

1.1. WDS

The Windows Deployment Services (WDS) server role enables the deployment of Windows operating systems to client and server computers. Using WDS, computers without an operating system installed boot from the network, contact the WDS server, and download and install the operating system.

- WDS is an update to Remote Installation Services (RIS) that was available with Windows 2003 and earlier operating systems.
- You can use WDS to deploy Windows Server 2008/2012/2016, Windows Vista/7/8/10, and earlier versions of Microsoft operating systems.
- WDS is available with Standard, Enterprise, and DataCenter editions of Windows Server 2008/2012/2016.

WDS uses disk images for the installation. An *image* is a single file containing the contents of an operating system installation. Image files have the .wim extension. There are four types of WDS images.

Image Type	Description
Install image	<p>An <i>install</i> image is an image of the operating system that will be installed on client computers.</p> <ul style="list-style-type: none">• A default install image (Install.wim) is included on the operating system DVD in the <DVDroot>\Sources folder.• Install.wim includes all editions of Windows Server 2008/2012/2016 within the single image file, including the Enterprise and Datacenter editions and the Server Core installations.• When you add the install image in WDS, you identify the editions within the install image that are available for clients to install.• When a client computer connects to the WDS server, and if there are multiple install images available or multiple editions within a single install image made available, a menu will be

	<p>shown allowing the user to select the version and edition to install.</p> <ul style="list-style-type: none"> Each install image is architecture specific. For example, you must have either the 32-bit, 64-bit, or 64-bit Itanium version.
Boot image	<p>A <i>boot</i> image is a minimal operating system (Windows PE) that is sent to the client when it first connects to the WDS server. Boot images are used as follows:</p> <ol style="list-style-type: none"> 1. During the boot process, the client computer locates the WDS server. 2. The WDS server sends a boot image file to the client. The boot image file contains the Windows PE operating system and the WDS client software. 3. The client installs the Windows PE operating system in the boot image and starts the WDS client. 4. The WDS client retrieves a list of available full operating systems to install. 5. The client computer downloads the appropriate install image and installs the full operating system. <p>When working with boot image files:</p> <ul style="list-style-type: none"> A default boot image file (Boot.wim) is included on the operating system DVD in the <DVDroot>\Sources folder. You can use multiple boot image files. If the WDS server has multiple boot image files, the client computer will display a menu of boot images to use. <p>Note: Client computers must support PXE boot (network boot) to use boot image files. PXE boot allows a computer without an operating system installed to locate and download the operating system through a network connection.</p>
Capture boot image	<p>A <i>capture</i> boot image is an image that you use to create custom install images. To create a custom install image you do the following:</p>

	<ol style="list-style-type: none"> 1. Create the capture boot image from a regular boot image. The capture image includes Windows PE and the WDS Image Capture Wizard. 2. Install the operating system on a reference computer. Once the operating system is installed, you can customize the installation as desired. 3. On the reference computer, run the SysPrep utility. SysPrep prepares the computer so that an image can be created from the installation. 4. Boot the reference computer from the network. When the computer connects to the WDS server, select the capture boot image you created earlier. 5. After the computer boots, it runs the WDS Image Capture Wizard. Use the wizard to select the disk partition containing the operating system installation you want to capture, and a location to save the resulting image file. 6. When the wizard completes, the resulting install image file is uploaded to the WDS server.
<p>Discover boot image</p>	<p>A <i>discover</i> image is a boot image that is placed on removable media (such as a CD, DVD, or USB drive) that can be used by non-PXE clients to boot and locate a WDS server. To use a discover image:</p> <ol style="list-style-type: none"> 1. Create the discover image from an existing boot image. 2. Use the Microsoft Windows AIK tools to create an ISO image that contains the discover boot image. 3. Burn the ISO image to disc. You must use a tool capable of creating a disc from an ISO image; simply copying the image to the disc will not work. 4. Insert the media in the client computer. Boot the computer from the media. 5. The computer installs the Windows PE operating system and connects to the WDS server. Select a desired install image to install the full operating system and complete the process.

1.2. WDS Installation

Following are the server and networking requirements for Windows Deployment Services:

- The WDS server role can only be installed on a Windows Server 2008/2012/2016 server. You cannot install WDS on a Server Core installation.
- Use Server Manager to add the Windows Deployment Services role. Add both the Deployment Server and Transport Server role services.
- Images on the WDS server must be stored on an NTFS partition.
- The WDS server must be a member of an Active Directory domain. DNS name resolution for the domain must be configured.
- You must have a DHCP server on the network. The DHCP service can run on the WDS server or on another server.
 - To deploy WDS and the DHCP server role on the same server, disable port 67 in the WDS server properties and configure DHCP option 60. You can perform both of these tasks during installation or using the WDS console.
 - If the DHCP service is on a server in a different subnet from the WDS server, do one of the following:
 - Configure IP helper tables on the router. Forward UDP port 67 to both the DHCP server and the WDS server. Forward UDP port 4011 from client computers to the WDS server.
 - Add DHCP option 66 to point to the WDS server, and configure option 67 with a value of **boot\x86\wdsnbp.com**
- You can manage and maintain WDS from a command line using the **WDSUtil** command line utility.

