# **Implementing Hard Drives** Chapter 12



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#### **Overview**

#### • In this chapter, you will learn how to

- Explain the partitions available in Windows
- Discuss hard drive formatting options
- Partition and format hard drives
- Maintain and troubleshoot hard drives

#### **Hard Drive Partitions**

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# Partitioning

- Process of electronically subdividing the physical hard drives
  - Windows assigns them names such as C: or D:
  - A hard drive must have at least one partition
  - Partitioning enables you to organize a drive according to your personal taste



- One physical drive
  - One or more partitions





#### • Three kinds of partitions:

- Basic disks (uses master boot record)
  - Older style
  - Readable by other utilities
- Dynamic disks
  - Proprietary Microsoft style
- GUID partition table (GPT)
  - Newer scheme that replaces the MBR

# Master Boot Record (MBR)

- The first sector of an MBR hard drive contains the master boot record (MBR).
- MBR is a small amount of data that contains the partition table.
- Partition table describes the number and size of partitions on the disk.
  - MBR partition tables support up to four partitions.
  - Instructions in the master boot record use this table to determine which partition contains the active operating system.

#### Master Boot Record (MBR) (continued)

- I. The master boot record looks for a partition with an operating system.
- 2. The partition table tells the master boot record where to look.



Figure 1: The master boot record

### Master Boot Record (MBR) (continued)

- After the MBR locates the appropriate partition, the partition boot sector loads the OS on that partition.
  - The partition boot sector stores information important to its partition, such as the location of the OS boot files.

#### Master Boot Record (MBR) (continued)



Figure 2: Using the master boot record to boot an OS

## Master Boot Record (MBR) (continued)

- MBR partition tables support two types of partitions: primary partitions and extended partitions:
  - Primary partitions are designed to support bootable operating systems—only one can be active.
  - Extended partitions are not bootable.
  - A single MBR disk may have up to four primary partitions or three primary partitions and one extended partition.

#### Master Boot Record (MBR) (continued)



Figure 3: The active partition containing Windows

### Master Boot Record (MBR) (continued)

- Every primary partition on a single drive has a special setting stored in the partition table called active that determines the active partition.
  - The MBR finds the active partition and boots the operating system on that partition. Only one partition can be active at a time because you can run only one OS at a time.

### Master Boot Record (MBR) (continued)

- To control multiboot setups, a bootloader can be used.
  - When the computer boots, the boot-manager software yanks control from the MBR and asks which OS you wish to boot.
  - Once a partition is set as active, the partition boot sector loads the operating system.
  - GRUB is a popular free bootloader found in Linux.

#### Master Boot Record (MBR) (continued)

GNU GRUB version 1.99–18ubuntu1

#### Ubuntu, with Linux 3.2.0–20–generic–pae

Ubuntu, with Linux 3.2.0–20-generic–pae (recovery mode) Memory test (memtest86+) Memory test (memtest86+, serial console 115200) Windows 7 (loader) (on /dev/sda1)

Use the + and + keys to select which entry is highlighted. Press enter to boot the selected OS, 'e' to edit the commands before booting or 'c' for a command-line.

#### Figure 4: GRUB in action

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## Master Boot Record (MBR) (continued)

- With a four-partition limit, an MBR disk is limited to four drive letters if using only primary partitions—an extended partition overcomes this limit.
  - An extended partition can contain multiple logical drives, each of which can get a drive letter.
  - A logical drive works like a primary partition, except that you cannot boot from it.

#### Master Boot Record (MBR) (continued)



Figure 5: An extended partition containing multiple logical drives

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## **Dynamic Disks**

- New since Windows 2000
- Partitions referred to as volumes
- Enable spanned volumes over multiple drives
- Enable use of software-based RAID
  - The RAID levels you can use depend on the version of Windows used.
  - Only higher-end editions of each version (XP, Vista, and 7) use dynamic disks (Professional, Business, Ultimate, and Enterprise editions).
- Not limited to 4 volumes

# Dynamic Disks (continued)

Volume	Windows XP Professional	Windows Vista Business/Ultimate/ Enterprise	Windows 7 Professional/Ultimate/ Enterprise	Windows Server 2008/Server 2008 R2
Simple	Х	Х	X	Х
Spanned	Х	Х	Х	Х
Striped	Х	X	X	Х
Mirrored			Х	х
RAID 5				Х

Table 1: Dynamic Disk Compatibility

# **GUID Partition Table**

- The globally unique identifier partition table (GPT) follows some of the same principles as the MBR scheme, but many limits have been overcome.
  - While MBR drives are limited to four partitions, a GPT drive can have an almost unlimited number of primary partitions (Microsoft has limited Windows to 128 partitions).
  - MBR partitions have a limit of 2.2 TB—but GPT is only limited to a size in zettabytes.
  - GPT partitioning supports LBA right out of the box—MBR schemes require the BIOS to see them as CHS values.



