

## 5.1.7 Volume Facts

Although some Windows systems have a single physical hard disk configured with a single volume that contains both the Windows operating system files and user data files, this is not necessarily an optimal disk configuration. Alternate configurations include multiple volumes on a single disk and/or multiple disks in a system. The benefits of these configurations include:

- Improving performance by separating paging files from operating system files.
- Isolating operating system files from data files and vice versa.

After installing a new disk, you must perform the following tasks using either the Disk Management utility, DiskPart command-line utility, or PowerShell cmdlets:

1. Initialize the disk.
2. Specify one of the following partition formats:
  - Master Boot Record (MBR)
  - GUID Partition Table (GPT)
3. Partition the disk and create volumes.
4. Format each volume with one of the following file systems:
  - NTFS
  - ReFS
  - FAT32 (Removable storage only)
  - exFAT (Removable storage only)
5. Assign a drive letter to each volume.

A *volume* can comprise a single partition on a single disk or span multiple partitions on multiple disks. The following table describes the different disk types you should be familiar with when working with volumes:

Disk Type	Description
Basic	<p>A <i>basic</i> disk is a physical disk type that can be accessed by all operating systems. A basic disk uses MBR-like partition tables to store the partitioning information.</p> <ul style="list-style-type: none"><li>▪ A basic disk has a limit of four partitions, only one of which can be an extended partition. An extended partition can be divided into a maximum of 26 logical drives.</li><li>▪ The <i>active</i> partition is the one whose operating system will boot. A system can have only one active partition at a time.</li><li>▪ A basic disk can have only simple volumes.</li><li>▪ The active primary partition is represented by the drive letter C:.</li></ul>
Dynamic	<p>A <i>dynamic</i> disk is a physical disk that uses the Logical Disk Manager (LDM) database to store the volume types, sizes, locations, drive letters, and configurations. The LDM information is copied to other dynamic disks on the computer, thereby providing redundancy.</p> <ul style="list-style-type: none"><li>▪ Dynamic disks support the following volume types:<ul style="list-style-type: none"><li>▪ <i>Simple</i> volumes use a single hard disk.</li><li>▪ <i>Spanned</i> volumes use disk space from multiple hard disks. The volume size is the total size of all space on all disks allocated to the spanned volume.</li></ul><p>If one of the disks in a spanned volume fails, the entire volume fails.</p></li><li>▪ <i>Striped</i> (RAID 0) volumes break data into units, or <i>stripes</i>, and store the units across a series of disks by reading and writing to all disks simultaneously. The volume size is the total size of all space on all disks allocated to the array.</li><li><p>If one of the disks in a striped volume fails, the entire volume fails. Converting an existing volume to a striped volume requires backing up data, removing the original volume, creating the striped volume, and restoring data.</p></li><li>▪ <i>Mirrored</i> (RAID 1) volumes store data redundantly to two disks simultaneously. If one disk fails, data is present on the other disk, and the system switches immediately from the failed disk to the functioning disk. The volume size is the same as a single disk in the array.</li><li>▪ <i>Striped with Parity</i> (RAID 5) volumes combine disk striping across multiple disks with parity for data redundancy.</li><li>▪ If a dynamic disk fails or is missing, use the Reactivate Disk option in Disk Management to reactivate the missing or offline disk.</li><li>▪ If the disk is completely lost and cannot be reactivated, remove it from the system by removing all volumes and then choosing the Remove option on the disk.</li></ul> <p>Keep in mind the following when converting a basic disk to a dynamic disk:</p>

- Data in existing partitions is not deleted.
- Existing partitions and logical drives in an extended partition are converted to simple volumes on the dynamic disk.
- You must reboot the system to complete the conversion if the disk contains the boot or system volume (or if the volume includes the page file).

When converting a dynamic disk to a basic disk, the drive must be repartitioned. This process includes the following steps:

1. Back up all data on the disk.
2. Remove all volumes from the dynamic disk.
3. Redefine the disk as a basic disk.
4. Recreate the volumes.
5. Restore data from the backup.