Clients that will use WDS for installing the operating system have the following requirements:

- To boot from the network, the client must be PXE boot capable, and the BIOS must be configured to boot from network. If the client is not PXE capable, plan on using discover images.
- The workstation requires a minimum of 512 MB of RAM to load the boot image.

- Additional RAM and hardware to meet the operating system requirements of the install image is required.
- The user account that will be used during the installation must be a member of the Domain Users group.
- WDS does not support the use of IPv6. Clients must use IPv4 to connect to the WDS server and download images.

Prestaging a computer account allows you to control various WDS options available to the client. Be aware of the following when managing computer accounts used by WDS.

- Prestage accounts to:
 - Control the computer name that gets assigned to the computer.
 - Assign the computer to use a specific PXE server.
 - Assign the computer a specific boot menu or configure which boot image is used.
 - Identify which unattend file will be used during the install.
- The PXE response setting for the WDS server identifies which computers the WDS server will respond to. The following table lists the various response methods:

Response	Action
Do not respond to any client computer	The WDS server is enabled and configured but not responding to any clients.
Respond only to known client computers	The WDS server sends a response and starts to copy an image to computers that have a computer account in Active Directory. This method prevents unknown computers or untrusted computers from accessing your network.
Respond to all (known and unknown) client computers	Any computer that requests an image from WDS will receive the image and start the installation process. When you select this option, you can require approval for all unknown clients (a response will only be sent after an administrator manually approves the client).

- By default, when a client completes the operating system installation using a WDS server, a computer account is automatically created in the domain if one does not already exist. Use the following methods to control how computer accounts are created:
 - Run ***Wdsutil /add-device /device:name /ID:idnumber*** or use Active Directory Users and Computers to create (prestage) a computer account before it attempts a network boot.
 - To prevent a computer account from being created, take one of the following actions:
 - Configure the WDS server to respond only to known computers. This means that only computers with an existing computer account can use the WDS server. The account will not be created because it already exists.
 - If the WDS server is configured to respond to unknown computers, select the **Do not create account in the domain after running WDS Client** option on the Client tab of the WDS server properties to disable creating computer accounts for successful installations.
 - On the WDS server properties, use the Directory Services settings to configure the location for computer accounts created by WDS and the naming format for those accounts. Use variables to customize the computer name:
 - Use **%Username**, **%First**, and **%Last** to create the computer name from the user logon or user name.
 - Use **%MAC** to use the MAC address as part of the computer name.
 - Use the format **%[0][n]#** to use a variable number. For example, the variable **%02#** adds numbers 01, 02, 03, etc. to the computer name.
- Note:** Computer names are limited to 15 characters. If the resulting name is longer than 15 characters, the name will be truncated to only 15 characters.*
- Use the ***Wdsutil /set-server /PrestageUsingMAC:Yes*** command to keep track of computers using the MAC address instead of the computer GUID.

1.3. Image Management

In addition to the WDS console, use the following tools as you manage WDS images:

Tool	Description
Windows Pre-installation Environment (WinPE)	<p>WinPE is a minimal installation of Windows that controls the early boot process and starts a limited operating system.</p> <ul style="list-style-type: none">• WinPE is used with WDS to boot the computer and select the installation image to install on the computer.• WinPE includes necessary drivers to connect to a network share, as well as tools to format and partition hard disks.• You use WinPE to boot a reference computer when capturing an image to use with WDS.
System Preparation Tool (SysPrep)	<p>Use SysPrep to prepare a Windows installation for imaging by removing machine-specific information. When creating a custom install image, you run SysPrep on the reference computer before capturing the operating system image.</p>
ImageX	<p>ImageX is a command-line tool used to create and modify operating system images. Use ImageX to:</p> <ul style="list-style-type: none">• Capture an installation to make a WDS install image.• Modify an existing image by adding drivers without recapturing the entire image.• Compress images.• Copy images to network distribution points. <p>Note: You can create an install image using the WDS Image Capture Wizard. Use ImageX for access to more features including the ability to capture to a network location, additional compression options, and the ability to capture partial volumes.</p>

