

A guide to using Windows Server 2008 R2 native VHD support

Ravikanth Chaganti
Dell Windows OS Engineering

Table of Contents

- Overview 4**
 - What is native VHD support? 4
 - Benefits of native VHD support 4
- Creating a virtual hard disk 5**
 - Virtual Hard disk types 5
 - Fixed virtual hard disk.....5
 - Dynamic hard disk.....5
 - Differencing virtual hard disk.....5
 - Using diskpart.exe..... 5
 - Using Disk Management MMC 6
 - Creating a differencing VHD 6
- Mounting / dismounting a VHD file 7**
 - Using diskpart.exe..... 7
 - Using Disk Management MMC 7
- Applying an OS image to VHD 8**
 - Pre-requisites for applying an OS image to VHD 8
- Partition layout recommendation for VHD boot 8**
- Implementing VHD boot in a multi-boot scenario 9**
- Implementing VHD boot on a bare metal system..... 9**
- Deploying VHD images using WDS 10**
- Best practices for VHD boot 11**
- Known issues and limitations of VHD boot 11**
- Tools and references..... 11**
- Appendix 1 – Sample Unattended.xml file for WDS Deployment 12**

DISCLAIMER

THIS WHITE PAPER IS FOR INFORMATIONAL PURPOSES ONLY, AND MAY CONTAIN TYPOGRAPHICAL ERRORS AND TECHNICAL INACCURACIES. THE CONTENT OF THIS WHITE PAPER ARE PROVIDED AS IS, WITH NO WARRANTIES, EXPRESS OR IMPLIED. DELL EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY. UNDER NO CIRCUMSTANCES, INCLUDING, BUT NOT LIMITED TO, NEGLIGENCE, SHALL DELL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF DATA OR PROFIT, ARISING OUT OF THE USE, OR THE INABILITY TO USE, THE INFORMATION, EVEN IF DELL OR A DELL AUTHORIZED REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

AT THE TIME OF WRITING THIS PAPER, WINDOWS SERVER 2008 R2 AND WINDOWS 7 ARE BETA PRODUCTS. THE FEATURES AND FUNCTIONALITY OF THESE PRODUCTS AS DESCRIBED IN THIS PAPER MAY CHANGE IN THE FUTURE.

© 2009 Dell Inc. All rights reserved.

Trademarks used in this text: *Dell*, *PowerEdge*, *EqualLogic* and *PowerVault* are trademarks of Dell, Inc.; *Microsoft*, *Windows Server*, *Hyper-V* and *Windows* are registered trademarks of Microsoft Corporation.

Other trademarks and trade names may be used in this document to refer to either the entities claiming the marks and names or their products. Dell Inc. disclaims any proprietary interest in trademarks and trade names other than its own.

March 2009

Overview

Windows Server 2008 R2 includes native support for Virtual Hard Disk file format a.k.a VHD. Unlike Windows Server 2008, you don't need to have Hyper-V role or Hypervisor be enabled to manage VHDs. Disk management interfaces (diskpart.exe and diskmgmt.msc) have been updated to add new options to create / manage VHDs.

What is native VHD support?

As mentioned earlier, VHD support within Windows Server 2008 R2 or Windows 7 enables the ability to create / manage virtual hard disk files natively without any need for 3rd party applications. On earlier versions of Windows Server 2008, management of VHD files is supported only through Hyper-V WMI interfaces and hence forces you to have Hyper-V role enabled. Windows Server 2008 R2 eliminates this limitation by adding native support for VHD management through various interfaces such as diskpart.exe, diskmgmt.msc, VDS APIs and of course, continues to support Hyper-V WMI interfaces. There is no in-box support for VHD management using PowerShell yet.

Apart from the native support for creating / managing VHDs, Windows Server 2008 R2 or Windows 7 implements support for booting the system from a VHD file. This feature does not require hypervisor software or Hyper-V role be enabled. Using this, you can boot the operating system from a VHD file stored on the file system.

Benefits of native VHD support

There are various applications of native VHD support in Windows Server 2008 R2 or Windows 7. A few of them include,

Consistent image management capabilities

Windows Server 2008 R2 or Windows 7 lets you use native tools such as diskpart.exe along with WAIK tools to manage OS images in the VHD format. These tools work the same way in both virtual as well as physical environment.

Simplified image deployment and image consolidation

You can use a single generalized VHD image in both virtual and physical environments. This drives a simplified way to deploy OS in both the above mentioned environments. This feature also eases multi-boot deployment methods for client systems. You can have multiple OS VHDs on the same machine and manage boot configuration data (BCD) to boot from any of these OS images.

