. The installation can take some time.
6. Click Close to exit.

When the Windows AIK is installed, you can access the Windows AIK from the All Programs menu. This gives you access to the Windows AIK documentation; the Deployment Tools command prompt, which offers command-line utilities that implement ImageX; DISM; the Oscdimg tool (for creating ISO images); and Windows SIM.

✔ **Quick Check**
- **Which Windows AIK tool do you use to create an answer file that enables hands-free installation of a WIM image?**

Quick Check Answer
- **Windows SIM**

Windows AIK Tools

Table 2-1 lists the tools included with the Windows AIK.

TABLE 2-1 Tools Included in the Windows AIK

TOOL	DESCRIPTION
Windows SIM	Opens Windows images, creates answer files, and manages distribution shares and configuration sets.
ImageX	Captures, creates, modifies, and applies Windows images.
DISM	Applies updates, drivers, and language packs to a Windows image. DISM is available in all installations of Windows 7.

TOOL	DESCRIPTION
Windows PE tools	The Windows AIK includes several tools used to build and configure Windows PE environments.
USMT	Used to migrate user data from a previous version of Windows to Windows 7. USMT is installed as part of the Windows AIK in the %PROGRAMFILES%\Windows AIK\Tools\USMT directory.
Oscdimg	Creates ISO images.

MORE INFO **USMT**

For more information about USMT, see the User State Migration Tool User's Guide. When you install Windows AIK and USMT, you can find this guide at %PROGRAMFILES%\Windows AIK\Docs\Usmt.chmz.

Using the Windows Preinstallation Environment

The Windows Preinstallation Environment (*WinPE* version 3.0—commonly known as *Windows PE*) is a lightweight version of Windows 7 that is primarily used for the deployment of client computers. It is intended as a 32-bit or 64-bit replacement for MS-DOS during the installation phase of Windows 7 and can be booted via the Preboot Execution Environment (PXE), DVD-ROM, UFD, VHD, or hard disk. Windows PE is available free via the Windows AIK.

Originally, Windows PE was used as a preinstallation platform for deploying Windows operating systems. It has developed into a platform that lets you deploy workstations and servers in the enterprise environment and as a recovery platform to run 32-bit or 64-bit recovery tools such as the Windows Recovery Environment (Windows RE).

Typically you use the *copype.cmd* script in the C:\Program Files\Windows AIK\Tools\PETools subdirectory to create a local Windows PE build directory. You then use the Oscdimg Windows AIK tool in the same subdirectory to create an ISO image of Windows PE 3.0. You use this image to create a bootable DVD-ROM. You can then boot from the DVD-ROM into the preinstallation environment and use the ImageX tool to capture a WIM image. You do this in the practice exercises at the end of this lesson.

Creating a Reference Image

Later in this chapter, you will see how to use the Windows AIK ImageX tool and the Windows PE environment to prepare a WIM image of a computer running Windows 7 Enterprise or Ultimate and place that image on a bootable VHD on the same computer so you can boot the image from the VHD. This gives you failover protection for that specific computer and a form of backup. You do this in the practices in this lesson and Lesson 2 of this chapter.

However, in the enterprise environment, you are more likely to be concerned with installing Windows 7, on a reference computer and generating an image of that reference computer that can be installed on a large number of client computers on your network. Chapter 3 discusses

adding the current operating system security updates, basic applications, and language packs to a captured image.

EXAM TIP

If you want to capture an image of your current computer running Windows 7 and save the image to a VHD from which you can boot the computer, you need Windows 7 Enterprise or Ultimate installed on the computer. However, if you have built a reference computer and want to create a system image of that computer to distribute to a number of destination computers, you can use any Windows 7 edition to create an image for distribution.

You need to generalize a reference image, removing hardware-specific information (such as the reference computer's SID), and generate an installation answer file and scripts to automate the installation.

Typically, in addition to the reference computer whose image you intend to build and capture, you require a technician computer that runs the tools you use to generalize and capture the image, for example the Windows AIK tools. The technician computer does not need to be running Windows 7—it could, for example, be a Windows Vista or Windows XP client.

The procedure for installing the Windows AIK on the technician computer is described in the previous section. To configure a reference computer and capture an image suitable for distribution to your client computers, you perform the following steps:

1. Build an answer file to automate the installation of Windows 7 on the reference computer (this is an option).
2. Validate and save your settings.
3. Configure a reference installation.
4. Create a bootable Windows PE optical disk or UFD that also contains the ImageX Windows AIK tool.
5. Capture the installation onto a network share.
6. Deploy the image from a network share.

NOTE **USING AN ANSWER FILE**

It is not compulsory to create an answer file, although this is the method recommended in Microsoft documentation. If you choose, you can install the reference computer manually.

Building an Answer File

The first step in creating a custom installation on your reference computer is (optionally) to build an answer file on your technician computer that you use to configure Windows settings during installation. You can, for example, configure the default Windows Internet Explorer settings, networking configuration, and other customizations. The answer file should contain all the settings required for an unattended installation so you are not prompted with user interface pages during installation. However, if you choose, you can build a reference computer using the traditional "click and type" installation method.

You use the Windows SIM utility in Windows AIK on your technician computer to create an answer file that includes basic Windows Setup configuration and minimum Windows Welcome customizations. In this example, the answer file does not import any special drivers, applications, or packages. You will study more advanced answer files in Chapter 3.

> **NOTE** **SAMPLE ANSWER FILE**
>
> **When you install the Windows AIK on your technician computer, a sample answer file, Corp_autounattended_sample.xml, is installed at C:\Program Files\Windows AIK\Samples.**

To create an answer file, you copy a Windows image (WIM) file to your technician computer and then use the Windows SIM tool. To create an answer file that will enable you to install Windows 7 on your reference computer using the WIM file on the installation DVD-ROM, perform the following procedure:

1. Create a folder on your technician computer called C:\Myimages.

2. Insert the Windows 7 product DVD into your technician computer.

3. Navigate to the \Sources directory on your DVD-ROM drive and copy the Install.wim file from the Windows product DVD to C:\Myimages.

4. Click Start, All Programs, Microsoft Windows AIK, and then Windows System Image Manager. This opens Windows SIM.

5. On the Windows SIM File menu, right-click Select A Windows Image Or Catalog File and choose Select Windows Image, as shown in Figure 2-1.
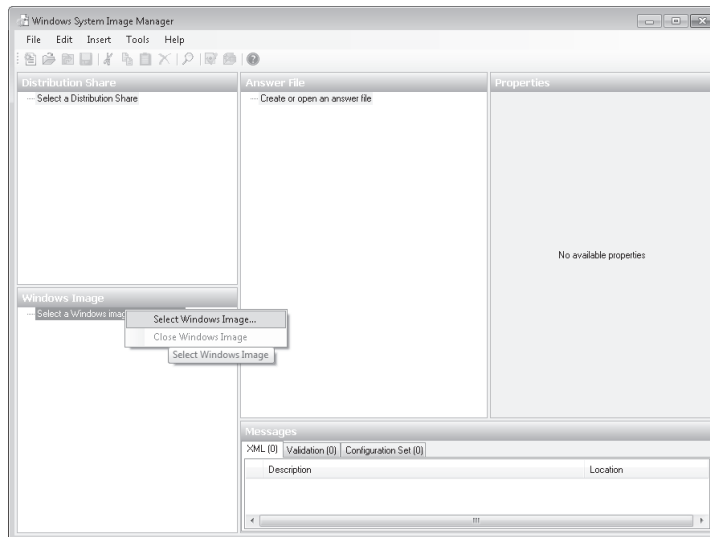
FIGURE 2-1 Selecting a Windows image

6. In the Select A Windows Image dialog box, navigate to C:\Myimages and then click Open.

7. You are prompted to select an image. Choose Install.wim and click Open. Select the image you want to install (for example, Windows 7 Ultimate) in the Select An Image dialog box and click OK.

8. If you are prompted to create a catalog file, click Yes. If prompted, click Yes again to allow the program to run. It can take some time to create a catalog file.

9. On the File menu, choose New Answer File. An empty (untitled) answer file appears in the Answer File pane, as shown in Figure 2-2.
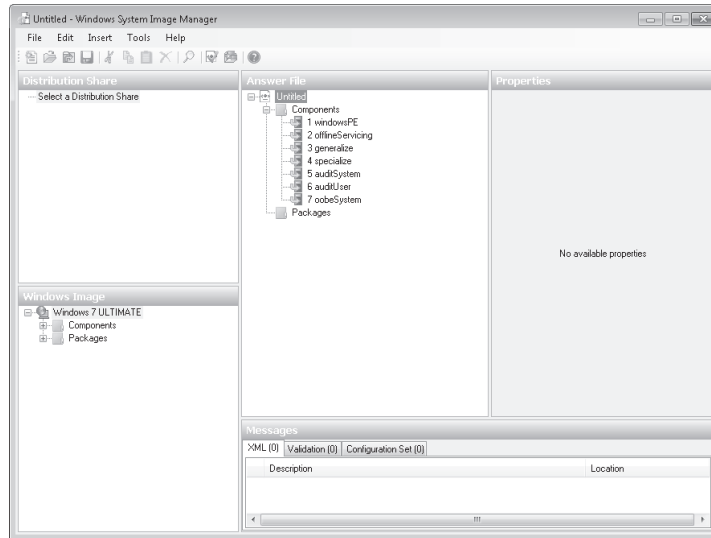
FIGURE 2-2 Creating an empty answer file

10. In the Windows SIM Windows Image pane, expand the Components node to display available feature settings.

11. On the expanded list of features, add features to your answer file by right-clicking each feature and then selecting the appropriate configuration pass. Table 2-2 shows a basic set of features and their associated configuration passes. Select a configuration pass, as shown in Figure 2-3.

TABLE 2-2 Specifying Features and Their Associated Configuration Passes

| FEATURE	CONFIGURATION PASS
x86_Microsoft-Windows-Deployment_6-1.<build>_neutral	**oobeSystem**
x86_Microsoft-Windows-International-Core-WinPE_6-1.<build>_neutral	**windowsPE**
x86_Microsoft-Windows-Setup_6-1.<build>_neutral	**windowsPE**
x86_Microsoft-Windows-Shell-Setup_6-1.<build>_neutral	**oobeSystem**
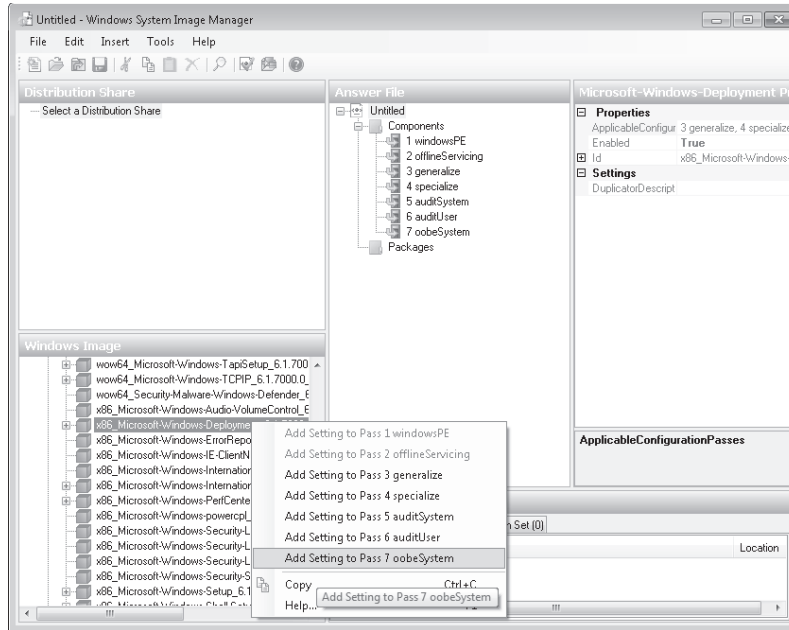
FIGURE 2-3 Selecting a configuration pass

12. Under Settings, select the appropriate setting and, in the right column, enter the appropriate value. Typical values are shown in Table 2-3 (for example, the table shows entries for the English-US Locale). Figure 2-4 shows the Windows SIM dialog box

TABLE 2-3 Adding Component Values

CONFIGURATION PASS	FEATURE	VALUE
WindowsPE	x86_Microsoft-Windows-International-Core-WinPE_6-1.<build>_neutral	InputLocale = en-US SystemLocale = en-US UILanguage = en-US UserLocale = en-US
WindowsPE	x86_Microsoft-Windows-Setup_6-1.<build>_neutral	EnableFirewall = true EnableNetwork = true LogPath = <path to log files> Restart = Restart UseConfigurationSet = true

CONFIGURATION PASS	FEATURE	VALUE
oobeSystem	x86_Microsoft-Windows-Deployment_6-1.<build>_neutral	Id = x86_Microsoft-Windows-Deployment__neutral_<guid>_nonSxS
oobeSystem	x86_Microsoft-Windows-Shell-Setup_6-1.<build>_neutral	BluetoothTaskbarIconEnabled = true DisableAutoDaylightTimeSet = false DoNotCleanTaskBar = true RegisteredOrganization = Microsoft RegisteredOwner = Microsoft ShowWindowsLive = true StartPanelOff = true TimeZone = EST
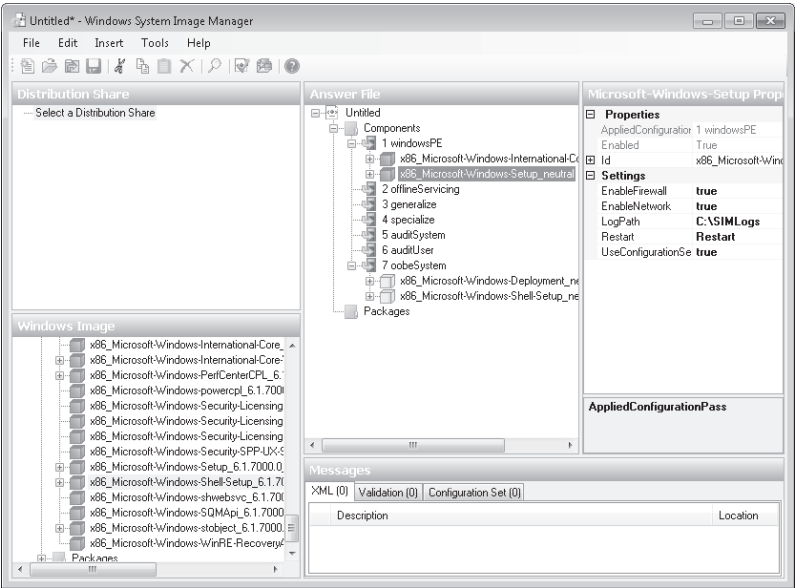
FIGURE 2-4 The Windows SIM dialog box with feature values