<p>Windows System Image Manager (Windows SIM)</p>	<p>Use Windows SIM to create and manage response files used for unattended installations. An unattended installation uses an <i>answer file</i> (also called a <i>response file</i>) that identifies the responses to installation questions. The installation starts automatically and completes without user intervention. For an unattended installation with WDS, you use two different response files:</p> <ul style="list-style-type: none"> • The WDS client answer file controls the WinPE boot and the selection of the operating system installation image. • The operating system installation answer file contains the responses required to install the operating system. <p>Windows SIM is included in the Windows Automated Installation Kit (Windows AIK).</p>
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For a large-scale WDS deployment, you will work with multiple images of each type. The following table lists considerations for managing each image type:

Image	Consideration
<p>Install</p>	<p>The install image is the operating system image that will be configured on the WDS client.</p> <ul style="list-style-type: none"> • Install images are architecture dependent. There are separate images for x86 (32-bit) systems and for x64 (64-bit) systems. • Install images include all versions of the respective operating system. For example, the x86 install image for Windows Server 2008 includes the 32-bit Standard, Enterprise, and Datacenter editions, along with the Server Core installations of each. • When you add an install image to WDS, you select the versions that will be available to clients. For example, you can deselect the Datacenter edition or the Server Core installations to prevent those versions from being selected and installed. You might do this to prevent users from installing versions for which you do not have the necessary licenses.

	<ul style="list-style-type: none"> • Install images for Vista/7/8/10 and Windows Server 2008/2012/2016 are hardware abstraction layer (HAL) independent. This means that a single image can be used for systems with varying hardware, as long as the architecture type matches. • Install images for earlier operating systems (such as Windows XP) are HAL dependent. You will need to create an install image for each HAL type needed.
Boot	<p>The boot image is the image that contains WinPE and the WDS client software and is used to boot the client and select the install image to use.</p> <ul style="list-style-type: none"> • Boot images are architecture dependent. There are separate images for x86 (32-bit) systems and for x64 (64-bit) systems. • An x64 computer can boot using either an x64 or x86 boot image. An x86 computer can only use an x86 boot or install image. • If you have multiple boot images on the WDS server, the boot menu will show both the x64 and x86 boot images. Only x86 boot images will be shown for x86 computers. • If the computer boots using an x86 boot image, both x64 and x86 install images will be shown on the install menu for x64 computers; only x86 images will be shown for x86 computers. • If the computer boots using an x64 boot image, only x64 install images will be shown on the install menu.
Discover	<p>If the client computer is not PXE-enabled, you must boot the computer using a discover image. When you create a discover image, you specify how the computer finds the WDS server:</p> <ul style="list-style-type: none"> • With <i>static</i> discovery, you manually identify the WDS server that will be used. • With <i>dynamic</i> discovery, the client uses a PXE-emulated request to locate a WDS server on the network.

Capture	<p>A capture image is a special boot image that contains WinPE and the WDS Image Capture Wizard. You boot the computer using the capture image to create an install image based on the reference computer.</p> <ul style="list-style-type: none"> • After creating the capture image, add the capture image back into the WDS console. • Install the operating system on a reference computer and customize it to meet your requirements. • Before booting the reference computer with the capture image, run SysPrep on the computer to prepare it for imaging. Choose the Enter System Out-of-Box Experience (OOBE) and the Generalize options to prepare the system for imaging. • When the reference computer reboots, it connects to the WDS server. Select the capture image to start the Capture Image Wizard. • You can also reboot the computer into WinPE and use ImageX to take advantage of features available with ImageX.
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If you have an existing install image, you can use ImageX to add drivers or operating system updates without recapturing the install image. Use the following process:

1. Create an empty directory that will be used for mounting the install image.
2. Run the **ImageX** command with the **/mountrw** command. This mounts the image in a read/write state so that changes can be made. (Using the **/mount** command mounts the image as a read-only image.)
3. Run the **Peimg /inf** command to add drivers to the image.
4. Run the **ImageX /unmount** command with the **/commit** switch to save the changes to the image.

Be aware of the following additional points about managing WDS images:

- A shared folder is created on the WDS server called **RemoteInstall** that clients connect to in order to download images.
 - The **Images** folder stores install images, and the **Boot** folder stores boot images.