# GUID Partition Table (continued)

# • GPT is arranged by LBA instead of sectors.

#### - LBA 0 is the protective MBR.



Figure 6: GUID partition table



# **Other Partition Types**

#### Hidden partition

 A primary partition that is hidden from the OS, often used for backup purposes—sometimes called a factory recovery partition

#### Swap partition

 Only found on Linux and BSD systems. Similar to a page file, but instead it has a dedicated partition.



# When to Partition

- When installing a new OS
- When adding a new hard drive
- Older Versions of Windows used the FDISK program
- Newer versions use Disk Management
- Linux uses FDISK (not the same as Windows) or other tools, like GParted
- Later versions of Windows can resize partitions by expanding them with available free space (XP/Vista/7) or shrink (Vista/7) partitions



## When to Partition (continued)

**Fourth Edition** 

MS-DOS Version 6 Fixed Disk Setup Program (C)Copyright Microsoft Corp. 1983 – 1993

FDISK Options

Current fixed disk drive: 1

Choose one of the following:

1. Create DOS partition or Logical DOS Drive

- 2. Set active partition
- 3. Delete partition or Logical DOS Drive
- 4. Display partition information

Enter choice: [1]

Press Esc to exit FDISK

#### Figure 7: FDISK

#### Figure 8: Windows 7 Disk Management tool in Computer Management

A Computer Management									
File Action View Help									
🗢 🏟 🖄 📰 📓 📰 📓									
Computer Management (Local)  System Tools   Gamma Scheduler     System Tools	Volume	Layout Type Simple Basic Simple Basic	File System	Status Healthy (Boot, Page File, Crash Dump, Primary Partition) Healthy (System, Active, Primary Partition)	Capacity 931.41 GB 100 MB	Free Space 454.02 GB 72 MB	% Free 49 % 72 %	Fault Tolerance No No	Overhead 0% 0%
	Basic 931.51 GB Online	System Reserv 100 MB NTFS Healthy (Syster	<b>ved</b> n, Active, Prima	y Pa Healthy (Boot, Page File, Crash Dump, Primary Pa	rtition)				
	CD-ROM 0 DVD (D:) No Media								
Unallocated Primary partition									

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# **Partition Naming Problems**

- Drive structures on an MBR or GPT disk are called partitions, regardless of which operating system is used—XP follows this convention.
- Dynamic disks (Microsoft proprietary) use volumes—not partitions.
- In Windows Vista and 7, they are called partitions during installation but volumes in Disk Management.

#### Partition Naming Problems (continued)

/olume	Lavout	Type	File System	Status	Capacity	Free Space	% Free	Eault Tolerance	Overhead
■ (C:)	Partition	Basic	NTES	Healthy (S	39.99 GB	33.77 GB	84 %	No	0%
New Volume (E:	Partition	Basic	NTES	Healthy	19.53 GB	19.47 GB	99 %	No	0%
■New Volume (F:	Partition	Basic	NTES	Healthy	9.77 GB	9.72 GB	99 %	No	0%
New Volume (G:	) Partition	Basic	NTES	Healthy	10.69 GB	10.64 GB	99 %	No	0%
Disk 0 Basic 39.99 GB	(C:)								
Disk 0 Basic 39.99 GB Online	(C:) 39.99 GB NTFS Healthy (System)			1					
Disk 0 Basic 39,99 GB Online Disk 1 Basic 40.00 GB Online	(C:) 39.99 GB NTFS Healthy (System) New Volume (E 19.53 GB NTFS Healthy	:)		New Volu 9,77 GB N Healthy	i <b>me (F:)</b> TFS		New V 10.69 Health	<b>olume (G:)</b> 38 NTFS 7	

Figure 9: Windows XP very clearly showing primary and extended partitions and logical drives in the extended partition

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# Partition Naming Problems (continued)

