MCTS Guide to Microsoft Windows 7

Chapter 4
Managing Disks
Objectives

- Understand common disk technology and related partition styles
- Understand basic and dynamic disk storage technology
- Understand typical disk management tools and tasks
- Understand partition and volume management
- Understand VHD disk management
Disk Technology

• Can be categorized by:
  – How it is connected to the computer
  – How it is presented to Windows 7

• Consider these disk technologies:
  – Internal Disk
  – External Disk
  – Virtual Hard Disk (VHD)
  – Multiple Disks as One Logical Disk
Internal Disk

• Typical internal disk interface types include IDE, SATA, and SCSI
• Firmware built in to the computer
  – Designed to recognize supported internal disk storage and boot from at least one of the installed internal disk devices
External Disk

• Used to connect removable portable disk storage
• Typical external disk interface types include USB, eSATA, SCSI, and FireWire (IEEE 1394)
• Best practice
  – Avoid using external disks as a location for operating system files
Virtual Hard Disk (VHD)

- Windows 7 is the first version of Windows to natively support Virtual Hard Disk operations
- Files can be stored in a VHD storage location just like any other disk technology
  - Once the VHD is made available in the Windows 7 operating system
- Only Windows 7 Ultimate and Windows 7 Enterprise support the ability to natively boot from a VHD
Multiple Disks as One Logical Disk

• Logical disk appears to the Windows 7 operating system as if it is one disk drive
• Windows 7 can combine multiple disks as one logical disk using software built into the operating system
• Multiple disks can be connected to an advanced hardware based RAID disk controller
  – Physical drives are managed by the disk hardware controller directly
  – Management operations are done with the software that comes with the third-party hardware
Partition Styles

- Windows 7 can organize data on disk drives using one of several partition styles
- When a blank disk is first configured for use by Windows, one of these styles must be selected:
  - Master Boot Record (MBR)
  - GUID Partition Table (GPT)
Master Boot Record (MBR)

• Master Boot Record (MBR)
  – Standard used for accessing hard disk data
• BIOS firmware initializes the computer
• Computer must find and load the operating system
• MBR includes the boot sector and a data table
  – Identifies how sections, or partitions, of space on the disk are used to store files
• MBR disk technology is limited to organizing partitions on a single logical drive up to 2 terabytes (TB)
Disk Storage Technology

• Hard disk
  – Bulk storage device that is limited to a maximum storage capacity
  – Managed by part of the operating system
    • That acts as a storage provider to applications and the operating system itself

• Master Boot Record (MBR)
  – Standard used for accessing hard disk data

• BIOS firmware initializes the computer
• Computer must find and load the operating system
GUID Partition Table (GPT)

- Hardware capacity has grown and technology has improved
- GUID Partition Table (GPT)
  - Replacement for MBR specifications
- Partitions of a GPT disk are each identified with a unique coded label called a GUID (Globally Unique Identifier)
- Only computers designed with EFI/UEFI firmware running the 64-bit Editions of Windows 7 can boot from a disk drive using the GPT partition style
Types of Disk Partitions

• Empty space on the drive can be organized using two different methods in Windows 7:
  – Basic disk storage
  – Dynamic disk storage
Basic Disk Storage

• Basic disk
  – Hard disk initialized to use basic storage technology

• Basic disk storage
  – Simple means to logically organize disk space

• Basic disk can have its space organized into one or more defined areas of storage called partitions
  – Partition is identified by size and type of data it holds

• Partition information is stored in the partition table of the MBR
Basic Disk Storage (cont'd.)

• Primary partition
  – Stores files that are used to load an operating system
  – Active partition
    • Capable of starting an operating system
    • Each disk can have one active primary partition

• Extended partition
  – Takes the place of one of the primary partitions that can be created on the basic disk
  – No drive letter or folder path assigned to it
  – Reserves space for and holds logical partitions
Basic Disk Storage (cont'd.)

• Logical partition
  – Can only be created using the free space inside an extended partition
  – Can be formatted using a file system to store files
  – Drive letters can be assigned
Dynamic Disk Storage

• Dynamic disk
  – Hard disk initialized to use dynamic storage

• Dynamic disk storage
  – Provides the flexibility to logically organize disk space across one or more disk drives
  – First introduced with Windows 2000

• On dynamic disks
  – Blocks of space are called volumes
    • Details about the volumes are stored in a hidden database on the dynamic disk
Dynamic Disk Storage (cont'd.)

• Dynamic disk technology is not appropriate for removable disk storage
  – A dynamic volume must be aware of the other dynamic volumes on the computer

• Simple volume
  – Exists on just a single dynamic disk
  – Is not fault tolerant
Dynamic Disk Storage (cont'd.)