- When you create an image group, a subfolder is created inside the **Images** folder. Any image you add to the image group is copied to this subfolder.
- When you add the same image to different image groups, the image is copied to each image group. When you use multiple image groups, you will have multiple copies of the image file on the WDS server.
- When you add an image to an image group, two files are created:
 - The .rwm file is the .wim file from the installation medium. This file includes all install images included on the installation medium. This file is only copied once to the image group folder. This file is large because it contains everything necessary to install Windows.
 - The .wim file contains metadata for the specific operating system installation you have made available. For example, if you chose to make the Standard and Standard Core editions available, you will have two .wim files, one for each edition. The size of these files is small because they only contain metadata about a specific installation option.
- You can configure permissions to control which images a specific user can access.
 - Configure permissions on an image group to allow or prevent users from accessing all images within the group. Setting permissions on the image group modifies the permissions set on the parent image group directory, and affects all .rwm files and .wim files within the image group directory.
 - Configure permissions on a specific image to prevent users from accessing specific images. Users will only see the images they have permissions to see. Setting permissions on the image file modifies permissions on the .wim file, but not the .rwm file.
- You can store install images on a server that is not a WDS server, and then use DFS to replicate images between multiple servers. Use this method to load balance the downloading of install images and for centralized administration of install images on multiple servers.
- To configure an unattended installation:
 - Save the WDS client answer file to the **<drive>:\RemoteInstall\WdsClientUnattend** folder. Edit the *server* properties to enable unattended installations and point to this file.

- Save the operating system answer file to a network share. Edit the *image* properties to enable unattended installation for the operating system and point to the operating system answer file.

1.4. WDS Multicast

New with Windows Server 2008/2012/2016, WDS multicasting allows multiple computers to receive an image simultaneously, reducing the amount of network traffic required for sending images. Without multicasting, when a client connects to the WDS server, the requested image is sent directly to the client as it is requested. When multiple clients connect multiple copies of the same image could be sent on the network.

To configure multicasting with WDS:

- Each client computer has its own unique unicast IP address. Each client listens to the same multicast IP address.
- IGMP snooping must be enabled on routers. If IGMP snooping is turned off or not supported on your devices, multicast traffic may be treated like broadcast traffic and sent to every device in the subnet.
- Use the Boot.wim image from the Windows Server 2008/2012/2016 or Vista SP1/7/8/10 DVD. The Boot.wim file from the Vista DVD does not support multicasting for clients.
- In the WDS server console, configure the server properties and configure the multicast address. Make sure that the multicast IP address used by the server does not overlap with other multicast addresses used on the network.
- In the WDS server console, create a multicast transmission. There are two types of multicast configurations:
 - With auto-cast, the transmission starts as soon as one client requests it. Subsequent clients join the transmission that has already started.
 - With scheduled-cast, the transmission starts based on the number of clients waiting and/or on the specific day and time.
- On the WDS server, you can customize how the server uses the network bandwidth for multicasting by configuring the network *profile*. The profile identifies the network bandwidth (10, 100, or 1,000 Mbps). For each profile, default properties control how much bandwidth the server uses for WDS multicasting. To use a custom profile, select the **Custom** option and edit the registry to configure the profile settings. The following table lists some profile settings you should know.

Setting	Description
ApBlockSize	Identifies how much data is transmitted in each packet. The block size should match the maximum block size supported by the networking architecture.
TpMaxBandwidth	Specifies the maximum bandwidth percentage used by WDS. A setting of 100 decimal (or 64 hex) means the server will use up to 100% of the available bandwidth. Configure a lower value to ensure that WDS does not consume all of the network bandwidth for multicasting.
TpMulticastTTL	Configures the maximum number of network hops for which a multicast packet is valid. This value should be greater than the number of routers between the WDS server and the farthest WDS client. Normally, the default value will be sufficient because routers will only forward multicast traffic to networks that include a host for that multicast transmission. If routers do not support IGMP snooping, you can decrease this value so that multicast packets are not forwarded unnecessarily.

Note: You can configure a stand-alone server with the Transport server role to support multicast transmissions. However, this configuration requires additional configuration steps beyond the scope of the course.

Use the WDS console to view and manage multicast transmissions that are in progress.

- If you enable scheduled-casting but do not specify a condition for when the transmission starts, images are not sent until you manually start the transmission.
- If you delete an existing transmission, current clients will continue the installation using unicasting.
- If you deactivate an existing transmission, current clients will finish using multicasting, but no new ones will be allowed to connect. After the transmission is finished, the transmission will be deleted.
- Disconnect a client to stop the installation on a client. This stops the installation immediately, and could leave the client in an unstable state.

- To disconnect a client from multicast but allow it to continue installation using unicast, right-click the client and select **Bypass multicast**.
- To modify the settings for a transmission (such as editing the start time or the threshold value), delete the transmission and create a new one.
- With multiple clients connected to a multicast transmission, the transmission will proceed at a rate that matches the slowest network client.