13. If you want, you can expand the feature and alter further sets of feature values from their defaults. Figure 2-5 shows this option.
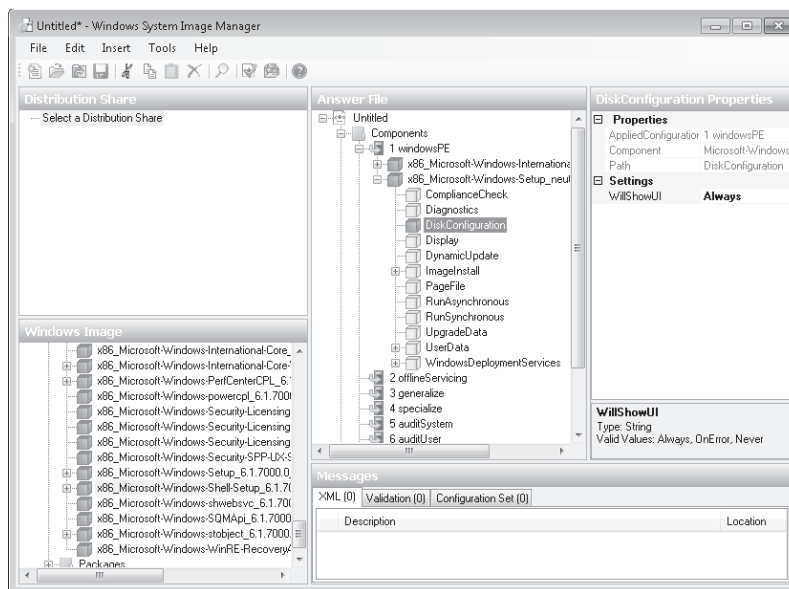
FIGURE 2-5 Altering default values

These settings define a basic unattended installation in which no user input is required during Windows Setup. When the installation is complete, the computer will reboot to audit mode. This enables you to boot quickly to the desktop, install additional applications and device drivers, and test the installation. Windows Welcome does not run in audit mode, but it will run the next time the computer restarts if you run the *sysprep /oobe* command. Windows Welcome, also called Machine OOBE, prompts the user to read the Microsoft Software License Terms and to configure the computer.

> **MORE INFO   AUDIT MODE AND SYSPREP**
>
> For more information about audit mode, see *http://technet.microsoft.com/en-us/library/cc722413.aspx*. For more information about the Sysprep utility, see *http://technet.microsoft.com/en-us/library/cc766049.aspx*.

Validating and Saving Settings

To validate the settings in your answer file and save them to a file on removable media, perform the following procedure:

1. Click Tools in Windows SIM and then choose Validate Answer File.

2. Warnings that state that default settings have not been changed will not prevent the file from being validated or saved. If error messages or other warnings appear in the Messages pane, you need to check your settings.

3. If an error occurs, double-click the error message in the Messages pane to navigate to the incorrect setting. Change the setting to fix the error, and then validate again by choosing Tools, Validate Answer File. Repeat this step until the answer file validates.

4. On the File menu, choose Save Answer File. Save the answer file as Autounattend.xml. Figure 2-6 shows a portion of an Autounattend.xml file.
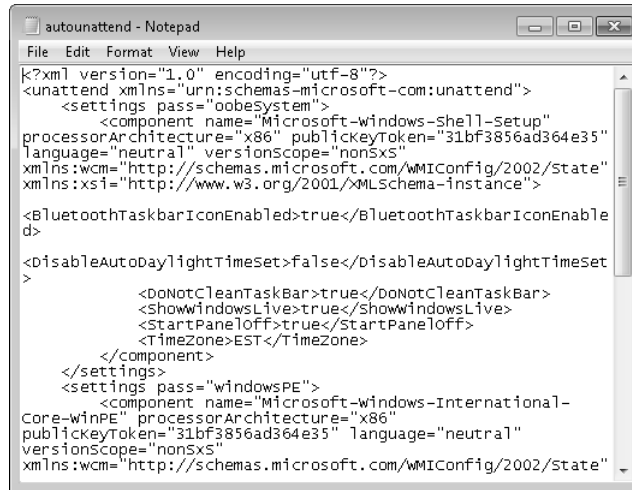
FIGURE 2-6 An Autounattend.xml file

5. Copy the Autounattend.xml file to the root directory of a removable storage device (such as a UFD). You now have a basic answer file that automates Windows Setup.

Building a Reference Installation

You configure your reference computer with a customized installation of Windows 7 that you then duplicate onto one or more destination computers. You can create a reference installation by using the Windows product DVD and (optionally) the answer file you created in the previous section. To install your reference computer using an answer file, perform the following procedure:

1. Turn on the reference computer. Insert the Windows 7 product DVD and the UFD containing the answer file (Autounattend.xml) that you created in the previous section. Note that the use of an answer file is optional, although it is the method Microsoft recommends. If you prefer, you can install Windows 7 manually from the installation DVD-ROM.

2. Restart the computer by pressing CTRL+ALT+DEL. You may have to override the boot order to boot from the CD/DVD-ROM disk. If so, select the appropriate function key to override the boot order during initial boot. Windows Setup (Setup.exe) starts automatically and searches the root directory of all removable media for an answer file called Autounattend.xml.

3. After Setup finishes, you can validate that all customizations were applied. For example, if you included the optional Microsoft-Windows-IE-InternetExplorer feature and set the Home_Page setting in your answer file, you can verify these settings by opening Internet Explorer.

> *NOTE* **INSTALLING A SMALL NUMBER OF CLIENT COMPUTERS**
>
> **If you want to install only a very small number of client computers, say five or less, you can simply repeat the installation using the DVD-ROM installation disk and the Autounattend.xml file on each computer in turn. However, for a larger number of computers, it is more efficient to create a WIM image and distribute it. To do this, the reference computer needs to be prepared for the end user.**

4. To prepare the reference computer for the user, you use the Sysprep utility with the */generalize* option to remove hardware-specific information from the Windows installation and the */oobe* option to configure the computer to boot to Windows Welcome upon the next restart. Open an elevated command prompt on the reference computer and run the following command:

   c:\windows\system32\sysprep\sysprep.exe /oobe /generalize /shutdown

Sysprep prepares the image for capture by cleaning up various user-specific and computer-specific settings, as well as log files. The reference installation now is complete and ready to be imaged.

> *CAUTION* **OUT-OF-BOX DEVICE DRIVERS**
>
> **When you run the *sysprep /generalize* command, out-of-box device drivers are removed from the Windows image. If you add out-of-box device drivers during installation and you intend to capture the Windows image that includes these drivers, set the PersistAllDeviceInstalls setting of the Microsoft-Windows-PnpSysprep feature to True in the answer file.**

Creating a Bootable Windows PE Medium

In this step, you create a bootable Windows PE CD-ROM or DVD-ROM disk by using the Copype.cmd script. Windows PE enables you to start a computer for the purposes of deployment and recovery by booting directly into memory. You can remove the Windows PE media after the computer boots. After you have booted into Windows PE, you can use the ImageX tool to capture, modify, and apply file-based disk images.

To create a bootable Windows PE CD-ROM or DVD-ROM disk and install the ImageX Windows AIK tool on that disk, perform the following procedure:

1. On your technician computer, create a local Windows PE build directory. Open an elevated command prompt and enter the following commands:

```
cd C:\Program Files\Windows AIK\Tools\PETools\
copype.cmd <architecture> <destination>
```

   Here *<architecture>* can be x86, amd64, or ia64, and *<destination>* is a path to the local directory. For example, to create a Windows PE build directory winpe_86 on an x86 computer, you enter the following command:

```
copype.cmd x86 C:\winpe_x86
```

2. Copy ImageX into the Iso subdirectory of your Windows PE build directory. On an x86 computer, you enter the following command:

```
copy "C:\program files\Windows AIK\Tools\x86\imagex.exe" C:\winpe_x86\iso\
```

3. Optionally, create a configuration file called Wimscript.ini by using a text editor such as Windows Notepad. The configuration file instructs the ImageX tool to exclude certain files during the capture operation (for example, Pagefile.sys or all .zip files). Figure 2-7 shows a Wimscript.ini file.
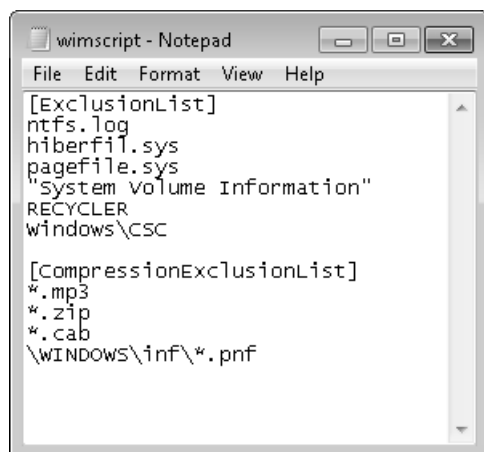
FIGURE 2-7 A Wimscript.ini file

4. Save the configuration file to the Iso subdirectory of the Windows PE build directory. The ImageX tool will recognize a Wimscript.ini file in the same location.

5. Create an image (.iso) file by using the Oscdimg tool. For example, on an x86 computer you would click All Programs, Microsoft Windows AIK, open the Deployment Tools Command Prompt, and enter the following:

   oscdimg -n –bc:\winpe_x86\etfsboot.com Cc:\winpe_x86\ISO c:\winpe_x86\winpe_x86.iso

> **MORE INFO ETFSBOOT.COM**
>
> **This specifies the location of the El Torito boot sector file. For more information, see *http://technet.microsoft.com/en-us/library/cc749036.aspx*. Note also there is no space between the –*b* flag and C:\Winpe_x86\Etfsboot.com.**

6. Burn the image (Winpe_x86.iso) to a CD-ROM or DVD-ROM disk. Windows AIK does not include CD/DVD-ROM burning software. Use trusted third-party software to burn the image to optical media. You now have a bootable Windows PE optical disk containing the ImageX tool.

Capturing the Installation onto a Network Share

You can capture an image of your reference computer by using Windows PE and the ImageX tool. Then you store that image on a network share. Alternatively, on a computer running Windows 7 Enterprise or Ultimate edition, you can store the image on a VHD and make that VHD bootable, as described in the practice in Lesson 2, later in this chapter.

To capture the installation image you have created on your reference computer to a network share, perform the following procedure:

1. Insert your Windows PE media into your reference computer and restart the computer. As before, you may have to override the boot order to boot from the CD/DVD-ROM drive. If so, select the appropriate function key to override the boot order during initial boot.

2. Windows PE starts and opens a command-prompt window. Use the ImageX tool located on your Windows PE media to capture an image of your reference computer installation. For example, if your optical drive is drive E:, your installation is on drive C:, and you want to capture the image on drive D:, you would enter:

```
e:\imagex.exe /capture C: d:\installationimage.wim "my Win7 Install" /compress
fast /verify
```

3. Copy the image to a network location. For example, enter:

```
net use y: \\network_share\images
copy d:\myimage.wim y:
```

4. If necessary, provide network credentials for appropriate network access. Your image is now on volume Y:.

Deploying from a Network Share

After you have imaged your reference installation, you can deploy the image onto new hardware (one or more destination computers). This section describes how you would do this manually. Chapter 3 discusses MDT 2010 and the automatic installation of multiple client computers.

To deploy an image from a network share, you use the Diskpart tool to format the hard drive of a destination computer. Then you copy the image from the network share. Perform the following procedure:

1. On your destination computer, insert your Windows PE media and restart the computer by pressing the CTRL+ALT+DEL keys. Windows PE opens a command-prompt window.

2. Format the hard drive to reflect the disk configuration requirements by using the Diskpart tool from the Windows PE command-prompt window. To do this, open an elevated command prompt.

3. Enter **diskpart.**

4. Enter **select disk 0.**

5. Enter **clean.**

6. Enter **create partition primary size=100.**

7. Enter **select partition 1.**

8. Enter **format fs=ntfs label="system".**

9. Enter **assign letter=c.**

10. Enter **active.**

> *NOTE* **SYSTEM PARTITION**
>
> Steps 6 through 9 create a 100-MB system partition. This is not strictly necessary because the Windows 7 installation routine creates a system partition automatically on installation if one has not been created already. However, Microsoft recommends creating this partition before installation.