Backup and restore

VHD format for backup and restore is natively supported by Windows Server 2008 R2. You can back up the content of a hard drive to a VHD and restore it elsewhere on a system with VHD support. Many other MS applications such as data protection manager support VHD format for backup and restore. This drives consistency in disaster recovery management.

This paper provides step-by-step guidance on how to create VHDs and implement VHD boot on a Windows Server 2008 R2 system.

Creating a virtual hard disk

Virtual Hard disk types

As per Microsoft's VHD specification on virtual hard disk files are implemented as files that reside on the native host file system. Windows 7 or Windows Server 2008 R2 includes native support for the all VHD file formats defined in the VHD format specification

Fixed virtual hard disk

When a fixed virtual hard disk is created, OS pre-allocates disk space to the size of the virtual hard disk. For example, if you have specified 100GB as the size of the fixed VHD, OS creates a VHD file of 100GB size on disk. Fixed virtual hard disk creation could be quite time consuming based on the disk size specified. However, fixed VHDs provide better write performance than other VHD file formats.

Dynamic hard disk

A dynamic virtual hard disk file, when created initially, does not fill the disk space as a fixed VHD. At any point in time, dynamic VHD is as large as the actual data written to it. This type of VHD grows dynamically – till the actual size specified during creation is reached -- as more data is written to it.

Differencing virtual hard disk

A differencing hard disk image represents the current state of the virtual hard disk as a set of modified blocks in comparison to a parent image. This type of hard disk image is not independent; it depends on another hard disk image to be fully functional. The parent hard disk image can be any of the mentioned hard disk image types, including another differencing hard disk image.

There are multiple ways to create a virtual hard disk file in Windows Server 2008 R2 (beta). On a Windows Server 2008 R2 system, you can use either diskpart.exe or disk management MMC interface. Also, on Windows Server 2008 R2 systems with hyper-v role, you can use Hyper-V WMI interfaces (in the root\virtualization namespace) to create / manage VHD files. However, these WMI interfaces will not be available if hyper-v role isn't enabled.

This article explains VHD creation process using diskpart.exe and diskmgmt.msc interfaces only. For information on using Hyper-V WMI interfaces creating / managing virtual hard disks, refer to Msvm_ImageManagementService class specification.

Using diskpart.exe

Run the following diskpart commands on a system with Windows Server 2008 R2 (beta) OS

- *Diskpart> Create vdisk file=c:\vhddname.vhd maximum=vhdsize*

Note

By default, diskpart creates a dynamic VHD if Type attribute is not specified. If you need to create a fixed VHD, you can use type=fixed attribute.

- *Diskpart> Select vdisk file=vhddname.vhd*
- *Diskpart> attach vdisk*

- *Diskpart*> Create Partition Primary
- *Diskpart*> Format quick fs=ntfs
- *Diskpart*> Assign letter=R
- *Diskpart*> Exit

Using Disk Management MMC

On a system with Windows Server 2008 R2 (beta) OS,

- Open Disk Management MMC, Start -> Run -> diskpart.msc and click OK
- Navigate to the Action Menu and select "Create VHD"
- In the subsequent window, click on "Browse" and select a hard disk location where you want to store the VHD
- Enter VHD size in the Virtual Hard Disk Size input box
- Select type of VHD and click OK
- VHD gets automatically mounted as disk and can be seen in the list of disks
- Right click on the newly added disk and select "initialize disk"
- Once initialized, right click on the unallocated space to create partitions
- After creating necessary partitions, right click on the disk again and select "detach VHD" to unmount the VHD

Creating a differencing VHD

A differencing VHD cannot be created using the disk management MMC. Instead, you need to use the diskpart.exe command-line interface for this purpose. A differencing disk is not an independent disk and requires a parent VHD to be functional and hence you need to have an existing parent VHD to create a differencing disk. The following section assumes that you have a parent VHD and provides steps to create a differencing disk. At the command prompt, run diskpart.exe

- *Diskpart*> create vdisk file=*differencing_vhd_name.vhd* **parent=parent_vhd_path.vhd**
size=*vhdsiz*e

Note

Path you specify for the parent parameter must exist and should be a valid VHD

- *Diskpart*> Select vdisk file= *differencing_vhd_name.vhd*
- *Diskpart*> Attach vdisk
- *Diskpart*> create partition primary
- *Diskpart*> format quick
- *Diskpart*> assign letter=S
- *Diskpart*> detach vdisk

Once a differencing disk gets attached to a parent VHD, all the IO writes will be redirected to the differencing disk and parent VHD will not be modified. For example, if you have a Windows Server 2008 R2 VHD as the parent VHD and you connected a new differencing disk to this, the child VHD or the differencing disk becomes the target for all I/O writes. Hence, if you enable any role after connecting the differencing disk, all information pertaining to the new role or feature will be written to the child VHD.