File Action	View Help						
(⇒ 🔿   🖬	2 🖬 🖸 🖆 🖪	3					
Volume	Layout	Туре	File System	Status	Capacity	Free Spa	9
∍ (C:) ∍System Rese	Simple rved Simple	Basic Basic	NTFS NTFS	Healthy (B Healthy (S	39.90 GB 100 MB	28.32 GB 72 MB	7
•		III					
Disk 0 Basic 40.00 GB Online	System Reserv 100 MB NTFS Healthy (System	er (C:) 39.90 Gl h, Healthy	B NTFS / (Boot, Page File,	Crash Dump, Pi	rimar		
Disk 1 Basic 2000.00 GB Online Unallocated	2000.00 GB Unallocated		New Simple V New Spanned New Striped V New Mirrored New RAID-5 V	olume Volume Volume Volume			
Disk 1 Basic 2000.00 GB Online Unallocated	2000.00 GB Unallocated		New Simple V New Spanned New Striped V New Mirrored New RAID-5 V Properties	olume Volume Volume Volume	3		

Figure 10: New volume option



## **Hard Drive Formatting**

- Formatting configures a partition to hold files and folders suitable to the OS.
- Two major functions of formatting:
  - Creates a file system
  - Creates a root directory

#### **File Systems**

# • Windows supports four different file systems

- FAT (often called FAT16)
- FAT32
- FAT64
- NTFS

# File Allocation Table (FAT)

- File allocation table (FAT) keeps track of the sectors that store the various parts of a file
- 16-bit FAT (FAT16) uses 4 hexadecimal digits to number the sectors

- 0000 thru FFFF

- FAT is like a two-column spreadsheet
  - Column one numbers the sectors
  - Column two contains the status of the sector
    - Bad sectors = FFF7
    - Good sectors = 0000
- Format creates the FAT and then writes to and reads from each sector to see if it is good

# File Allocation Table (FAT) (continued)



Figure 11: 16-bit FAT



## **FAT Limitations**

- 16 bits can address only 64 K (2<sup>16</sup>) sectors
- Sector sizes limited to 512 bytes
- 64 K × 512 bytes = 32 MB max. size in early drives
  - What to do to increase capacity?
- Solution was clustering, enabling partition sizes up to 2 GB

## Clustering

- Clustering combines a set of contiguous sectors and treats them as a single unit
- Called a cluster or file allocation unit
  - Instead of numbering the sectors, clusters were numbered
  - Allowed partition sizes up to 2 GB
- Size of cluster increases with the size of the partition



## Clustering (continued)

If FDISK makes a partition this big:	You'll get this many sectors/cluster:
16 to 127.9 MB	4
128 to 255.9 MB	8
256 to 511.9 MB	16
512 to 1023.9 MB	32
1024 to 2048 MB	64

Table 2: FAT16 Cluster Sizes

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### **How FAT Works**

- Windows looks for the first cluster marked 0000 (good and available)
- If the file fits in that cluster, FFFF is put in the status column
- If the file is larger than the cluster, Windows finds the next open cluster
  - That open cluster's number is put in the first status field to know where to link
  - Process continues until the file is fully stored
  - Last cluster's status field is marked FFFF (end-of-file)

#### **Examples of FAT Storage**



Figure 13: The initial FAT

# Examples of FAT Storage (continued)



Figure 14: The first cluster used
# Examples of FAT Storage (continued)



Figure 15: The second cluster used

# Examples of FAT Storage (continued)



#### Figure 16: End of file reached



#### Fragmentation

- Fragmentation occurs when files are spread across clusters (not contiguous).
  - Individual files are broken into pieces that fit into a sector or cluster.
  - The pieces are stored on the hard drive but may not be stored in contiguous clusters.
- Fragmentation slows down the system during hard drive reads and writes.
- Programs such as **Disk Defragmenter** can be used to defragment files, folders, or both.