11. Enter **create partition primary.**

12. Enter **select partition 2.**

13. Enter **format fs=ntfs label="Windows".**

14. Enter **assign letter=d.**

15. Enter **exit.**

> *NOTE*   **CREATING A SCRIPT**
>
> You can create a script with this information in a text file and store in the same location as your image. To run the script from a Windows PE command-prompt window, enter diskpart /s <*scriptname*>.txt, where <*scriptname*> is the name of the text file that includes the Diskpart commands. Figure 2-8 shows a typical script file named DiskConfigurationFormat.txt.


```
diskpart
select disk 0
clean
create partition primary size=100
select partition 1
format fs=ntfs label="system"
assign letter=c
active
create partition primary
select partition 2
format fs=ntfs label="windows"
assign letter=d
exit
```
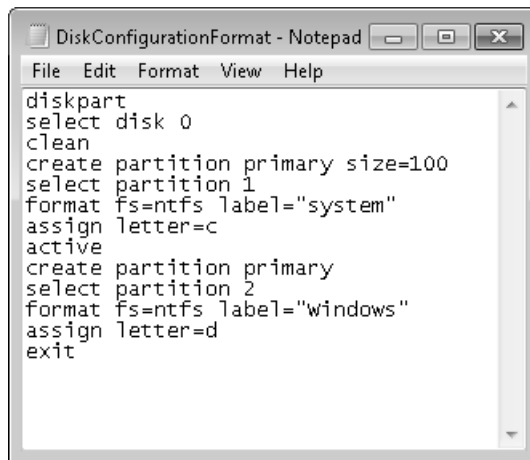
FIGURE 2-8 A disk configuration format file

16. Copy the image from the network share to your local hard drive. For example, at an elevated command prompt, type:

```
net use y: \\network_share\images
copy y:\installationimage.wim d:
```

17. If necessary, provide network credentials for appropriate access.

18. Apply the image to the hard drive by using the ImageX tool located on the Windows PE media. For example, at an elevated command prompt, enter:

```
e:\imagex.exe /apply d:\myimage.wim 1 C:
```

19. Use BCDboot to initialize the Boot Configuration Data (BCD) store and copy boot environment files to the system partition. For example, at a command prompt, type:

```
d:\windows\system32\bcdboot d:\windows
```

Your custom image is now deployed onto your destination computer. The computer is ready for customer delivery. Repeat this procedure for each additional computer that you configure.

> **EXAM TIP**
>
> Know the functions of a Wimscript.ini, disk configuration format, and Autounattend. xml file. Know how these files are created, how they are accessed, and when you would use them.

Windows Imaging Format

You can use the ImageX Windows AIK tool to create a WIM file that images a reference computer. Unlike ISO files, which are used to contain images of operating systems and toolkits across an intranet or the Internet, WIM is a file-based disk image format that contains a set of files and associated file system metadata. However, unlike sector-based formats (such as ISO) used for CD-ROM and DVD-ROM images, WIM is file-based, which means that the smallest unit of information in a WIM image is a file. A file-based image is hardware-independent and provides unique single-instance storage of a file that can be referenced multiple times in the file system tree.

The files are stored inside a single WIM database. The resource cost of reading or writing many thousands of individual files on a local disk is reduced by hardware- and software-based disk caching and sequential data reads and writes. WIM images are deployed to an existing volume or partition because the toolset does not create low-level disk structures, nor does it format them. Instead, the Microsoft command-line tool Diskpart is used to create and format volumes on the target computer.

WIM files can contain multiple disk images, which are referenced either by a numerical index or a unique name. Because WIM uses single-instance storage, information common to more than one image is stored only once. Thus, as more images are added, each typically takes up less disk space than did the first image. A WIM can be split (or spanned) into multiple parts. Spanned WIM image parts have a .swm extension.

A WIM image can also be mounted as a new volume under Windows with a drive letter associated with it to facilitate easier extraction or updating of its contents. The WimFltr.sys device driver needs to be loaded before a WIM image can be mounted using ImageX.

The Wimgapi.dll dynamic link library provides a set of public application programming interfaces (APIs) for manipulating WIMs. A number of third-party applications include the capability to read or write WIM files. You can make WIM images bootable by using the ImageX tool, this time with the */boot* switch.

✔ **Quick Check**

1. **What file can you create, if you want, to instruct the ImageX tool to exclude specified files and folders when capturing a system image?**

2. **How does ImageX detect this file?**

Quick Check Answer

1. **The Wimscript.ini file.**

2. **You save the file in the same folder as the ImageX tool (Imagex.exe), and ImageX detects it automatically.**

Distributing an Image to Many Computers

This section describes how you capture a WIM image from a reference computer and distribute it manually to one or more destination computers. However, if you have a large number of destination computers, manual distribution would be tedious and time consuming. To avoid this, you need an automated method of simultaneously distributing an image to many computers on your network.

Chapter 1 introduced Windows Deployment Services (WDS). This is suitable for destination computers that boot from PXE. If you want to use WDS to distribute an image to a non-PXE computer, you need to boot that computer into a WDS capture image. WDS images are discussed later in this lesson.

Windows 7 introduces MDT 2010, which is a powerful tool for distributing system images to multiple destination computers. Chapter 3 discusses MDT 2010 in some detail, but it is appropriate to introduce the tool briefly in this chapter.

Using MDT 2010

MDT 2010 is the Microsoft solution accelerator for operating system and application deployment and offers flexible driver management, optimized transaction processing, and access to distribution shares from any location. You can use the MDT on imaging and deployment servers to implement the automatic deployment of Windows 7 (for example) on client computers. It is possible to run MDT 2010 on a client running Windows 7, but in practice it would typically run from a distribution server running Windows Server 2008.

The MDT provides detailed guidance and job aids and offers a common deployment console that contains unified tools and processes that you can use for client and server deployment. The toolkit offers standardized desktop and server images, along with improved security and ongoing configuration management.

The Lite Touch Installation (LTI) method lets you distribute images with a small degree of user intervention and can be used when no other distribution tools are in place. Most of the new features in MDT 2010 are related to LTI.

The Zero Touch Installation (ZTI) method requires no user intervention but requires that Microsoft System Center Configuration Manager (SCCM) 2007 with the Operating System Deployment Feature Pack is available on the network. This method also requires other software utilities, such as Microsoft SQL Server.

> *NOTE* **SYSTEM MANAGEMENT SERVER (SMS) 2003**
>
> **MTD 2010 ZTI does not work with SMS 2003.**

When you have installed MDT 2010, you can start Deployment Workbench from the Microsoft Deployment Toolkit program suite. This gives you access to the following items:

- **Information Center**   This lets you access MDT 2010 documentation.
- **Distribution Share**   This gives you a checklist of tasks you need to perform before you can deploy an operating system. You can also create a distribution share directory.
- **Task Sequences**   This provides a list of task sequences in the details pane and enables you to create and configure a task sequence.
- **Deploy**   You can expand this item to see the Deployment Points and Database items. You can configure deployment points and the MDT database.

> *MORE INFO* **MDT 2010**
>
> **To download MDT documentation files (without necessarily installing the software), go to**
> *https://connect.microsoft.com/site/sitehome.aspx?SiteID=14* **and click Download.**

WDS Images

WDS provides a PXE-booted version of Windows PE. A WDS image is contained in a WIM file and is booted over the network into a RAMDisk. The installation then proceeds under Windows PE.

WDS integrates into Active Directory Domain Services (AD DS), but the PXE server can also run without AD DS if required. WDS can be initiated from Windows PE booted from something other than PXE, such as a CD/DVD-ROM or UFD.

The process of capturing a WIM image into a WDS server is similar to the use of ImageX and Sysprep except that the last step involves booting into the WDS capture image. This is a Windows PE image that helps you capture a client system to the WDS server.

WDS is relatively lightweight compared to other image deployment methods such as MDT and provides a method that can be faster than an optical media-based installation of Windows.

You use WDS images to deploy system files to client computers. A number of image files exist; for example, you use a capture image to create an install image. You should be familiar with the following image types:

- Install
- Boot
- Capture
- Discover

An install image is an operating system image that you deploy to the client computer. Typically, this is a WIM file.

A boot image is a Windows PE image into which you boot a client before you install the WIM image file. To install Windows 7, you first boot the computer into the boot image, and then you select the install image to install. Unless you are using a reference computer and adding applications to the image, you should use the standard boot image that is included on the Windows 7 installation media (Install.wim). Capture and discover images are types of boot images.

A capture image is a type of boot image into which you boot a client computer to capture the operating system as a WIM install image file. You create a capture image before you create a custom install image. A capture image contains Windows PE and the Windows Deployment Services Image Capture Wizard. When you boot a computer (after preparing it with Sysprep) into a capture image, the wizard creates an install image of the computer and saves it as a WIM file. Then you can upload the image to the WDS server or copy it to bootable media (for example, DVD-ROM).

A discover image is a type of boot image that you can use to install Windows 7 (or another Windows operating system) on a computer that is not PXE-enabled. When you boot a computer into a discover image, the WDS client locates a valid WDS server, and then you can choose the install image you want to install. A discover image enables a computer to locate a WDS server and use it to install an image.

Using the Deployment Image Servicing and Management Tool

Windows 7 introduces the DISM command-line tool. Chapter 3 discusses this tool in some detail, so it is introduced only briefly here. You can use DISM to service a Windows image or to prepare a Windows PE image. DISM replaces Package Manager (Pkgmgr.exe), PEimg, and Intlcfg in Windows Vista, and includes new features to improve the experience for offline servicing.

You can use DISM to perform the following actions:

- Prepare a Windows PE image.
- Enable or disable Windows features within an image.
- Upgrade a Windows image to a different edition.
- Add, remove, and enumerate packages.
- Add, remove, and enumerate drivers.
- Apply changes based on the offline servicing section of an unattended answer file.
- Configure international settings.
- Implement powerful logging features.
- Service operating systems such as Windows Vista with SP1 and Windows Server 2008.
- Service a 32-bit image from a 64-bit host and service a 64-bit image from a 32-bit host.
- Service all platforms (32-bit, 64-bit, and Itanium).
- Use existing Package Manager scripts.

DISM Command-Line Options

To service a Windows image offline, you must apply or mount it. WIM images can be mounted using the WIM commands within DISM, or applied and then recaptured using ImageX. You can also use the WIM commands to list the indexes or verify the architecture for the image you are mounting. After you update the image, you must dismount it and then either commit or discard the changes you have made.

Table 2-4 lists and describes the *dism* command options that you can use to mount, dismount, and query WIM files, as well as their associated flags. These options and flags are not case-sensitive.

TABLE 2-4 DISM Command Options

OPTION	DESCRIPTION	FLAGS
/mount-wim	Mounts the WIM file to the specified directory so that it is available for servicing. The optional */readonly* flag sets the mounted image with read-only permissions. Example: dism /mount-wim /wimfile:C:\practice\myimages\ install.wim /index:1 /mountdir: C:\practice\offline /readonly	/wimfile:*<path_to_ image.wim>* /index:*<image_index>* /name:*<image_name>* /mountdir:*<path_to_mount_ directory>* /readonly
/commit-wim	Applies the changes you have made to the mounted image. The image remains mounted until the */dismount* option is used. Example: dism /commit-wim /mountdir:C:\practice\offline	/mountdir:*<path_to_mount_ directory>*
/unmount-wim	Dismounts the WIM file and either commits or discards the changes that were made while the image was mounted. Example: dism /unmount-wim /mountdir:C:\practice\offline /commit	/mountdir:*<path_to_mount_ directory>*{/commit | / discard}
/remount-wim	Recovers an orphaned WIM mount directory. Example: dism /remount-wim /mountdir:*<path_to_mount_directory>*	/mountdir:*<path_to_mount_ directory>*
/cleanup-wim	Deletes all the resources associated with a mounted WIM image that has been abandoned. This command does not dismount currently mounted images, nor does it delete images that can be remounted. Example: dism /cleanup-wim	None
/get-wiminfo	Displays information about the images within the WIM. When used with the */index* option, information about the specified image is displayed. Example: dism /get-wimInfo /wimfile: C:\practice\offline\install.wim /index:1	/wimfile:*<path_to_image. wim>* /index:*<Image_index>* /name:*<Image_name>*

OPTION	DESCRIPTION	FLAGS
/get-mountedwiminfo	Lists the images that are currently mounted and information about the mounted image such as read/write permissions, mount location, mounted file path, mounted image index. Example: dism /get-mountedwimInfo	/name:*<image_name>* /mountdir:*<path_to_mount_directory>* /readonly

DISM Syntax

DISM commands have a base syntax that is very similar from command to command. After you mount your Windows image, you can specify DISM options, the servicing command that will update your image, and the location of the mounted image. You can use only one servicing command per command line. If you are servicing a running computer, you can use the */online* option instead of specifying the location of the mounted Windows image.

The syntax for DISM is as follows:

```
DISM.exe {/image:<path_to_image> | /online} [dism_options] {servicing_command}
[<servicing_argument>]
```

EXAM TIP

You use DISM to manipulate existing images. You cannot use the tool to capture new operating system images.

Using Sysprep to Prepare a Windows 7 Installation

You use the Sysprep command-line tool to prepare an installation of Windows for imaging or delivery to a user. *Sysprep /generalize* and *sysprep /oobe* were mentioned earlier in this lesson. Sysprep is a powerful tool that includes the Sysprep executable (Sysprep.exe) located in the %WINDIR%\System32\Sysprep directory. Sysprep.exe first verifies that Sysprep can run. You can run Sysprep only as an administrator, and only one instance of Sysprep can run at any given time. Also, the version of Sysprep differs with each version of Windows. Sysprep must run on the version of Windows with which it was installed.

Sysprep.exe calls other executable files that prepare the Windows installation. The Sysprep process initializes logging and parses any command-line arguments provided. If no command-line arguments are provided, the Sysprep window appears. This lets you specify Sysprep actions. Sysprep processes these actions and calls the appropriate .dll and executable files. It adds the actions to the log file.

When all tasks are processed, Sysprep either shuts down and restarts the system, or exits.

Sysprep Command-Line Options

If you have experience with Windows Vista, you will find the *sysprep* command-line options for Windows 7 very similar. These are described in Table 2-5.