This way, you can keep the parent VHD unmodified and connect multiple child VHDs to it and enable different roles/features in every child VHD. The following figure illustrates how this can be done

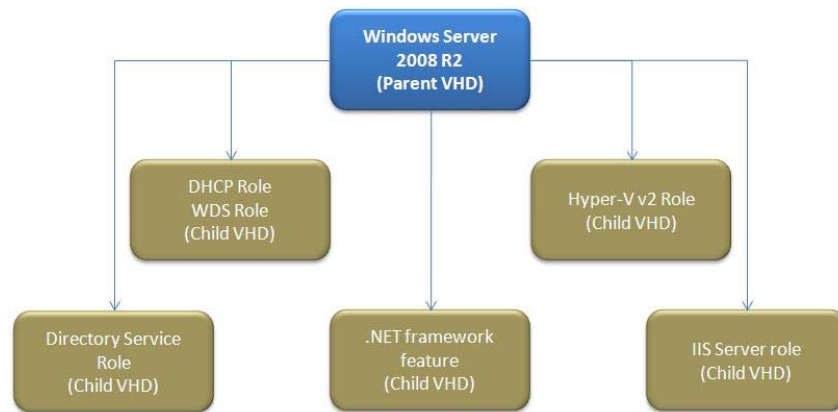


Figure1. Differencing disks with a single parent

In figure 1, Windows Server 2008 R2 is the parent VHD or the base VHD for the child VHD connected underneath. In this scenario, all child VHDs are connected to the same parent and hence when started will use the base operating system stored in parent. You can connect a few more differencing disks to an existing differencing disk. In that scenario, you need to specify the existing differencing disk as the parent to the new differencing disk. The entire differencing disk chain must be on the same hard disk volume.

Mounting / dismounting a VHD file

Similar to creating a VHD, mounting and dismounting of VHD can be done using either diskpart.exe or disk management MMC.

Using diskpart.exe

To mount, run the following diskpart commands on a system with Windows Server 2008 R2 (beta) OS

- *Diskpart> Select vdisk file=vhdname.vhd*
- *Diskpart> attach vdisk*
- *Diskpart> Exit*

To dismount,

- *Diskpart> Select vdisk file=vhdname.vhd*
- *Diskpart> detach vdisk*
- *Diskpart> Exit*

Using Disk Management MMC

To mount, on a system with Windows Server 2008 R2 (beta) OS,

- Open Disk Management MMC, Start -> Run -> diskpart.msc and click OK

- Navigate to the Action Menu and select “Attach VHD”
- In the subsequent window, click on “Browse” and select the VHD you want to mount
- Select “Read-only” check box if you do not want the mounted VHD to be writable and click OK

To dismount,

- Open Disk Management MMC, Start -> Run -> diskpart.msc and click OK
- Right click on the mounted VHD, and select “Detach VHD”
- In the subsequent window, click OK to complete

Applying an OS image to VHD

Pre-requisites for applying an OS image to VHD

- Windows Automated Installation Kit (WAIK) for Windows 7
- System with Windows 7 or Windows Server 2008 R2 OS
- Windows Server 2008 R2 or Windows 7 OS DVD

Windows Automated Install Kit installs tools such as imagex.exe. To apply an OS WIM to a VHD, you need to use imagex.exe on the system where you are performing this action. By default, WAIK gets installed at %systemdrive%\Program Files\Windows AIK folder. To apply an OS image to a VHD, on a system with Windows server 2008 R2 and WAIK tools,

- Create a VHD (Refer to “[Creating a Virtual Hard disk](#)” section) and mount it using either [diskpart.exe](#) or [diskmgmt.msc](#)
- At the command prompt, change the folder to “%systemdrive%\Program Files\Windows AIK\Tools\AMD64”
- Run, `imagex /apply <DVDDrive>:\Sources\Install.WIM <imagex_index_of_OS_image> <mounted_VHD_Drive_Letter>`. For example, to apply Windows Server 2008 R2 Enterprise edition image from install.wim to a VHD, `imagex /apply D:\Sources\install.wim 3 R:\`

Note

To obtain the image index number for a given OS edition, you can run `imagex /info <DVDDrive>:\sources\install.wim`

When a VHD created using the above method is used for VHD boot – during first boot – OS (specialize pass) configures required services and device drivers based on the hardware configuration. At the end of this configuration phase, system will be booted in to the OS.