Be aware of the following when managing partitions and volumes:

Task	Description
Partitioning and Formatting a Storage Device	<p>You can partition a hard drive using Disk Management, PowerShell cmdlets, or the DiskPart command line utility.</p> <p>The legacy <b>fdisk</b> command is not available in newer versions of Windows.</p> <p>Select the file system type, and then format the disk. Formatting:</p> <ul style="list-style-type: none"> <li>▪ Prepares a partition so the operating system can use it.</li> <li>▪ Is typically performed in conjunction with creating partitions and volumes.</li> <li>▪ Is not required to create a partition or a volume.</li> <li>▪ Must be performed before you can save data on the disk.</li> </ul>
Resizing a Volume	<p>You can resize a volume by either expanding it or shrinking it. Be aware of the following:</p> <ul style="list-style-type: none"> <li>▪ The volume can be extended using only contiguous free space on the same disk.</li> <li>▪ A volume cannot be decreased to a size smaller than the amount of data on the volume.</li> <li>▪ Volume resizing is supported only for simple and spanned volumes.</li> <li>▪ There are several reasons for expanding or shrinking a volume: <ul style="list-style-type: none"> <li>▪ The volume is running out of space and you have free space available on the disk or on other disks in the system.</li> <li>▪ You need to create a dual-boot system, but there is only one disk in the system, and it already has a single partition on it that is consuming all of the available disk space.</li> </ul> </li> </ul> <p>You can also use a mount point to add space to an existing volume that is out of disk space. A mount point is an empty folder on the existing volume that points to another partition that doesn't have a drive letter assigned. Data saved to the empty folder is physically saved on the referenced partition.</p>
Moving Storage Devices Between Computers	<p>Perform the following tasks when removing a disk from a functioning computer:</p> <ul style="list-style-type: none"> <li>▪ Use Disk Management to check the status of the disk and, if necessary, repair volumes using the Repair option.</li> <li>▪ Uninstall or remove the disk from the system configuration. <ul style="list-style-type: none"> <li>▪ Use Device Manager for a basic disk. Right-click the disk to be removed and select <b>Uninstall</b>.</li> <li>▪ Use Disk Management for a dynamic disk. Right-click the disk to be removed and select <b>Remove Disk</b>.</li> </ul> </li> <li>▪ Physically move the disk to the new computer. <ul style="list-style-type: none"> <li>▪ The system will automatically detect a basic disk and assign it a drive letter.</li> <li>▪ When you move a dynamic disk to another computer, use the <b>Rescan and Import Foreign Disks</b> option in the Disk Management utility.</li> </ul> </li> </ul>

Partition and volume management tasks can be completed from the command line using the DiskPart utility. For example, to create a new volume, you would first launch an administrator-level command prompt session and run **diskpart**. Then you would use the commands shown in the following table:

DiskPart Command	Description
<b>list disk</b>	Lists all disks installed in the system.
<b>select disk <i>disk_number</i></b>	Specifies which disk in the system you want to manage.