TABLE 2-5 Sysprep Command-Line Options

OPTION	DESCRIPTION
/audit	Restarts the computer in Audit mode rather than Windows Welcome mode. Audit mode lets you add additional drivers or applications to Windows 7. You can also test an installation of Windows 7 and verify its integrity before it is sent to a user. If you specify an unattended Windows setup file, the Windows Setup */audit* mode runs the auditSystem and auditUser configuration passes.
/generalize	Prepares the Windows installation to be imaged. If you specify this option, all unique system information is removed from the Windows installation. The SID is reset, system restore points are cleared, and event logs are deleted. The next time the computer starts, the specialize configuration pass runs. A new SID is created, and the clock for Windows activation resets (unless the clock has already been reset three times).
/oobe	Restarts the computer in Windows Welcome mode. Windows Welcome enables users to customize their Windows 7 operating system, create user accounts, and name the computer. Any settings in the *oobeSystem* configuration pass in an answer file are processed immediately before Windows Welcome starts.
/reboot	Restarts the computer. You can use this option to audit the computer and to verify that the first-run experience operates correctly.
/shutdown	Shuts down the computer after Sysprep completes.
/quiet	Runs Sysprep without displaying on-screen confirmation messages. You can use this option if you want to automate Sysprep.
/quit	Closes Sysprep after the specified commands complete.
/unattend: answerfile	Applies settings in an answer file to Windows during unattended installation. The variable *answerfile* specifies the path and file name of the answer file.

If you do not specify a command-line option, Sysprep presents you with the graphical user interface (GUI) shown in Figure 2-9. This lets you specify a system cleanup action, choose the *generalize* option, and specify a *shutdown* option.
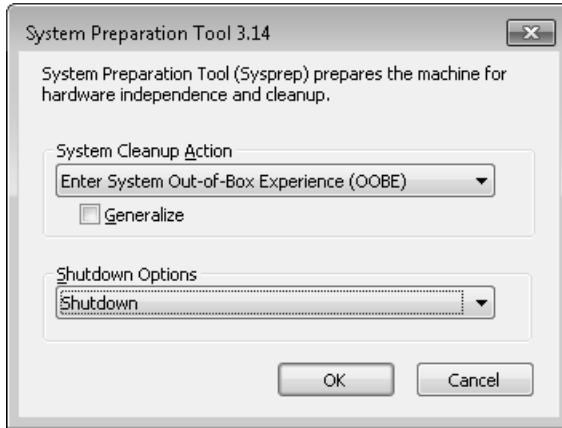
FIGURE 2-9 The Sysprep GUI

> **MORE INFO** **AUDIT MODE**
>
> For more information about Audit mode, see *http://technet.microsoft.com/en-us/library/cc722413.aspx*.

If you intend to transfer a Windows 7 image to a different computer, you need to run *sysprep /generalize* even if the computer has the same hardware configuration. The *sysprep /generalize* command removes unique information from your Windows 7 installation. This enables you to reuse your image on different computers. The next time you boot the Windows 7 image the specialize configuration pass runs. During this pass, many feature actions are processed automatically when you boot a Windows 7 image on a new computer.

All methods of moving a Windows 7 image to a new computer, such as through imaging or hard disk duplication, must be prepared with the *sysprep /generalize* command. You cannot move or copy a Windows 7 image to a different computer without running *sysprep /generalize*.

Configuration Passes

Configuration passes are phases of Windows Setup during which you apply settings to an unattended installation answer file. Table 2-6 describes the different configuration passes.

TABLE 2-6 Configuration Passes

CONFIGURATION PASS	DESCRIPTION
windowsPE	Configures Windows PE options and basic Windows Setup options. These options can include setting the product key and configuring a disk. You can use this configuration pass to add drivers to the Windows PE driver store and to reflect boot-critical drivers required by Windows PE if you require that drivers for Windows PE access the local hard disk drive or a network.

CONFIGURATION PASS	DESCRIPTION
offlineServicing	Applies updates to a Windows image. Also applies packages, including software fixes, language packs, and other security updates. During this pass, you can add drivers to a Windows image before that image is installed during Windows Setup.
specialize	Creates and applies system-specific information. For example, you can configure network settings, international settings, and domain information.
generalize	Enables you to minimally configure the *sysprep /generalize* command and other Windows settings that must persist on your reference image. The *sysprep /generalize* command removes system-specific information from the image, for example the unique SID and other hardware-specific settings. The generalize pass runs only if you run the *sysprep /generalize* command.
auditSystem	Processes unattended Setup settings while Windows is running in system context before a user logs onto the computer in Audit mode. The *auditSystem* pass runs only if you boot to Audit mode.
auditUser	Processes unattended Setup settings after a user logs onto the computer in Audit mode. The auditUser pass runs only if you boot to Audit mode.
oobeSystem	Applies settings to Windows before Windows Welcome starts.

EXAM TIP

Know the Sysprep command-line options and the Windows Setup configuration passes, and also know when the configuration passes run; for example, *generalize* runs if you run the *sysprep /generalize* command, and *auditUser* and *auditSystem* run if you boot to Audit mode. Remember that you can use several Sysprep switches in the same command. For example, to generalize an image and specify the boot-up mode you could enter C:\windows\system32\sysprep\Sysprep.exe /oobe /generalize /shutdown. Also, know how to boot to Audit mode (Ctrl+Shift+F3), as described later in this lesson.

Sysprep Answer Files

You can use a Sysprep answer file to configure unattended Setup settings. Not all configuration passes run during Windows Setup—some are available only when you run Sysprep.exe. For example, the *generalize, auditSystem,* and *auditUser* passes are available only if you run Sysprep.exe. If you add settings to your answer file in these configuration passes, you need to run Sysprep.exe to apply the settings.

To apply settings in the *auditSystem* and *auditUser* passes, you use the *sysprep /audit* command to boot to Audit mode. To apply settings in the *generalize* pass, you use the *sysprep /generalize* command to generalize the Windows image.

If you install Windows using an answer file (for example, Autounattend.xml), that answer file is cached. When subsequent configuration passes run, settings in the answer file are applied to the system. Because the answer file is cached, settings in the cached answer file are applied when you run Sysprep.exe. If you want to use the settings in a different answer file, you can specify a separate answer file by using the *sysprep /unattend:filename* option. You need to ensure your answer file is a .xml file but is not named Autounattend.xml.

You can use the Answer File pane in Windows SIM to create this file and you can edit it with a text editor such as Microsoft Notepad. Some experienced administrators use a text editor rather than Windows SIM to create answer files.

> **MORE INFO   CREATING AN ANSWER FILE WITH WINDOWS SIM**
>
> For step-by-step instructions that enable you to create an unattended answer file, see *http://technet.microsoft.com/en-us/library/dd349348.aspx.*

> **NOTE   PERSISTING PLUG AND PLAY DEVICE DRIVERS DURING THE GENERALIZE PASS**
>
> You can persist device drivers when you run the *sysprep /generalize* command by specifying the PersistentAllDeviceInstalls setting in the Microsoft-Windows-PnPSysprep feature. During the *specialize* pass, Plug and Play scans the computer for devices and installs device drivers for the detected devices. By default, these device drivers are removed from the system when you generalize the system. If you set PersistAllDeviceInstalls to True in an answer file, Sysprep does not remove the detected device drivers.

You can view the status of RunSynchronous commands that run during *auditUser* in Audit mode. The AuditUI window displays the status for commands and provides visual progress to indicate that an installation is continuing and not suspended and a visual indication of when and where failures occur.

If there are RunSynchronous commands in the answer file in the *auditUser* configuration pass, a list of the commands are displayed in the AudiUI window in the order specified by RunSynchronous/RunSynchronousCommand/Order.

All RunSynchronous commands are processed in order. If the command succeeds, then its related list item is annotated with a green checkmark. If the command fails, then its related list item is annotated with a red cross. If a reboot is requested, the AuditUI is redisplayed after the boot, but only unprocessed list items are shown.

If the list of items in the AuditUI exceeds the height of the display, then the list is clipped to the display and does not scroll. As a result, some items might not be visible.

Resetting Windows 7 Activation

When you install Windows 7 with a single license product key, you have a 30-day period during which you must activate the Windows installation. If you do not activate Windows within this 30-day period, Windows enters Reduced Functionality Mode (RFM). This prevents you from logging on to the computer until Windows 7 is activated.

When you run the *sysprep /generalize* command, the activation clock automatically resets. You can use the *sysprep /generalize* command to reset Windows a maximum of three times. After the third time you run the *sysprep /generalize* command, the activation clock can no longer be reset.

You can bypass resetting the activation clock by using the SkipRearm setting in the Microsoft-Windows-Security-Licensing-SLC feature. You can set the value of SkipRearm to 1 in the *sysprep /generalize* command, which enables you to run the Sysprep utility without resetting the activation clock.

> *MORE INFO*   **MICROSOFT-WINDOWS-SECURITY-LICENSING-SLC**
>
> **For more information about the Microsoft-Windows-Security-Licensing-SLC feature, see *http://technet.microsoft.com/en-us/library/cc766403.aspx.* This is a Microsoft Vista link, but it is also applicable to Windows 7.**

For volume licenses, activation clock reset behavior is different depending on the type of license. Activation can be reset an unlimited number of times for activated Key Management Service (KMS) clients. For non-activated KMS clients, the activation clock can be reset only up to three times, the same as a single license.

Microsoft recommends KMS clients to use the *sysprep /generalize* command where the value of the SkipRearm setting is equal to 1. After capturing this image, use the *sysprep /generalize* command, where the value of the SkipRearm setting is equal to 0.

Microsoft recommends Multiple Activation Keys (MAK) clients to install the MAK immediately before running *sysprep* the last time before delivering a client computer to a user.

For OEM Activation licenses, you do not typically require activation. OEM Activation is available only to royalty OEMs.

Most users can manage activation after receiving their clients running Windows 7. However, if you prefer, you can activate the software on behalf of your users. After activation, most users do not need to activate their installation again.

To activate Windows on a client computer, use the unique Product Key from the certificate of authenticity (COA) label that is affixed to the specific computer, and activate the computer on behalf of the user. Run the *sysprep /oobe* command to prepare the computer for delivery to the user.

Booting to Audit Mode or Windows Welcome

When Windows 7 boots, the computer can start in the following modes:

- **Windows Welcome**   By default, all Windows installations boot to Windows Welcome first. Windows Welcome is also called Machine OOBE. It is the first user experience and enables users to customize their Windows installation. Users can create user accounts, read and accept the Microsoft Software License Terms, and choose language and time zones. The *oobeSystem* configuration pass runs immediately before Windows Welcome starts.

- **Audit mode**   Audit mode enables enterprise organizations to customize their Windows images. Audit mode does not require Windows Welcome settings to be applied. Bypassing Windows Welcome lets you access the desktop quicker to perform the required customizations. You can, for example, add additional device drivers, install applications, and test installation validity. Settings in an unattended answer file in the *auditSystem* and *auditUser* configuration passes are processed in Audit mode.

If you are running in Audit mode, run the *sysprep /oobe* command to configure the installation to boot to Windows Welcome. By default Windows Welcome starts after installation completes. However, you can skip Windows Welcome and boot directly to Audit mode by pressing Ctrl+Shift+F3 at the first Windows Welcome screen.

For unattended installation, you can configure Windows to boot to Audit mode by using the Microsoft-Windows-Deployment | Reseal setting in an answer file.

> *MORE INFO*   **AUDIT MODE**
>
> For more information about Audit mode, see *http://technet.microsoft.com/en-us/library/cc722413.aspx*. This is a Windows Vista link, but the information also applies to Windows 7.

> *MORE INFO*   **DETECTING THE STATE OF A WINDOWS IMAGE**
>
> You can identify the state of a Windows image, such as whether it will boot to Audit mode, Windows Welcome, or if the image is still in the process of installation. For more information, see *http://technet.microsoft.com/en-us/library/cc721913.aspx*. This is a Windows Vista link, but the information also applies to Windows 7.

Sysprep Log Files

Sysprep logs Windows Setup actions in different directories depending on the configuration pass. Because the *generalize* pass deletes some Windows Setup log files, Sysprep logs generalize actions outside the standard Windows Setup log files. Table 2-7 shows the log file locations that Sysprep uses.

TABLE 2-7 Sysprep Log File Locations

ITEM	LOG PATH
Generalize pass	%WINDIR%\System32\Sysprep\Panther
Specialize pass	%WINDIR%\Panther\
Unattended Windows setup actions	%WINDIR%\Panther\Unattendgc

PRACTICE   **Creating a WIM Image**

In this practice, you install the Windows AIK. You then create a Windows PE boot disk and boot the computer into Windows PE. This enables you to use the ImageX tool in the Windows AIK to create a WIM image of the computer.

EXERCISE 1   Installing the Windows AIK and Creating a Windows PE Boot DVD

In this exercise, you download the ISO image in Windows AIK and create an installation DVD. You then install the Windows AIK. Instructions for doing this were given in the section entitled "Installing and Using the Windows Automated Installation Toolkit," earlier in this lesson. You create a Windows PE build directory and copy ImageX into it. You use the Oscdimg tool to create an ISO image of Windows PE. You burn this image onto optical media (CD-ROM or DVD) that you can use to boot the computer. You need to be connected to the Internet to perform this exercise.

1. Log on to the Canberra computer using the Kim_Akers account.
2. Download the appropriate ISO image, burn this to optical media, and install the Windows AIK.
3. In Accessories in the All Programs menu, right-click Command Prompt and choose Run As Administrator. If prompted, click Yes to permit the program to run.
4. In the Command Prompt window, enter **cd C:\Program Files\Windows AIK\Tools\ PETools\.**
5. At the C:\Program Files\Windows AIK\Tools\PETools> prompt, enter **copype.cmd x86 c:\winpe_x86.** This exercise is written for a 32-bit computer and the Windows PE build directory is Winpe_x86. If you are using an amd64 or ia64 computer, amend the entry accordingly. Figure 2-10 shows the output from this command.
6. To copy ImageX into the Windows PE build directory, enter **copy "c:\program files\ Windows AIK\Tools\x86\imagex.exe" c:\winpe_x86\iso.**
7. To create an image (.iso) file by using the Oscdimg tool, click Microsoft Windows AIK in All Programs and then click Deployment Tools Command Prompt.