Partition layout recommendation for VHD boot

For implementing VHD boot, it is always recommended to copy VHD files to a different partition than the system partition. The following figure illustrates the same.

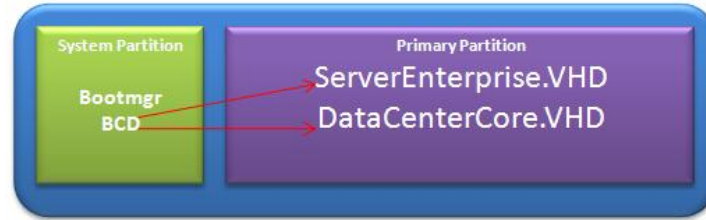


Figure 2, recommended partition layout for implementing VHD boot

In figure 2, there are two partitions created. First partition is the system partition (~100MB in size) that holds all boot configuration information or BCD and second partition is a data partition to store all VHD files. BCD on the system partition can be modified to point to the VHDs on the data partition. The following sections explain how VHD boot can be implemented in different scenarios.

Implementing VHD boot in a multi-boot scenario

Once you have created a VHD and applied an OS image to it, you can configure this VHD to be a part of multi-boot scenario. In this scenario, you can have Windows 7 or Windows Server 2008 R2 as the primary OS. Within this OS, you can add an OS VHD and configure that to be a second OS on the same system. To do this, on a system with Windows Server 2008 R2 or Windows 7

- Mount the previously created VHD with OS image as R: or any drive letter you prefer
- At the command prompt, change to R:\Windows\System32
- Run, `bcdboot.exe R:\windows`

Note

BCDBOOT.exe is a new tool included in Windows Server 2008 R2 to modify BCD entries for VHD boot

- Dismount the VHD file and reboot the system. You should be able to see the new VHD entry and boot from that upon selection

Implementing VHD boot on a bare metal system

Implementing VHD boot on a bare metal system is not straight forward. To accomplish this, you need to create a VHD, apply an OS image to it and then store it on a network share or USB disk for later use.

Once you have the VHD ready,

- Boot the system using Windows Server 2008 R2 OS DVD
- At the "Install Now" screen, press *Shift+F10* key sequence to open a command prompt
- At the command prompt, open `diskpart` and create two partitions of at least 100MB and 40GB respectively; format these new partitions and assign drive letters (S: and R: respectively)
- Copy the previously created VHD to the data partition
- [Mount the VHD](#) using `diskpart.exe`
- At the command prompt, move to the <mounted VHD drive>:\Windows\System32
- Run, `bcdboot.exe /s S:\`. This command will copy the required BCD and boot files from the VHD to the system partition

- You can now reboot the system and boot to the VHD

Deploying VHD images using WDS

Windows Server 2008 R2 provides support for deploying operating system using VHD images as a part of unattended installation. However, there is no GUI support for adding these VHD images to the repository. You must use the WDSUtil command-line to perform the same. The additional support for VHD images for WDS deployment is in line with the single image format goal of VHD format. In a data center scenario, an administrator can now use a single file format (VHD) for image based deployment.

This section explains steps involved in adding VHD as an install image. You must add a boot image – either a custom boot image or boot.wim from Windows Server 2008 R2 DVD – to the WDS server before trying to deploy VHD images on WDS clients. You can find more information on managing WDS images at <http://technet.microsoft.com/en-us/library/cc770667.aspx>

To add a VHD image to the WDS server,

- At the command prompt, create an image group using
`wdsutil /Add-ImageGroup /ImageGroup:"WDS VHD Images"`
- Add the VHD image to the newly created group
`wdsutil /verbose /progress /Add-Image /ImageFile:"Path_to_VHD" /ImageType:Install /ImageGroup:"WDS VHD Images"`
- As mentioned earlier, VHD image deployment using WDS is supported only in the unattended mode. To configure an unattended installation for a VHD image,
 - At the command prompt, run `WDSUTIL /Set-Server /WDSUnattend /Policy:enabled /File:wdsclientunattend\unattend.xml /Architecture:<arch>`
Note
Valid values for <Arch>can be x86 or x64
 - You must create a unattend.xml file. Refer to <http://technet.microsoft.com/en-us/library/dd363560.aspx#BKMK9> or [Appendix 1](#) section of this paper for sample unattend.xml file for VHD deployment
Note
you need to modify the <InstallImage> section in the XML file to point to a right VHD image filename.
 - Once the XML file is created, copy it to RemoteInstall\WDSClientUnattend folder on WDS Server
 - In the WDS MMC snap-in, right click the image that you want to associate the unattend file with and click “properties”
 - On the “Client” tab, select “Enable Unattended installation” and then browse to the unattend.xml file created in an earlier step and then click “Open”
 - Click “OK” on the “Properties” page