• Spanned volume
  – Exists on two or more dynamic disks
  – Links blocks of space from multiple dynamic disks
  – Not fault tolerant

• Striped volume
  – Minimum of two dynamic disks, maximum of 32
  – Links blocks of space from multiple dynamic disks
  – Striped volume is a RAID 0 solution
Dynamic Disk Storage (cont'd.)

- Mirrored dynamic volume
  - Can only be created with two dynamic disks
  - Block of space on one dynamic disk must be matched to an identically sized block of space
    - On a second dynamic disk
    - Redundant Array of Independent Disks (RAID) 1
    - Fault tolerant

- RAID 5 dynamic volume
  - Can only be created with three or more dynamic disks
  - Fault tolerant
Disk Management Tools

- Windows 7 tools
  - Disk Management
  - DiskPart
Disk Management

- Disk Management console
  - MMC console snap-in
  - Part of the Computer Management utility
  - Provides a graphical interface
    - Allows a member of the Administrators group to observe and make changes to the computer’s disk configuration
    - Allows changes to be made interactively
      - Usually takes effect immediately without restart
Disk Management (cont'd.)

Figure 4-1 Disk management console

Courtesy Course Technology/Cengage Learning
DiskPart

• Command-line tool
  – Allows disk and volume operations to be performed:
    • From a text-based screen interactively
    • From a scripted file
• Operations are driven by a sequence of commands
  – Each command has object to focus its action on
• Commands can execute:
  – As part of a scheduled task
  – As an automated response on the local computer or remotely on another computer
DiskPart (cont'd.)

Figure 4-2 DiskPart command-line tool

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Disk Management Tasks

• Major activities for proper disk administration include:
  – Preparing hard disks
  – Disk cleanup
  – Checking disk health
  – Defragmenting disks
  – Moving disks
  – Converting disk types
  – Managing fault tolerance
Preparing Hard Disks

• Scan for New Hardware Changes
  – The hardware used to connect hard disk to the computer may consist of many individual components
  – Device Manager utility detects device driver issues
    • Triggers a manual scan for hardware changes if the plug and play system did not detect the change

• Scan for Disks
  – OS may not see the new disks immediately
  – Windows 7 can be forced to manually recheck all of the connected hardware
Preparing Hard Disks (cont'd.)

- Initializing New Disks
  - Disk cannot be used until it is initialized with a fundamental structure
  - Disk Management console can trigger the process manually
Disk Cleanup

- Cleanup can be for one or all users
- Disk Cleanup utility helps the user identify common sources of data
  - That can be purged from the disk to recover space
- Disk Cleanup More Options tab
  - Allows the user to trigger additional methods to recover disk space
Disk Cleanup (cont'd.)

Figure 4-3  Disk Cleanup button on a disk's General properties tab

Courtesy Course Technology/Cengage Learning
Disk Cleanup (cont'd.)

![Disk Cleanup window](image)

**Figure 4-4 Disk Cleanup options**

*Courtesy Course Technology/Cengage Learning*
Disk Cleanup (cont'd.)

Figure 4-5 Disk Cleanup additional space recovery options

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Checking Disk Health

• Hard disk can have damaged physical areas
  – Corrupt data stored in those locations
• Damaged area is typically reported as bad sectors
• Disk health can be checked by selecting the Check Now button on the Tools tab
  – Of the properties of a volume
• chkdsk command-line utility is also available for use at the command prompt or from a script
Checking Disk Health (cont'd.)

![Image of disk properties with error-checking, defragmentation, and backup options]

**Figure 4-6 Checking disk health from a disk's properties, Tools tab**

*Courtesy Course Technology/Cengage Learning*
Defragmenting Disks

- Files are stored in partitions and volumes on the physical disk.
- Sectors and clusters used by a file can become distributed throughout the physical disk’s surfaces.
  - Can have a significant impact on performance.
- Defragmentation is a “best effort” utility that tries to improve the layout of files within a disk.
- Defragmentation utility does not add a significant drain on the computer’s performance.
  - While it rewrites files on the disk.
Defragmenting Disks (cont'd.)

![Defragmenter window and table](image)

**Figure 4-7** Disk defragmentation control utility

*Courtesy Course Technology/Cengage Learning*
Moving Disks

• Physical disks can be moved from one computer to another
  – However, the partitions and volumes they contain require special consideration
• Drive letters assigned to a basic disk’s logical and primary partitions will be retained
  – If they are not already in use on the current local computer
• Dynamic disk database stores the name of the computer to which the dynamic disk belongs
Moving Disks (cont'd.)