FIGURE 2-10 Creating the Windows PE build directory

8. To create the ISO image, enter **oscdimg -n c:\winpe_x86\ISO c:\winpe_x86\winpe_x86.iso -n -bc:\winpe_x86\etfsboot.com**. Figure 2-11 shows the output from this command. Note that there is no space between the *−b* flag and *c:\winpe_x86\etfsboot.com*.

FIGURE 2-11 Creating the Windows PE ISO image

9. The ISO image is in C:\Winpe_x86 and is named Winpe_x86.iso. However, the Windows AIK toolset currently does not include an image-burning utility, and Microsoft advises the use of reputable third-party software to create the Windows PE boot disk from this ISO image.

EXERCISE 2 Creating a WIM Image of the Canberra Computer

In this exercise, you boot the Canberra computer from the optical Windows boot disk that contains ImageX, which you created in Exercise 1. You then create a WIM image of the Windows 7 installation and (optionally) save it to a network share.

1. If necessary, log on to the Canberra computer using the Kim_Akers account.

2. On the Canberra computer, insert the Windows PE medium and restart the computer.

> *NOTE* **CHANGING THE BIOS BOOT ORDER**
>
> **To boot from the optical drive, you may have to override the BIOS boot order. During initial boot, select the appropriate function key.**

3. Windows PE starts and opens a command-prompt window.

4. To capture an image of the reference installation by using the ImageX tool located on your Windows PE medium, enter **e:\imagex.exe /capture c: d:\images\ myimage.wim "Canberra Win7 Install" /compress fast /verify**. This command uses ImageX on the CD/DVD-ROM drive E: to capture the image of the system disk C: to the folder images on the second hard disk D:. If your volume assignments are different, amend the command accordingly. The command takes a considerable time to complete and lists folders (such as the recycle bin) that are not included in the image by default.

5. Enter **exit** and remove your Windows PE boot disk. The computer boots into Windows 7.

6. Check that the file Myimage.wim exists on the D: drive (or wherever you chose to put it).

7. Optionally, if you want to share the image across a network, create a network share, (for example, \\Canberra\Images) and map it to a network drive (such as Y:) and then copy the WIM file to this share.

Lesson Summary

- The Windows AIK introduced in Windows 7 offers various tools for creating system images. These include Windows SIM, ImageX, Oscdimg, DISM, USMT, and several Windows PE tools.

- You use Windows SIM to create an unattend answer file that you can in turn use with a WIM image to install a reference computer. You use Sysprep to prepare the image and then boot the reference computer into Windows PE and use the ImageX tool to capture the image in a WIM file.

- WIM images are file-based and can be installed on a VHD or placed on a network share for distribution. You can store several images in the same WIM file.

- You use the Sysprep command-line tool to prepare an installation of Windows for imaging or delivery to a user. In particular, you can generalize an image and remove specific information such as the SID.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 1, "Capturing System Images." The questions are also available on the companion DVD if you prefer to review them in electronic form.

> *NOTE* **ANSWERS**
>
> **Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.**

1. You are creating a WIM system image of a Windows 7 installation on a reference computer. What operating system should you boot to, and what Windows AIK tool should you use?

   A. Boot to Windows 7 and use ImageX.

   B. Boot to Windows 7 and use Windows SIM.

   C. Boot to Windows 7 and use DISM.

   D. Boot to Windows PE and use ImageX.

   E. Boot to Windows PE and use Windows SIM.

   F. Boot to Windows PE and use DISM.

2. You are creating an unattend answer file for automatic Windows 7 installation. What can you use to do this? (Choose all that apply.)

   A. The Windows SIM tool in Windows AIK

   B. The DISM tool in Windows AIK

   C. The Deployment Workbench MDT tool

   D. Sysprep.exe

   E. Microsoft Notepad

3. You want to prepare a reference computer and capture its Windows 7 image for distribution to several destination computers. You intend to use your own client running Windows 7 as the technician computer. Which of the following tasks must you perform to achieve your goal? (Choose all that apply.)

   A. Install the Windows AIK on your technician computer (if not already installed).

   B. Use Windows SIM to create an Autounattend.xml answer file and save this to the root directory of a UFD.

  C. Install your chosen edition of Windows 7 on the reference computer.

  D. Install MDT 2010 on your technician computer (if not already installed).

  E. Create a WDS capture image.

  F. Create a bootable Windows PE optical disk or UFD (if one does not already exist).

  G. Use the ImageX tool to capture a systems image of the reference computer.

  H. Use the Sysprep tool to prepare the reference computer for imaging.

4. You are using the Sysprep tool to prepare a Windows 7 installation to be imaged. Which command-line option removes all unique system information from the installation?

  A. */audit*

  B. */oobe*

  C. */generalize*

  D. */unattend*

5. Which Windows Setup configuration pass applies settings to Windows 7 before Windows Welcome starts?

  A. *oobeSystem*

  B. *auditSystem*

  C. *specialize*

  D. *offlineServicing*

Lesson 2: Managing Virtual Hard Disk Files

This lesson discusses how to create native VHD files on a computer running Windows 7 and how to deploy, mount, attach, detach, and delete these files using tools such as Diskpart. It discusses bootable VHD files and the use of the BCDEdit tool.

The lesson looks at how you use Windows Image to Virtual Hard Disk (WIM2VHD) command-line tool to create VHD images from a Windows 7 installation source or from an image in a custom WIM file. It describes how you use the Offline Virtual Machine Servicing Tool to update the image on a VHD that is normally offline, and how you use the tools provided by WDS to manage images and export them to client computers and to virtual machines and VHDs that are online.

After this lesson, you will be able to:

- Create, mount, attach, and deploy VHD files and create a bootable VHD.
- Use the Diskpart, BCDEdit, and Disk Management tools.
- Use WIM2VHD to create VHD images from a WIM file.
- Describe the Offline Virtual Machine Servicing Tool and the GUI and command-line tools provided by WDS.

Estimated lesson time: 45 minutes

Using Native VHDs in Windows 7

The VHD format specifies a VHD encapsulated in a single file, capable of hosting native file systems and supporting standard disk operations. VHD files are used by Hyper-V, Virtual Server, and Virtual PC for virtual disks connected to a virtual machine. The VHD file format is used by Microsoft Data Protection Manager, Windows Server Backup, client computer backup (Vista and Windows 7 Enterprise and Ultimate), and other Microsoft and non-Microsoft solutions.

In Windows 7 Enterprise or Ultimate, you can use a native VHD to host the running operating system without any other parent operating system or virtual machine. Windows 7 disk management tools, such as Diskpart and Disk Management, can be used to create a VHD file. You can deploy a Windows 7 WIM image to a VHD and the VHD file can be copied to multiple systems. Windows Boot Manager can be configured for a native boot of the VHD Windows image.

Although virtual machines are widely used, many enterprise environments operate on physical machines. For example, you might need to run tests on a physical machine to access a specific hardware device. As an enterprise administrator, you probably need to maintain images based on both the WIM format for physical machines and the VHD format for virtual machines. A common image format supporting both physical and virtual machines provides flexibility in image deployment and simplifies the process of image management.

In Windows 7, native support for the VHD format means that VHD files can be created and modified without installing the Hyper-V Server role. VHD files can be attached using the Disk Management tool, and the Windows image inside the VHD is available for servicing. The Windows Deployment tools in the Windows AIK (specifically ImageX and DISM) can be used to create a Windows image to be stored on VHD, and to apply updates to the system image in the VHD file (available in Windows 7 Ultimate and Enterprise editions only).

A native boot of Windows 7 from a VHD file requires the Windows 7 boot environment. The Windows 7 boot environment is initialized during a full operating system installation and includes the Windows Boot Manager and Boot Configuration Data (BCD).

MORE INFO **RECOMMENDATIONS AND LIMITATIONS**

For more information about recommendations and limitations for VHDs, see *http://technet.microsoft.com/en-us/library/dd440865.aspx.*

NOTE **EDITION LIMITATIONS**

Only Windows 7 Enterprise and Windows 7 Ultimate can be booted when installed on a VHD. This was said before but is worth remembering.

Creating a Native VHD

Windows 7 provides native support for VHD. Previously, VHD files were used in virtualization platforms, such as Hyper-V, Virtual Server, and Virtual PC, and this facility is still available. However, in Windows 7, you can also create native VHDs on non-virtual computers.

You will find step-by-step instructions in the practice later in this lesson that enable you to create a native VHD and attach and detach the VHD file. However, the high-level procedure is as follows.

To create a native VHD, you right-click My Computer and click Manage to open Computer Management. You then select Disk Management, You can then right-click Disk Management and click Create VHD. This opens the Create And Attach Virtual Hard Disk dialog box. You select the location where you want to create the VHD file (first making sure you have sufficient free space).

Typically, you place the VHD on a second internal or external hard disk (although this is not essential). You then specify the VHD size and format settings. Microsoft recommends the default Fixed Size setting, but you can select Dynamic Expanding if you do not want to allocate the disk space. Fixed Size gives better performance and is more suitable in a production environment.

When you click OK, a newly attached (mounted) VHD is created. To initialize the disk, right-click the icon beside the disk designation and click Initialize Disk. This opens the Initialize

Disk dialog box. You select the partition and click OK. Typically, you do not need to change the default settings. The status of the disk then changes to Online.

You create a new simple volume on a VHD by right-clicking Unallocated and selecting New Simple Volume. This starts the New Simple Volume Wizard. You specify size, file system, and drive letter; label the drive; and click Finish to create the VHD.

Attaching and Detaching a VHD

You can also use the Disk Management tool to attach a VHD so you can use it and to detach it so you can change its properties or delete it. In Computer Management, you click Disk Management and then right-click Disk Management and click Attach VHD. This opens the Attach Virtual Hard Disk dialog box. Click OK to attach the existing VHD. If you do not want to change the VHD contents (for example, if you have installed an operating system on it), you can select the Read-Only check box.

To detach a VHD, you click the icon beside the disk designation and click Detach VHD. A Detach Virtual Hard Disk message appears. Click on OK to detach the VHD. If you want to delete the VHD permanently after it is detached, you can select the Delete The Virtual Hard Disk File After Deleting The Disk check box.

Using the Diskpart Utility to Create and Attach a VHD

You can use the Diskpart command-line utility to create and attach a VHD by performing the following steps:

1. On the Accessories menu, right-click Command Prompt and choose Run As Administrator. If necessary, click Yes to allow the program to run.

2. Enter **diskpart**.

3. Enter **create vdisk file=c\win7\myothervhd.vhd maximum=20000**. This creates a VHD file called Myothervhd Win7 with a maximum size of 20 GB in a folder called Win7 on the C: drive. You can also create a VHD on a second internal hard disk or on a USB external hard disk formatted with the NTFS filing system.

4. Enter **select vdisk file=c:\win7\myothervhd.vhd**.

5. Enter **attach vdisk**.

6. Enter **create partition primary**.

7. Enter **assign letter=v**.

8. Enter **format quick label=Windows7**.

9. Enter **exit**.

This creates the VHD file *C:\Win7\Myothervhd.vhd* as a primary partition. Figure 2-12 shows the Diskpart commands to create and attach a new VHD. Figure 2-13 shows the newly attached disk in Disk Management with drive letter V:.

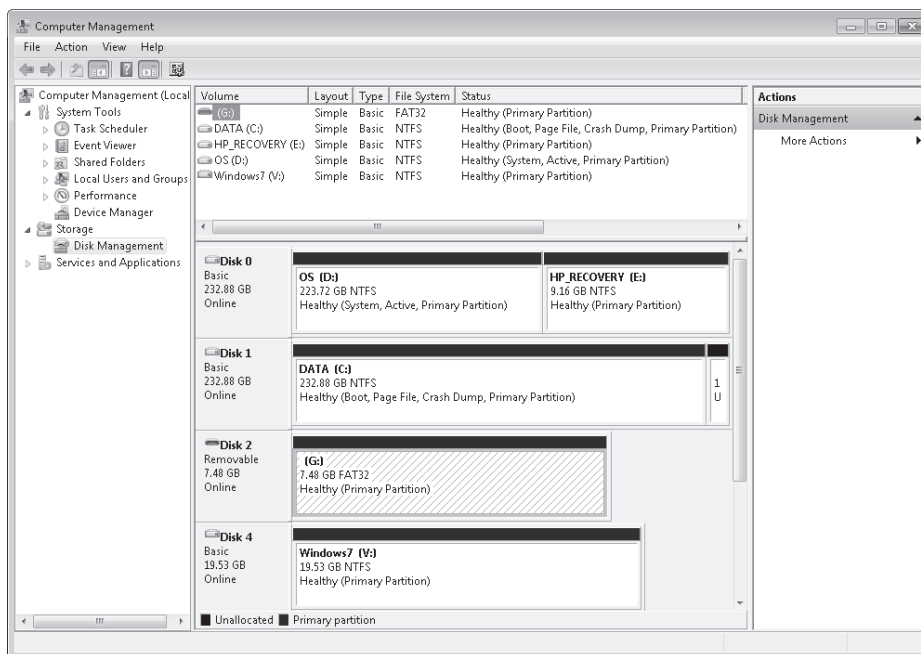**FIGURE 2-12** Creating and attaching a VHD

FIGURE 2-13 The VHD listed in Disk Management

Booting from VHD

The ability to boot from VHD (available in Windows 7 Ultimate and Enterprise editions only) is one of the more significant new features introduced by Windows 7. You can boot the machine as if it were running from the primary hard disk, and your operating system recognizes all the hardware available in your system. This lets you run multiple operating systems on the same computer without the performance issues sometimes encountered in virtual PCs. You can create multiple VHDs with multiple operating systems installed on them.