Note

By using the above method to configure unattended installation for VHD images, all WDS clients pertaining to a specific architecture will always receive the same deployment image. Refer to <http://technet.microsoft.com/en-us/library/dd363560.aspx#BKMK9> for information on associating VHD images to specific client systems in a WDS deployment

Best practices for VHD boot

- When implementing VHD boot, do not place the VHD on a hard disk volume with volume snapshots ON. This will degrade the system performance.
- It is always recommended to use a fixed disk type for improved performance
- Differencing VHD chain must reside on the same physical disk volume
- Do not place application data or user data within the VHD. Use a separate hard disk volume for improved performance

Known issues and limitations of VHD boot

- Hibernation is disabled when booting from a VHD; sleep is supported
- Nesting of VHD files is not recommended
- No WMI interfaces to manage VHDs unless you have installed Hyper-V role
- Dynamic VHDs are pre-expanded by default; For example, if you create a 30GB dynamic VHD, it is expanded by default to 30GB
- At the time of writing this paper, Windows Server 2008 R2 VHD boot supports only Windows 7 family of operating systems
- When using native VHD boot, BitLocker encryption is not supported

Tools and references

[WIM2VHD](#) – Tool to create VHD files from any given WIM

[New features in Windows Server 2008 R2 Windows Server 2008 R2](#)

[WAIK for Windows 7 download](#)

[Deploying VHD images to WDS](#)

[Virtual Hard Disk format specification](#)

Appendix 1 – Sample Unattended.xml file for WDS Deployment

```
<?xml version="1.0" ?>
<unattend xmlns="urn:schemas-microsoft-com:unattend">
  <settings pass="windowsPE">
    <component name="Microsoft-Windows-Setup" publicKeyToken="31bf3856ad364e35"
language="neutral" versionScope="nonSxS" processorArchitecture="amd64">
      <WindowsDeploymentServices>
        <Login>
          <WillShowUI>OnError</WillShowUI>
          <Credentials>
            <Username>User_Name_Here</Username>
            <Domain>Domain_Name_Here</Domain>
            <Password>Password_here</Password>
          </Credentials>
        </Login>
      <ImageSelection>
        <WillShowUI>OnError</WillShowUI>
        <InstallImage>
          <ImageName>WindowsServer2008R2</ImageName>
          <ImageGroup>VHD Image Group</ImageGroup>
          <Filename>ServerCoreEnt.vhd</Filename>
        </InstallImage>
        <InstallTo>
          <DiskID>0</DiskID>
          <PartitionID>1</PartitionID>
        </InstallTo>
      </ImageSelection>
    </WindowsDeploymentServices>
    <DiskConfiguration>
      <WillShowUI>OnError</WillShowUI>
      <Disk>
        <CreatePartitions>
          <CreatePartition>
            <Order>1</Order>
            <Size>60000</Size>
            <Type>Primary</Type>
          </CreatePartition>
        </CreatePartitions>
        <ModifyPartitions>
          <ModifyPartition>
            <Active>true</Active>
```

```
        <Extend>false</Extend>
        <Format>NTFS</Format>
        <Label>OS</Label>
        <Letter>C</Letter>
        <Order>1</Order>
        <PartitionID>1</PartitionID>
    </ModifyPartition>
</ModifyPartitions>
<DiskID>0</DiskID>
<WillWipeDisk>true</WillWipeDisk>
</Disk>
</DiskConfiguration>
</component>
<component name="Microsoft-Windows-International-Core-WinPE"
publicKeyToken="31bf3856ad364e35" language="neutral" versionScope="nonSxS"
processorArchitecture="amd64">
    <SetupUILanguage>
        <WillShowUI>OnError</WillShowUI>
        <UILanguage>en-US</UILanguage>
    </SetupUILanguage>
    <UILanguage>en-US</UILanguage>
</component>
</settings>
</unattend>
```