<b>online disk</b>	(Optional) Brings the selected disk online if it is currently offline.
<b>clean</b>	<p>(Optional) Removes all existing partitions and volumes from the selected hard disk drive.</p> <p>This operation cannot be undone. All of the data on the disk will be deleted. Before you run this command, back up anything on the disk that you want to keep.</p>
<b>convert mbr</b> <b>convert gpt</b>	<p>Initializes the selected hard disk and configures it to use the specified partitioning format (MBR or GPT).</p> <p>The <b>convert</b> command can also be used to convert a basic disk to a dynamic disk or vice versa.</p>
<b>create partition</b> <b>primary size=size</b>	Creates a new partition on the selected disk. Use the <b>size=size</b> option with this command to specify a size (in MB) for the partition. If this option is omitted, then all of the unallocated space on the selected disk will be assigned to the new partition.
<b>list part</b>	Lists all partitions on the specified disk.
<b>select part</b> <b>partition_number</b>	Selects a specific partition on the selected disk.
<b>format</b>	<p>Formats the selected partition with a file system. Use the following options with this command:</p> <ul style="list-style-type: none"> <li>▪ <b>fs=file_system</b> specifies the file system the partition should be formatted with. You can specify FAT, FAT32, exFAT, NTFS, ReFS, or UDF.</li> <li>▪ <b>label="label"</b> assigns the specified label to the new volume.</li> <li>▪ <b>quick</b> performs a quick format.</li> <li>▪ <b>compress</b> compresses the new volume.</li> </ul>
<b>assign letter</b> <b>drive_letter</b>	Assigns a drive letter to the selected partition.
<b>list volume</b>	Lists all volumes on all hard disks in the system.
<b>add</b> <b>disk=disk_number</b>	Adds a mirror to an existing simple volume using the specified disk.
<b>extend</b>	<p>Adds space to an existing volume. Use the following options with this command:</p> <ul style="list-style-type: none"> <li>▪ <b>size=size</b> specifies the amount of space (in MB) to add to the selected volume.</li> <li>▪ <b>disk=disk_number</b> specifies which disk to extend the volume to.</li> </ul>
<b>expand</b>	Increases the maximum size of a virtual disk.

Partition and volume management tasks can be completed from the command line environment using PowerShell cmdlets. For example, to create a new volume, you would first launch an administrator-level PowerShell session, and then you would use the commands shown in the following table:

PowerShell Commandlet	Description
<b>Get-Disk</b>	Lists all disks installed in the system. This cmdlet is used to identify the number assigned to the disk that you want to manage.
<b>Clear-Disk <i>disk_number</i> - RemoveData</b>	<p>(Optional) Removes all existing partitions and volumes from the specified hard disk drive.</p> <p>This operation cannot be undone. All of the data on the disk will be deleted. Before you run this command, back up anything on the disk that you want to keep.</p>
<b>Initialize-Disk <i>disk_number</i></b>	Initializes the specified disk. If no parameters are included with this command, it will configure the disk to use the GPT partition format. If you wish to use the MBR partition format, use the <b>-PartitionStyle MBR</b> option with this command.
<b>New-Partition</b>	<p>Creates a new partition on the disk. Use the following options with this cmdlet:</p> <ul style="list-style-type: none"> <li>▪ <b>-DiskNumber <i>disk_number</i></b> specifies the disk to create the partition on.</li> <li>▪ <b>-UseMaximumSize</b> specifies that the partition use all of the unallocated space on the drive.</li> </ul>

	<ul style="list-style-type: none"><li>▪ <b>-Size</b> <i>size</i> specifies a custom size for the partition. Specify a value in bytes, KB, MB, GB, or TB.</li><li>▪ <b>-AssignDriveLetter</b> assigns the next available drive letter to the new partition.</li></ul>
<b>Get-Partition -DiskNumber</b> <i>disk_number</i>	Lists all partitions on the specified disk.
<b>Format-Volume</b>	Formats a partition with a file system. Use the following options with this cmdlet: <ul style="list-style-type: none"><li>▪ <b>-DriveLetter</b> <i>drive_letter</i> specifies which partition to format.</li><li>▪ <b>-FileSystem</b> <i>file_system</i> specifies the file system the partition should be formatted with. You can specify NTFS, ReFS, exFAT, FAT32, or FAT.</li><li>▪ <b>-FileSystemLabel</b> "<i>label</i>" assigns the specified label to the new volume.</li></ul>
<b>Get-Volume -DriveLetter</b> <i>drive_letter</i>	Lists all volumes on the specified disk.
<b>Set-Volume -DriveLetter</b> <i>drive_letter</i> - <b>NewFileSystemLabel</b> <i>"label"</i>	Assigns a label to a volume.