Previously in this lesson, you saw how to create a new VHD and attach it using Disk Management or the Diskpart utility. If you choose to install the Windows 7 operating system from the installation DVD-ROM, you require the Install.wim file from that optical device. You also need the ImageX utility (Imagex.exe). If you have installed the Windows AIK, as instructed in Lesson 1, you will find this file at C:\Program Files\Windows AIK\Tools\\x86.

You can also copy a WIM system image that you created for your computer (as described in Lesson 1) to a VHD on that computer. You do this in the practice later in this lesson.

Adding a Boot Entry for a VHD File

When you have created a VHD and installed a system image on it, you can use the BCDEdit tool Bcdedit.exe to add a boot entry for the VHD file in your computer running Windows 7. A step-by-step procedure to do this is given in the practice later in this lesson. The high-level procedure is as follows:

Open the elevated command prompt with Administrator privileges and enter a command similar to the following:

bcdedit /copy {current} /d "Your New VHD Description"

This returns the GUID of the loader object. You use this value to replace the variable *<guid>* in the following commands:

bcdedit /set <guid> device vhd=[driveletter:]\<directory>\<vhd filename>
bcdedit /set <guid> osdevice vhd=[driveletter:]\<directory>\<vhd filename>

BCDEdit locates the VHD file and Bootmgr locates the partition containing the VHD File to boot from. Finally, you enter the command:

bcdedit /set <guid> detecthal on

Detecthal is used to force Windows 7 to automatically detect the Hardware Abstraction Layer (HAL). The following command tests if your boot entry is successfully created:

bcdedit /v

If you want to delete an existing VHD entry from the Boot menu, you use the following command:

bcdedit /delete <guid> /cleanup

This deletes the specified operating system entry from the store and removes the entry from the display order.

When you restart your computer after successfully completing this procedure, you should see an additional entry in the Boot menu along with the default Windows 7 operating system.

> **MORE INFO**   **BCDEdit**
>
> For more information about BCDEdit, go to *http://msdn.microsoft.com/en-us/library/aa906217.aspx,* expand BCD Boot Options Reference, and click the links in the navigation pane.

EXAM TIP

You can use Bcdedit.exe to enable a VHD file as a boot option, but you cannot use the tool to create VHD files.

Using the Windows Image to Virtual Hard Disk Tool

You can use the WIM2VHD command-line tool to create VHD images from any Windows 7 installation source or from an image in a custom WIM file. WIM2VHD creates VHDs that boot directly to the Out-of-Box Experience (OOBE). You can also automate the OOBE configuration by supplying your own Unattend.xml file.

You need a client computer running Windows 7 that has the Windows AIK installed, and an operating system image in a WIM file. You also need to have created a native VHD on that computer.

The WIM2VHD tool runs from the Cscript command. The syntax is as follows:

cscript wim2vhd.wsf. /wim:<wimPath> /sku:<sku> *[/vhd:*<vhdPath>*] [/size:*<vhdSizeInMb>*] [/disktype:*<dynamic|fixed>*] [/unattend:*<unattendxmlPath>*] [/qfe:*<qfe1,.,qfen>*] [/hyperv:*<true|false>*] [/ref:*<ref1,.,refn] [/dbg:<args>] [/passthru:*<physicaldrive>*])*

WIM2VHD Parameters

Table 2-8 describes the parameters of the WIM2VHD tool.

TABLE 2-8 WIM2VHD Parameters

PARAMETER	DESCRIPTION
/wim:<wimPath>	This is the path of the WIM file you use when creating the VHD.
/sku:<skuName>|<skuIndex>	The Stock-Keeping Unit (SKU) identifies the operating system to use when creating the VHD (for example, "HomePremium"). You can also specify a number that you obtain by using ImageX to analyze the relevant WIM file.

PARAMETER	DESCRIPTION
/vhd:<vhdPath> (optional)	This defines the path and the name of the VHD to be created. If a file with this name already exists, it will be overwritten. If no VHD is specified, a VHD will be created in the current folder.
/size:<vhdSizeInMb> (optional)	For Fixed disks, this is the size in megabytes of the VHD that will be created. For Dynamic disks, this is the maximum size in megabytes to which the VHD can grow if additional space is required. If you do not specify this parameter, a default value of 40 GB is used.
/disktype:<dynamic|fixed> (optional)	This specifies what kind of VHD should be created, dynamic or fixed. A Fixed disk allocates all of the necessary disk space for the VHD upon creation. A Dynamic disk only allocates the space required by files in the VHD at any given time and will grow as more space is required. The default value is Dynamic.
/unattend:<unattendxmlpath> (optional)	This specifies the path to an Unattend.xml file that is used to automate the OOBE portion of Windows setup the first time the VHD is booted.
/qfe:<qfe1,.,qfen> (optional)	This is a comma-separated list of Quick Fix Engineering (QFE) or hotfix patches to apply to the VHD after the WIM is implemented.
/ref:<ref1,.,refn> (optional)	This is a comma-separated list of WIM "pieces" (split files) to apply to the VHD. A WIM "piece" is the result of a split WIM, and typically has a .swm file extension. The first piece of the split WIM should be specified with the /wim switch. Subsequent pieces should be specified (in order) with /ref.
/dbg:<protocol>,<port/ channel/target>[,<baudrate>]. (optional)	This configures debugging in the OS on the VHD.

You can use your own custom WIM files in this process. However, be careful. Although Microsoft supports the underlying process, as documented in the Windows AIK, WIM2VHD is not supported at this time.

You can copy files manually into the VHD, but there is no mechanism to do this with WIM2VHD.

WIM2VHD Examples

To create a Windows 7 Ultimate VHD with an automated setup answer file Unattend.xml, open an elevated command prompt and enter:

```
cscript wim2vhd.wsf /win:x:\mysources\install.wim /sku: ultimate
/unattend:C:\answer_files\unattend.xml
```

You need to adjust the location of the WIM file and the answer file to your own specifications.

To apply the first image in a custom WIM in the folder C:\Mystuff to a VHD named Mycustom.vhd when you have analyzed the WIM file with ImageX and know the SKU is designated as 1 within the WIM, open an elevated command prompt and enter:

cscript wim2vhd.wsf /wim:C:\mystuff\custom.wim /sku:1 /VHD:C:\mycustom.vhd

---

MORE INFO   **VIM2VHD**

For more information about VIM2VHD, see *http://code.msdn.microsoft.com/wim2vhd.*

Using the Offline Virtual Machine Servicing Tool to Update a VHD

The Offline Virtual Machine Servicing Tool 2.0.1 is a solution accelerator (as is MDT 2010). In addition to the appropriate installation files, a *solution accelerator* provides automated tools and additional guidance files. You can install the tool on a server running Windows Server 2008 or Windows Server 2003 SP2, where it works with Microsoft System Center Virtual Machine Manager (SCVMM) 2007 or SCVMM 2008 to maintain offline virtual machines and VHDs.

If your server is on the same network as a client running Windows 7 Enterprise or Ultimate edition, on which you have configured a bootable VHD, you can use the tool to update the VHD content when the VHD is typically offline. If your computer running Windows 7 is not normally booted from the VHD, the offline VHD does not receive operating system updates. The tool provides a way to keep the VHD up to date so that booting from the VHD does not introduce vulnerabilities into your computer.

The Offline Virtual Machine Servicing Tool can be configured to boot the client computer from the VHD just long enough for the VHD to receive updates from either SCCM 2007 or Windows Server Update Services (WSUS). As soon as the VHD's operating system is up to date, the tool reboots the client computer from its default boot disk.

The Offline Virtual Machine Servicing Tool solution accelerator includes the following features:

- Brief Overview
- OfflineVMServicing_x64.msi installation file
- OfflineVMServicing_x86.msi installation file
- Offline Virtual Machine Servicing Tool Getting Started Guide
- Offline_VM_Servicing_Tool_2.0_Release_Notes
- Offline_Virtual_Machine_Servicing_Tool_Help

The tool uses a servicing job that you schedule using Windows Task Scheduler on the server to manage the update operation. The servicing job boots the client computer from the

VHD, triggers the appropriate software update cycle using SCCM or WSUS, and then reboots the client computer from its default boot disk.

Installing the Offline Virtual Machine Servicing Tool

You cannot install the Offline Virtual Machine Servicing Tool until you have first installed SCVMM (although you can download and study the associated documentation). A beta version of SCVMM 2008 is currently available at *http://www.microsoft.com/systemcenter/ scvmm/downloadbeta.mspx*. You can download SCVMM documentation from the same source. Note that the Offline Virtual Machine Servicing Tool and SCVMM are server tools. You cannot install them on a computer running Windows 7.

You can download the Offline Virtual Machine Servicing Tool installation files and associated documentation directly from *http://www.microsoft.com/downloads/ details.aspx?FamilyID=8408ecf5-7afe-47ec-a697-eb433027df73&DisplayLang=en*. However, it is probably easier to access *http://technet.microsoft.com/en-us/library/cc501231.aspx* and click the link at the end of the Web page. All the files are downloaded as a single compressed file that you expand into a folder that you have created on the server for this purpose. It is a good idea to read the release notes and the Getting Started Guide and become familiar with them before running the appropriate installation file.

The SCVMM Administrative Console

SCVMM provides a management solution for the virtualized data center that helps enable centralized management of IT infrastructure, increased server utilization, and dynamic resource optimization across multiple virtualization platforms. It works with the Offline Virtual Machine Servicing Tool to ensure virtual machines and VHDs are kept up to date. SCVMM delivers the following features:

- It manages virtual machines running on Windows Server 2008 Hyper-V and Microsoft Hyper-V Server.
- It provides virtualization support for virtual machines running on Virtual Server and VMware ESX Server.
- It offers end-to-end support for consolidating physical servers onto a virtual infrastructure.
- It provides performance and resource optimization (PRO) for dynamic management of virtual infrastructure.
- It implements placement of virtual workloads on the best-suited physical host servers.
- It provides a complete library to manage all the building blocks of the virtual data center centrally.

The SCVMM Administrator Console, shown in Figure 2-14, is built upon a Windows PowerShell command-line interface. Any action in the Administrator Console can be performed through the Windows PowerShell command line, and each wizard in the

user interface shows the associated command-line actions. The Administrator Console integrates with System Center Operations Manager 2007 to provide insight into the physical environment as well as the virtual environment.
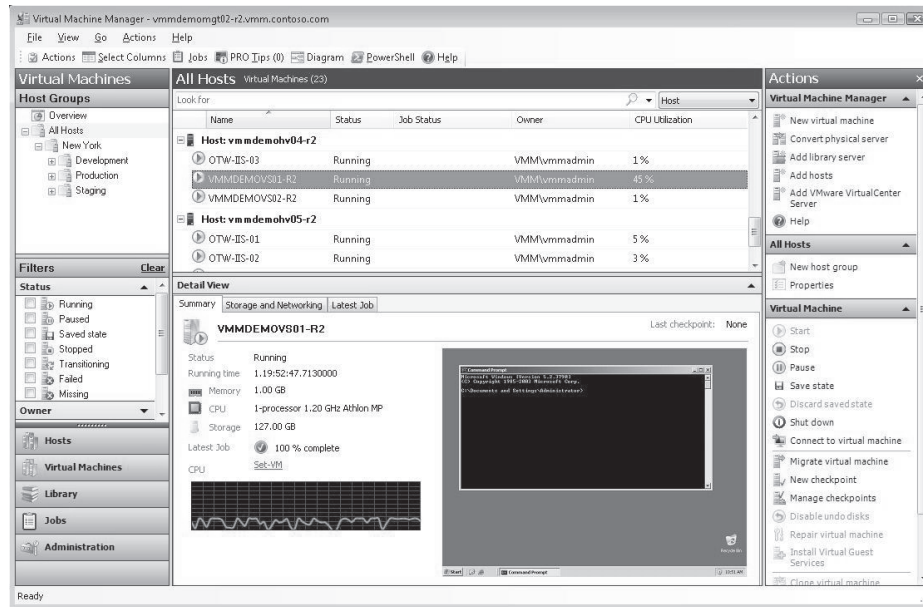

FIGURE 2-14 The SCVMM Administrator Console

Deploying to an Online VHD Using Windows Deployment Services

WDS enables you to deploy Windows 7 Enterprise or Ultimate remotely to bootable VHDs on client computers. Lesson 1 of this chapter briefly discussed WDS images. You can download the WDS documentation (including a Getting Started Guide, Deployment Guide, and WDSUTIL command-line syntax) at *http://www.microsoft.com/downloads/details.aspx?display lang=en&FamilyID=3cb929bc-af77-48d2-9b51-48268cd235fe*. You can download a step-by-step guide at *http://www.microsoft.com/downloads/details.aspx?familyid=14CA18B1-B433-4F62-8586-B0A2096460EB&displaylang=en*.

To use WDS to distribute Windows 7 images, you should install it on a server running Windows Server 2008 or Windows Server 2008 R2. WDS is a server role and you can install it by using the Initial Configuration Wizard, Server Manager, or the ServerManagerCmd command-line utility.

MORE INFO **WDS INSTALLATION REQUIREMENTS**

For more information about the requirements for installing and using WDS, see *http://technet.microsoft.com/en-us/library/cc771670(WS.10).aspx.*

WDS reduces the complexity of deployments and the costs associated with manual installation. It enables you to perform network-based installation of Windows operating systems, including Windows 7, to destination computers, online virtual machines, and online VHDs. WDS uses standard Windows Server 2008 setup technologies, including Windows PE, WIM files, and image-based setup.