• Disk Management console reports the status of the disk as a Foreign Disk
  – When it recognizes that the disk does not belong to that computer
• To import a disk you must use the Import Foreign Disk option from the Disk Manager utility
Converting Disk Types

• Versions of Windows 7 that support dynamic disks can convert between basic and dynamic disk
  – Using the Disk Management console or the DiskPart command-line utility

• When a basic disk is converted to a dynamic disk
  – All primary and logical partitions it contains are converted to simple volumes

• When a dynamic disk is converted to a basic disk
  – All volumes contained on that disk are destroyed
Managing Fault Tolerance

• Basic disks are not fault tolerant by design
• Dynamic disks support two types of fault-tolerant volumes: mirrored and RAID-5
• If a single disk fails in a mirrored set
  – Mirror can be broken using the Disk Management console or the DiskPart command-line utility
• If a single disk fails in a RAID-5 array of disks
  – RAID-5 volume will continue to operate in a degraded mode
Partition and Volume Management

- Partition describes reserved regions of space on a basic disk
- Volume describes regions of reserved space on a dynamic disk
- Not all dynamic volume types are supported in Windows 7
Partition and Volume Management (cont'd.)

Table 4-1  Volume types supported by disk type in Windows 7

<table>
<thead>
<tr>
<th>Volume Type</th>
<th>Dynamic Disk</th>
<th>Basic Disk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary partition</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Extended partition</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Logical partition</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Simple</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Spanned</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Striped</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mirrored</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>RAID-5</td>
<td>No (restricted to servers)</td>
<td>No</td>
</tr>
</tbody>
</table>
Partition and Volume Management (cont'd.)

- Common administrative tasks for partitions and volumes include:
  - Creating partitions and volumes
  - Deleting partitions and volumes
  - Extending partitions and volumes
  - Shrinking partitions and volumes
Creating Partitions and Volumes

• Use either the Disk Management snap-in or the DiskPart command-line utility
  – Requires Administrator privileges
• Creating Basic Disk Partitions
  – See Table 4-2
• Creating Dynamic Disk Partitions
  – See Table 4-3
## Creating Partitions and Volumes (cont'd.)

### Table 4-2 Basic Disk Partition Creation Rules

<table>
<thead>
<tr>
<th>Partition Type</th>
<th>Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary</strong></td>
<td>A maximum of four primary partitions can exist on one basic MBR-style disk. The Disk Management tool in Windows 7 will only allow the creation of three primary partitions before the fourth partition is created as an extended partition. A maximum of 128 primary partitions can exist on one GPT-style disk. A primary partition is required to start the load sequence of an operating system. A primary partition can only be used as part of the load sequence of an operating system if it has been flagged as the active primary partition. If a single disk contains multiple primary partitions, only one of them can be flagged as active. If a basic disk contains primary partitions and none of them are used to start the operating system then none of the primary partitions have to be flagged as active. This assumes that a second disk exists in the computer and is responsible for starting the operating system.</td>
</tr>
<tr>
<td><strong>Extended</strong></td>
<td>An extended partition can take the place of one of the primary partitions on a single basic MBR-style disk. Only one extended partition can exist on a single basic MBR-style disk. An extended partition is not required unless logical partitions are required on a disk.</td>
</tr>
<tr>
<td><strong>Logical</strong></td>
<td>A logical partition can exist only inside an extended partition. The number of logical partitions is only limited by the availability of free space in an extended partition.</td>
</tr>
</tbody>
</table>
Creating Partitions and Volumes (cont'd.)

Table 4-3  Dynamic Disk Volume Creation Rules

<table>
<thead>
<tr>
<th>Volume Type</th>
<th>Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>A simple volume exists only on one dynamic disk.</td>
</tr>
<tr>
<td></td>
<td>A simple volume can be made up of one or more regions of disk space on the single dynamic disk.</td>
</tr>
<tr>
<td></td>
<td>If multiple regions of disk space are used on a single dynamic disk, they are not required to be contiguous on the disk.</td>
</tr>
<tr>
<td>Spanned</td>
<td>A spanned volume consists of pooled regions of disk space from multiple dynamic disks.</td>
</tr>
<tr>
<td></td>
<td>A simple volume becomes a spanned volume if extra space is added to a simple volume from another dynamic disk.</td>
</tr>
<tr>
<td></td>
<td>The total space available to store files is the sum total of all linked regions of disk space.</td>
</tr>
<tr>
<td>Striped</td>
<td>Equally sized blocks of space are pooled across multiple dynamic disks.</td>
</tr>
<tr>
<td></td>
<td>The total space available to store files is the sum total of all linked blocks of disk space.</td>
</tr>
<tr>
<td></td>
<td>Striped volumes support a minimum of two and a maximum of 32 dynamic disks.</td>
</tr>
<tr>
<td>Mirrored</td>
<td>Equally sized blocks of space are linked across two dynamic disks. Data is written identically to both blocks of space.</td>
</tr>
<tr>
<td>volume creation</td>
<td>The total space available to store files is the size of a single block of disk space.</td>
</tr>
<tr>
<td></td>
<td>Mirrored volumes require only two dynamic disks.</td>
</tr>
<tr>
<td>RAID 5</td>
<td>Equally sized blocks of space are pooled across multiple dynamic disks.</td>
</tr>
<tr>
<td></td>
<td>The total space available to store files is the sum total of all linked blocks of disk space minus one block of disk space for parity data.</td>
</tr>
<tr>
<td></td>
<td>RAID 5 volumes support a minimum of three and a maximum of 32 dynamic disks.</td>
</tr>
</tbody>
</table>
Deleting Partitions and Volumes