WDS provides the Windows Deployment Services MMC snap-in GUI tool and the WDSUTIL command-line tool. The console enables you to perform almost all deployment tasks, although you cannot use it to pre-stage client computers. You can, however, use it to set the Auto-Add policy and approve or reject pending computers.

You can use the WDSUTIL command-line tool to perform all deployment tasks. WDSUTIL also enables you to script common tasks and run the required commands from simple batch files, because no WDSUTIL command requires an interactive user session.

MORE INFO   **CONFIGURING YOUR DEPLOYMENT**

For more information about configuring a deployment using WDS,
see *http://technet.microsoft.com/en-us/library/cc732529(WS.10).aspx.*

MORE INFO   **WDS DEPLOYMENT SCENARIOS**

For a description of scenarios in which you would use WDS, see *http://technet.microsoft.com/
en-us/library/cc770667.aspx.*

✔ **Quick Check**

   1. **What management tools are provided by WDS?**

   2. **Which of these tools can you use to pre-stage a client computer?**

   Quick Check Answers

   1. **The Windows Deployment Services MMC snap-in GUI tool and the WDSUTIL**
      command-line tool

   2. **The WDSUTIL command-line tool**

Using WDS Images

WDS uses a split WIM image method in which file resources are shared across each image group and the metadata of each image resides in a separate image file. The WDS image store creates a split media set consisting of two files:

■ A minimal WIM file that contains only the definition of the image

■ A Res.rwm file that contains all the file resources for all images in the image group. The data within Res.rwm is single-instanced and compressed.

At this juncture, it is probably helpful to briefly restate the difference between an install image and a boot image. Install images are the operating system images that you deploy to the client computer on internal disks, bootable external disks, and bootable VHDs. Boot images are the images that you boot a client computer into to perform an operating system installation. Boot images contain Windows PE and the WDS client Setup.exe with its supporting files for WDS. You can use the standard boot images that are included on the Windows 7 or Windows Server 2008 R2 media without modification.

> **MORE INFO**   **WDS DOCUMENTATION**
>
> **You can download WDS documentation (including a step-by-step guide) at**
> ***http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=3cb929bc-***
> ***af77-48d2-9b51-48268cd235fe.* You might need to supply your Microsoft Passport. This is**
> **a Windows Server 2008 link because WDS is a server role and cannot be installed on a client**
> **computer.**

When you install the WDS server role on your deployment server, you also install the WDSUTIL command-line tool. You can create boot images from the WIM file on an appropriate operating system installation disk by using the Windows Deployment Services MMC snap-in or WDSUTIL.

Creating a Capture Image

To use the Windows Deployment Services MMC snap-in to create a capture image, perform the following procedure on your WDS server:

1. In the Windows Deployment Services MMC snap-in, expand the Boot Images node.

2. Right-click the image to use it as a capture image (typically the \Sources\Boot.wim file from the installation media).

3. Click Create Capture Boot Image.

4. Type a name, description, and location where you want to save a local copy of the file. You specify a location so that if there is a network issue when you deploy the capture image, you have a local copy.

5. Follow the instructions in the wizard. When it completes, click Finish.

6. Right-click the boot image folder.

7. Click Add Boot Image.

8. Select the new capture image and then click Next.

9. Follow the instructions in the Image Capture Wizard.

To use WDSUTIL to create a capture image, perform the following procedure:

1. Open an elevated command prompt.

2. Enter **WDSUTIL /New-CaptureImage /Image:<*source boot image name*>
   /Architecture:{x86|ia64|x64} /DestinationImage /FilePath:<*file path*>**, where
   <*file path*> is the path and name for the capture image.

Adding a Boot Image

To use the Windows Deployment Services MMC snap-in to add a boot image to the WDS image store, perform the following procedure on your WDS server:

1. Right-click the Boot Images node and then click Add Boot Image.

2. Enter the path to the boot image or browse to the image file, and then click Next. Typically, you use the standard boot image that is included on the Windows Server operating system installation media without modification.

3. Enter an image name and description, and then click Next.

4. Review your choices, and then click Next.

To use WDSUTIL to add a boot image, perform the following procedure:

1. Open an elevated command prompt.

2. Enter **WDSUTIL /Verbose /Progress /Add-Image /ImageFile:<*path*> /ImageType:Boot**, where <*path*> is a full path to the image file.

Creating a Discover Image

To use the Windows Deployment Services MMC snap-in to create a discover image, perform the following procedure on your WDS server:

1. In the Windows Deployment Services MMC snap-in, expand the Boot Images node.

2. Right-click the image you want to use as a discover image. Typically, this is the Boot. wim file from the \Sources directory of the operating system installation DVD.

3. Click Create Discover Boot Image.

4. Follow the instructions in the Image Capture Wizard. When it completes, click Finish.

To use WDSUTIL to create a discover image, perform the following procedure:

1. Open an elevated command prompt.

2. Enter **WDSUTIL /New-DiscoverImage /Image:<*name*> /Architecture:{x86|x64|ia64} /DestinationImage /FilePath:<*path and name to new file*>**. To specify which server the discover image connects to, append **/WDSServer:<*server name or IP*>**.

Adding an Install Image

To use the Windows Deployment Services MMC snap-in to add an install image to the WDS image store, perform the following procedure on your WDS server:

1. Right-click the image group in the MMC console and click Add Install Image.

2. Select an image group.

3. Select the file to add.

4. Proceed through the rest of the wizard.

To use WDSUTIL to add an install image, perform the following procedure:

1. Open an elevated command prompt.

2. If you need to create an image group, enter **WDSUTIL /Add-ImageGroup /ImageGroup:<*image group name*>**.

3. Enter **WDSUTIL /Verbose /Progress /Add-Image /ImageFile:<*path to .wim file*> /ImageType:Install**.

If more than one image group exists on the server, append **/ImageGroup:<*image group name*>** to specify to which group the image should be added. If you want to skip the integrity check before adding the image, append **/SkipVerify** to the command in step 3.

Exporting an Image

When you export a boot image, WDS copies the file to the specified destination. When you export an install image, WDS combines the metadata in the Install.wim file with the resources in the Res.rwm file into a single WIM file at the specified destination.

To use the Windows Deployment Services MMC snap-in to export a boot or install image from your server to a hard disk or bootable VHD on a client computer, perform the following procedure on your WDS server:

1. Right-click a boot or install image and click Export Image.

2. In the dialog box, choose a file name and network path to which to export the image.

To use WDSUTIL to export a boot or install image from your server to a hard disk or bootable VHD on a client computer, perform the following procedure:

1. Open an elevated command prompt.

2. To export a boot image, enter **WDSUTIL /Verbose /Progress /Export-Image /Image:<*name*> /ImageType:Boot /Architecture:{x86|x64|ia64} /DestinationImage /Filepath:<*path and file name*>**.

3. To export an install image, enter **WDSUTIL /Verbose /Progress /Export-Image /Image:<*name*> /ImageType:Install /ImageGroup:<*image group name*> /DestinationImage /Filepath:<*path and file name*>**.

You can append **/Name:<*name*>** or **/Description:<*description*>** to the command if you want to set these metadata fields on the image. To determine behavior when the image specified in **/DestinationImage** already exists, append **/Overwrite:{Yes|No|Append}**. Yes overwrites the image, No causes an error, and Append (available for install images only) appends the new image to the existing WIM file.

Updating an Image

To use the Windows Deployment Services MMC snap-in to replace an image on the server with an updated version, perform the following procedure on your WDS server:

1. Right-click a boot or install image, and then click Replace Image.

2. Browse to the updated image.

3. Complete the wizard.

To use WDSUTIL to replace an image on the server with an updated version, perform the following procedure:

1. Open an elevated command prompt.

2. To replace a boot image, enter **WDSUTIL /Verbose /Progress /Replace-Image /Image:<*name*> /ImageType:Boot /Architecture:{x86|x64|ia64} /ReplacementImage/ImageFile:<*path*>**.

3. To replace an install image, enter **WDSUTIL /Verbose /Progress /Replace-Image /Image:<*name*> /ImageType:Install /ImageGroup:<*image group name*> /ReplacementImage /ImageFile:<*path*>**.

These procedures add the new image to the image store and remove the old one. You can then export the new image to destination computers, online virtual machines, or online VHDs.

EXAM TIP

You can update WIM images on rewritable media, place them in a WDS image store, and export them to the appropriate destination computers, online virtual machines, and online VHDs. However, if you want to "wake" offline virtual machines or VHDs on a scheduled basis so they can receive updates from WSUS (for example), you need to use the Offline Machine Servicing Tool described previously in this lesson.

MORE INFO **MANAGING IMAGES WITH WDS**

For more information about how you can use WDS to manage images, including how to set and display image attributes, how to remove an image and add and remove an image group, and how display information about all images in an image group, see *http://technet.microsoft.com/en-us/library/cc732961.aspx*.

Pre-staging Client Computers

You can use WDS to link physical computers to computer account objects in AD DS servers. This is called pre-staging the client. Pre-staged clients are also called *known computers*. You can then configure properties on the computer account to control the installation for the client. For example, you can configure the network boot program and the unattend answer file that the client should receive, as well as the server from which the client should download the network boot program. You do not pre-stage a VHD, but rather the client computer that boots from that VHD.

If you use WDS as part of the image installation process, a client computer is joined to a domain by default. You can disable this functionality using the Client tab of the server's Properties page.

You can use the WDSUTIL tool or the Active Directory Users And Computers snap-in to pre-stage client computers before deploying an image. You can also enable the Auto-Add policy. If you enable this policy and approve the installation for an unknown client,

the installation proceeds and a computer account is created in AD DS for that client. The WDSUTIL command to pre-stage a computer is WDSUTIL /Add-Device /Device:<*name*> /ID:<ID>.

When the Auto-Add policy is enabled, administrative approval is required before clients that are not pre-staged can have an image installed. To enable this policy, open an elevated command prompt and enter **WDSUTIL /Set-Server /AutoAddPolicy /Policy:AdminApproval.** You can also enable the policy using the PXE Response settings tab of the server's Properties page.

> *MORE INFO* **USING THE ACTIVE DIRECTORY USERS AND COMPUTERS SNAP-IN TO PRE-STAGE CLIENT COMPUTERS**
>
> **For more information about using the Active Directory Users And Computers snap-in to pre-stage client computers, see** *http://technet.microsoft.com/en-us/library/cc754289(WS.10).aspx.*

Pre-staging clients adds an additional layer of security. You can configure WDS to answer only to pre-staged clients, ensuring that clients that are not pre-staged are not able to boot from the network. If you pre-stage clients, you can control the following:

- The computer account name and location within AD DS
- Which PXE server should service the client
- Which network boot program (NBP) the client should receive
- What boot image a client receives and what WDS client unattend answer file the client will use

Pre-staging allows multiple PXE servers to service the same network segment by restricting the server to answer only a particular set of clients. Note that the pre-staged client must be in the same forest as the WDS server.

The Auto-Add policy applies only when the WDS server is set to answer all clients and WDS does not find a pre-staged computer account for a booting computer. In all other cases, this policy will not take effect. This policy does not pertain to computers that use Extensible Firmware Interface (EFI).

> *MORE INFO* **PRE-STAGING CLIENT COMPUTERS**
>
> **For more information about pre-staging client computers, see** *http://technet.microsoft.com/en-us/library/cc770832(WS.10).aspx.*

PRACTICE **Creating a Bootable VHD**

In this practice, you use the Computer Management tool to create a VHD. You then add the VHD to the Boot menu so that your computer can boot from it. You need to have completed the practice exercises in Lesson 1 before attempting this practice.

EXERCISE 1   Creating a VHD

To use Computer Management to create a VHD, perform the following procedure:

1. Log on to the Canberra computer with the Kim_Akers account.

2. Create a folder called VHDs on the C: drive. If you prefer to use an external USB disk drive, adjust your drive letter accordingly, but first ensure that the external drive is formatted with the NTFS file system.

3. On the Start menu, right-click Computer and choose Manage. If prompted, click Yes to allow the program to run.

4. Select Disk Management.

5. Right-click Disk Management and choose Create VHD, as shown in Figure 2-15.
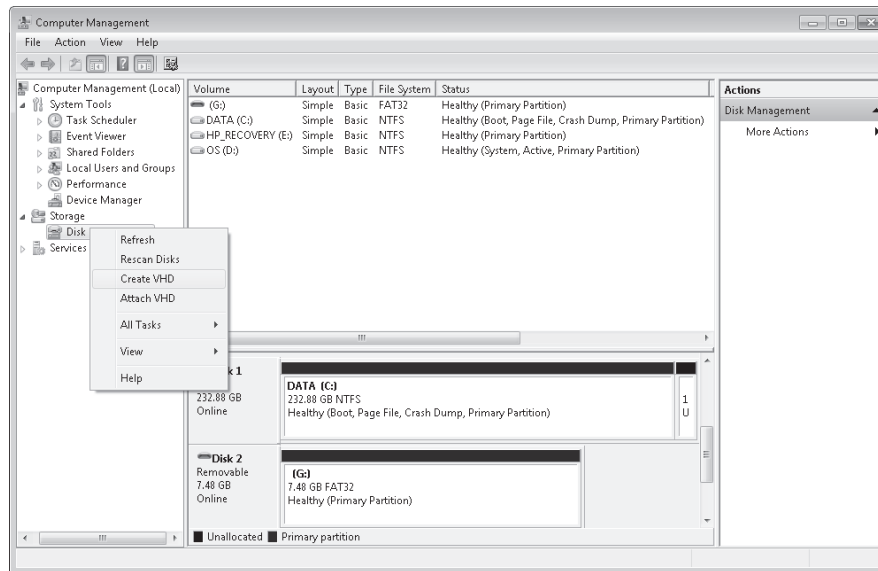

FIGURE 2-15 Creating a VHD

6. Complete the Create And Attach Virtual Hard Disk Drive dialog box, as shown in Figure 2-16. Click OK. If necessary, close the AutoPlay dialog box.