• Use the Disk Management MMC console or the DiskPart command-line utility
  – Requires Administrator-equivalent user account
• Deleting a volume or partition results in data loss
• Extended partitions cannot be deleted unless all of the logical partitions they contain are deleted first
Extending Partitions and Volumes

• Use the Disk Management MMC console or the DiskPart command-line utility
  – Requires an Administrator-equivalent user account

• Extending Basic Disk Partitions
  – Extended partitions cannot be further extended
Extending Partitions and Volumes (cont'd.)

- Extending Basic Disk Partitions (cont'd.)
  - Considerations
    - System and boot partitions can be expanded
    - Free space must be:
      - Available that is not assigned to another partition
      - Contiguous with the partition being expanded
    - Partition being expanded must have either no file system or NTFS
    - Partition expansion is immediate; no reboot needed

- Extending Dynamic Disk Volumes
  - Not all dynamic volumes can be extended
Extending Partitions and Volumes (cont'd.)

• Extending Dynamic Disk Volumes (cont'd.)
  – Considerations
    • System and boot volume can be expanded
    • Simple volume can be extended using any free disk space on the same physical disk
    • Free disk space used to extend a simple volume does not have to be contiguous
    • If a simple volume is extended with free space from another physical disk, it becomes a spanned volume
    • Spanned volume cannot be used to create a larger striped or fault-tolerant volume
    • Volume expansion is immediate; no reboot needed
Shrinking Partitions and Volumes

• Use the Disk Management snap-in or the DiskPart command-line utility
  – Requires an Administrator-equivalent user account
Shrinking Partitions and Volumes (cont'd.)

• Rules
  – Free space must exist within the partition
  – Files are automatically moved within the partition as required
  – Some files, such as the swap file or shadow copy storage, cannot be moved
  – Partition or volume either has no file system or is formatted with NTFS
  – If a high number of bad sectors detected on the disk, the shrink may be unsuccessful
Virtual Disk Management Tasks

- Windows 7 introduces native support for working with Virtual Hard Disks (VHDs):
  - Creating VHDs
  - Attaching VHDs
  - Detaching VHDs
  - Advanced VHD Management
Creating VHDs

• VHD in Windows 7 is created as a single file on an attached physical disk drive
• Use the Disk Management snap-in or the DiskPart command-line utility
  – Requires an Administrator-equivalent user account
• To create a VHD, you must specify the following information:
  – Location
  – Virtual Hard Disk Size
  – Virtual Hard Disk Format
Attaching VHDs

- VHD must be attached, or mounted, to be available to the operating system and the user
- Use the Disk Management snap-in or the DiskPart command-line utility
  - Requires an Administrator-equivalent user account
- Only time a VHD automatically mounts as the computer starts
  - Special case where Windows 7 is configured to boot from a VHD file
Detaching VHDs

- VHD must be detached, or dismounted, to make it unavailable to the operating system and the user
- Use the Disk Management snap-in or the DiskPart command-line utility
  - Requires an Administrator-equivalent user account
- When a computer is restarted, the VHD files currently attached automatically detach
Advanced VHD Management

• Disk Management snap-in is limited in what management operations can be done with VHD files

• DiskPart command line utility allows for advanced management operations such as:
  – Compact VHD
  – Expand VHD
  – Detail VHD Properties
Summary

• Windows 7 supports basic and dynamic disk technology to organize data into partitions and volumes

• Disk management activities include preparing new disks for use, cleaning up wasted space, checking the disk health, minimizing access delays, and moving disks

• Disk type limits partitions and volumes created on a disk
  – Once a partition or volume is created, it is possible to extend and shrink them if specific conditions apply
Summary (cont’d.)

• Virtual Hard Disks (VHDs) are natively supported by Windows 7
  – Can be managed as a basic disk once the VHD is attached in the operating system