FIGURE 2-16 Specifying VHD file size, file name, and location

7. In Disk Management, right-click the icon beside the disk designation, as shown in Figure 2-17, and choose Initialize Disk. The VHD appears in the Disk Management pane. (Note: It can take some time for this to happen.)
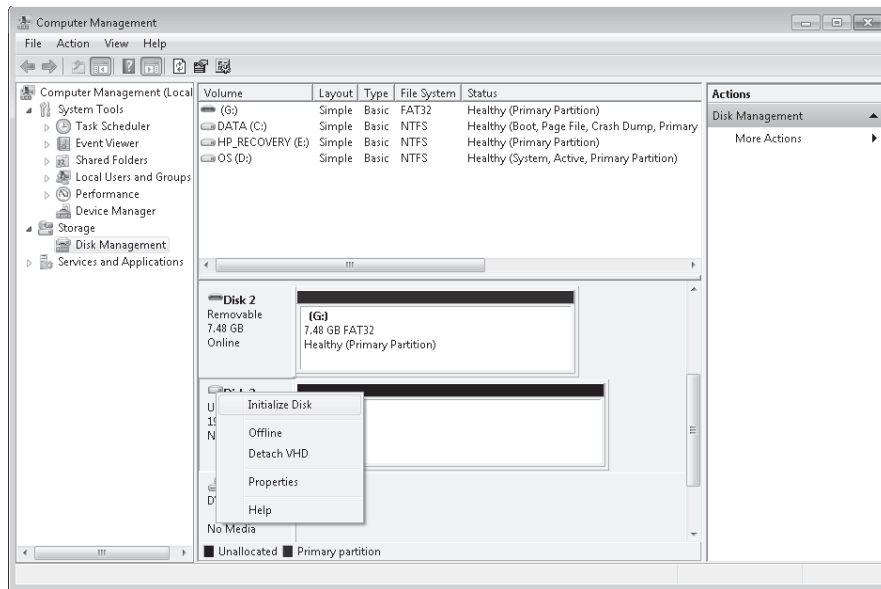
FIGURE 2-17 Initializing the VHD

8. Ensure MBR (Master Boot Record) is selected and click OK. The status of the disk changes to Online.

9. On the newly created disk, right-click Unallocated and select New Simple Volume. This starts the New Simple Volume Wizard. Click Next.

10. Click Next to accept the volume size defaults.

11. In the Assign Drive Letter Or Path dialog box, select W and then click Next.

12. In the Format Partition dialog box, give the volume a label (such as MyVHD), as shown in Figure 2-18. Ensure that Perform A Quick Format is selected. Click Next.
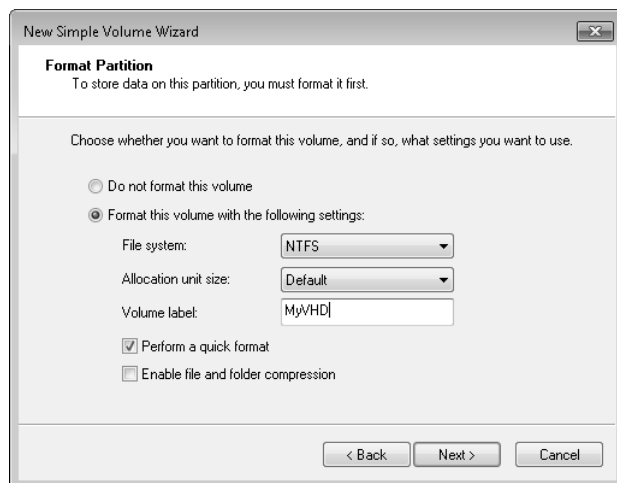

FIGURE 2-18 The Format Partition dialog box

13. Click Finish.

EXERCISE 2 Adding a VHD to the Boot Menu

To add the VHD that you have created to the Boot menu, perform the following procedure:

1. If necessary, log on to the Canberra computer with the Kim_Akers account.

2. Open an elevated command prompt and enter **bcdedit /copy {current} /d "MyVHD"**. As shown in Figure 2-19, this returns the GUID of the loader object. You use this value to replace the variable *<guid>* in the next steps in this procedure. The GUID that you detect will be different from that shown in Figure 2-19.
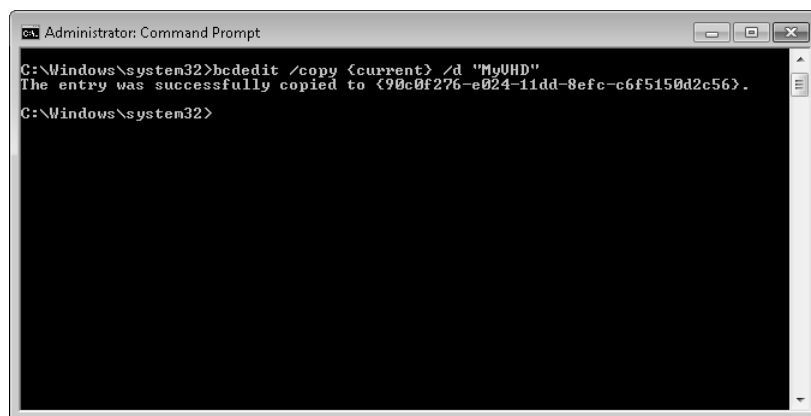

FIGURE 2-19 Identifying the GUID

3. Enter **bcdedit /set** ***<guid>*** **device vhd=partition w:**.

4. Enter **bcdedit /set** ***<guid>*** **osdevice vhd=C:\vhds\myvhd.vhd**.

5. To force Windows 7 to automatically detect the HAL, enter **bcdedit /vbcdedit /set** ***<guid>*** **detecthal on**.

6. To test if your boot entry has been successfully created, enter **bcdedit /v**.

7. Copy the WIM image file Myimage.wim that you created in Lesson 1 to the bootable W: drive.

8. Reboot the computer. Check that you can boot from the device MyVHD.

Lesson Summary

- You can use the Disk Management GUI tool or the Diskpart command-line tool to create a native VHD on a computer running Windows 7. The same tools enable you to attach, mount, detach, and delete a VHD.

- You can use the BCDEdit tool to add a boot entry for a VHD file.

- The WIM2VHD command-line tool uses WIM images to create VHDs that boot directly to the OOBE.

- You can use the Offline Virtual Machine Servicing Tool to implement a scheduled update of the image on bootable VHDs that are normally offline. WDS provides tools that let you deploy images to client computers and to virtual machines and VHDs that are online.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 2, "Managing Virtual Hard Disk Files." The questions are also available on the companion DVD if you prefer to review them in electronic form.

> *NOTE* **ANSWERS**
>
> Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You want to create a 20-GB native VHD called Systemvhd in a folder called Windows 7 on an external USB hard disk with the drive designation G:. Which command do you use?

    A. **create vdisk file=g:\windows7\systemvhd maximum=20000**

    B. **create vdisk file=g:\windows7\systemvhd.vhd maximum=20000**

    C. **create vdisk file=g:\windows7\systemvhd.vhd maximum=20**

    D. **create vdisk file=g:\windows7\systemvhd maximum=20**

2. You have used the ImageX tool to install a WIM system image on a VHD and added a boot entry for that VHD using the BCDEdit tool. The bootable VHD has been designated with the drive letter W:. The variable *<guid>* is replaced by the GUID of the VHD. What command can you use to verify that your boot entry is created successfully?

   A. **bcdedit /set <guid> detecthal on**

   B. **bcdedit /delete <guid> /cleanup**

   C. **bcdedit /v**

   D. **bcdedit /copy {current} /d "My New VHD"**

3. You want add an install image to the image store on a WDS server. You want to use the source image file Install.wim in the C:/Myimages folder. Which command do you use?

   A. **WDSUTIL /Verbose /Progress /Replace-Image /Image:myimage.wim/ ImageType:Install /ImageGroup:<myimagegroup> /ReplacementImage /ImageFile:C:\myimages/oldimage**

   B. **WDSUTIL /Set-Server /AutoAddPolicy /Policy:AdminApproval**

   C. **WDSUTIL /New-DiscoverImage /Image:myimage.wim /Architecture:x86 /DestinationImage /FilePath C:/myimages/install.wim**

   D. **WDSUTIL /Verbose /Progress /Add-Image /ImageFile:C:/myimages/ install.wim /ImageType:Install**

4. You administer a network in which all the client computers run Windows 7 Ultimate. You have created bootable VHDs on all your clients to provide failover protection. However, because the VHDs are normally offline, the images they hold do not receive all the latest security updates. You want to boot the clients from their VHDs automatically every Saturday at 11:30 P.M. just long enough for them to receive updates from your WSUS server. What tool do you use to do this?

   A. Offline Virtual Machine Servicing Tool

   B. SCVMM

   C. Windows Deployment Services MMC snap-in

   D. WDSUTIL

Chapter Review

To further practice and reinforce the skills you learned in this chapter, you can perform the following tasks:

- Review the chapter summary.
- Review the list of key terms introduced in this chapter.
- Complete the case scenarios. These scenarios set up real-world situations involving the topics of this chapter and ask you to create a solution.
- Complete the suggested practices.
- Take a practice test.

Chapter Summary

- Windows 7 operating systems support native VHDs, and you can make a VHD containing a WIM image (in Ultimate and Enterprise editions only) bootable by using the BCDEdit tool.
- You need to install the Windows AIK before you can create or deploy WIM image files. Windows AIK tools include Windows SIM, ImageX, Oscdimg, DISM, USMT, and Windows PE tools.
- You can use the Diskpart and Disk Management tools to create, attach, and initialize VHDs. You can use the Sysprep tool to generalize an image and remove computer-specific information.
- The WDS provides tools that allow you to create and manage images for online deployment. The Offline Virtual Machine Servicing Tool works with SCVMM on a server running Windows to schedule updates of images on offline VHDs.

Key Terms

Do you know what these key terms mean? You can check your answers by looking up the terms in the glossary at the end of the book.

- **solution accelerator**
- **system image**
- **Virtual Hard Disk (VHD)**
- **Windows Automated Installation Toolkit (Windows AIK)**
- **Windows Preinstallation Environment (Windows PE)**

Case Scenarios

In the following case scenarios, you apply what you've learned about configuring system images. You can find answers to these questions in the "Answers" section at the end of this book.

Case Scenario 1: Generating a System Image

You are an enterprise administrator at a large computer software organization. You want to install Windows 7 Ultimate automatically on any new client computers in your organization. You also need to transfer user data from computers running Windows Vista Ultimate to computers running Windows 7 Ultimate. Your company has recently developed a graphics toolkit, and you want to distribute an installation image over the Internet that will enable customers to generate an installation DVD-ROM. Answer the following questions:

1. What type of image file should you generate to install Windows 7 Ultimate and what tool do you use to do this?

2. What type of image file should you generate to distribute the graphics toolkit over the Internet, and what tool do you use to do this?

3. What Windows AIK tool can you use to transfer user data from computers running Windows Vista Ultimate to computers running Windows 7 Ultimate?

Case Scenario 2: Working with VHDs

You have set up a test network to investigate the Windows 7 operating systems. You have two client computers on your network. One runs Windows 7 Ultimate and the other runs Windows 7 Home Premium. Answer the following questions:

1. You want to create VHDs on your client computers and create a WIM file using each of the computers as reference computers. You want to install the reference WIM files on to VHDs on both clients and boot each computer into an operating system from the VHD. On which of your client computers can you do this?

2. You add three more client computers to your test network and want to install Windows 7 Ultimate on all of them. You use the computer running Windows 7 Ultimate on your network as a reference computer. What Sysprep utility do you need to run before you create a WIM image file on your reference computer and install the image on the additional clients?

Suggested Practices

To help you master the exam objectives presented in this chapter, complete the following tasks.

Use Windows SIM and Sysprep

In this practice, you create an answer file. Optionally, you use this answer file to install Windows 7 on a reference computer and then use the Sysprep tool to generalize the installation before capturing it as a WIM image. It is a bad idea to use the Canberra computer for this because you need it set up for other lessons in this book, so Practices 2 and 3 are optional. You should do them if you have another client computer that you can use for this purpose.

- **Practice 1**   Practice using Windows SIM to generate a number of answer files. You will find step-by-step instructions at *http://technet.microsoft.com/en-us/library/dd349348.aspx.*
- **Practice 3**   Install Windows 7 on a reference computer using one of the answer files you generated. Again, refer to the URL given in the first practice.
- **Practice 2**   Run *sysprep /generalize* to remove hardware-specific information from the reference computer and generate a WIM image of the reference computer. As before, refer to the URL given in the first practice.

Work with VHDs

Complete Practice 1. Practice 2 is optional.

- **Practice 1**   Create, mount, attach, detach, and delete VHDs. Use both Disk Management and Diskpart to do this. It becomes quite easy with a bit of practice. Also practice installing WIM images on VHDs and using BCDEdit to create bootable VHDs.
- **Practice 2**   Create and configure a virtual server running Windows Server 2008 or Windows Server 2008 R2. Install the Offline Virtual Machine Servicing Tool and SCVMM. Create a scheduled task that boots your client running Windows 7 from its bootable VHD.

Take a Practice Test

The practice tests on this book's companion DVD offer many options. For example, you can test yourself on just one exam objective, or you can test yourself on all the 70-680 certification exam content. You can set up the test so that it closely simulates the experience of taking a certification exam, or you can set it up in study mode so that you can look at the correct answers and explanations after you answer each question.

> ***MORE INFO***   **PRACTICE TESTS**
>
> **For details about all the practice test options available, see the section entitled "How to Use the Practice Tests," in the Introduction to this book.**