#### **Fragmented File**

• Takes longer for system to piece together and can impact performance



Figure 17: Three files saved

#### Fragmented File (continued)



Figure 18: The mom.txt file erased

### Fragmented File (continued)

lder Tree						
	Name	Size	Туре	Date	Condition	Folder
	DSC_4741.NEF	5914820	.NEF	6/23/2006 8:51:06 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
Documents and Settings	DSC_4734.NEF	5961536	.NEF	6/23/2006 8:27:28 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4736.NEF	5721249	.NEF	6/23/2006 8:27:54 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
Program Files	DSC_4735.NEF	5979558	.NEF	6/23/2006 8:27:36 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
- RECYCLER	DSC_4728.NEF	6051601	.NEF	6/23/2006 8:25:28 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
·	DSC_4731.NEF	5641274	.NEF	6/23/2006 8:26:28 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
🚊 🔂 Dc3	DSC_4733.NEF	5721203	.NEF	6/23/2006 8:26:46 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
.RWSettings	DSC_4732.NEF	5874057	.NEF	6/23/2006 8:26:40 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
- 🛄 System Volume Information	DSC_4742.NEF	5881651	.NEF	6/23/2006 8:51:14 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
- 🗋 WINDOWS	DSC_4743.NEF	5831309	.NEF	6/23/2006 8:51:32 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4750.NEF	5936657	.NEF	6/23/2006 8:52:28 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4745.NEF	5851799	.NEF	6/23/2006 8:51:40 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 📷 DSC_4744.NEF	5826227	.NEF	6/23/2006 8:51:36 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4745.psd	85142654	.PSD	6/26/2006 1:22:14 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 📷 DSC_4738.NEF	5954948	.NEF	6/23/2006 8:49:54 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4740.NEF	5861658	.NEF	6/23/2006 8:50:56 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4739.NEF	6011682	.NEF	6/23/2006 8:50:06 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4718.NEF	5669512	.NEF	6/23/2006 8:01:48 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	DSC_4717.NEF	5716669	.NEF	6/23/2006 8:01:36 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 📷 DSC_4720.NEF	5539173	.NEF	6/23/2006 8:02:14 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 🐻 DSC_4719.NEF	5623425	.NEF	6/23/2006 8:02:02 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 🐻 DSC_4714.NEF	5728578	.NEF	6/23/2006 8:00:54 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 🐻 DSC_4713.NEF	5842288	.NEF	6/23/2006 8:00:26 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 📷 DSC_4716.NEF	5691664	.NEF	6/23/2006 8:01:12 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	🔲 📷 DSC 4715.NEF	5661850	.NEF	6/23/2006 8:01:00 PM	Good	C:\RECYCLER\S-1-5-21-682003330-
	<					>

Figure 19: WinUndelete in action

#### Fragmented File (continued)



Figure 20: The taxrec.xls file fragmented



### **Disk Defragmenter**

Can defragment disk

Scheduled defragment	ation is turned on	🛞 Configure schedule
Run at 12:00 PM (noon)	every Wednesday	
Next scheduled run: 3/2	1/2012 12:00 PM	
rrent status:		
)isk	Last Run	Progress
<b>L</b> (C:)	2/29/2012 3:07 PM (0% fragmented	d)
System Reserved	3/15/2012 4:44 PM (0% fragmented	d)
nly disks that can be defra	gmented are shown. sks need defragmenting right now. vou ne	ed to first analyze your disks.
nly disks that can be defra o best determine if your di	gmented are shown. sks need defragmenting right now, you nee	ed to first analyze your disks.

#### Figure 21: Windows Disk Defragmenter





#### • FAT32 was introduced with Windows 95 OSR2 (OEM Service Release 2)

- Supports partitions up to 2 terabytes
- Uses 32 bits to describe each cluster
- Allows the use of small clusters
- Can still become fragmented

#### FAT32 (continued)

Drive Size	Cluster Size
512 MB or 1023 MB	4 KB
1024 MB to 2 GB	4 KB
2 GB to 8 GB	4 KB
8 GB to 16 GB	8 KB
16 GB to 32 GB	16 KB
>32 GB	32 KB

Table 3: FAT32 Cluster Sizes





- File system of choice today
- Six major improvements and refinements
  - Redundancy
  - Security
  - Compression
  - Encryption
  - Disk quotas
  - Cluster sizing



### **NTFS Improvements**

- NTFS structure provides redundancy
  - Uses an enhanced file allocation table called the master file table (MFT)
    - NTFS keeps a backup copy in the middle of the disk

#### Security

- Provides file and folder access control
- Uses Access Control List (ACL) to restrict or grant access

# NTFS Improvements (continued)

Piriform Defraggler							
Action Settings Help							
Drive	File System	Capacity	Used	Free Space	Fragmentation	Status	
Removable Disk (A:)	Unknown NTFS	0.0 GB 931.4 GB	0.0 GB (0%) 480.2 GB (52%)	0.0 GB (0%) 451.2 GB (48%)	Unknown 3%	Ready Search Finishe	:d
, a <b>a</b> a a a a a a a a a a a a a a a a a a a			ی میں <mark>اور اور اور اور اور اور اور اور اور اور </mark>			, a , a , a , a , a , a , (a , a , a , a , a , a , a , a , a , a ,	
		بر بیانی کارماند اند. در هارد انداز داند انداز در هارد انداز داند اندازد. در اندازد انداز داند اندازد.		ی بر بر بر بر بر بر بر بر بر مالی او او او او او او او مالی او او او او او او او	المراجع من المراجع الم مراجع المراجع ا مراجع المراجع ا	ر مربع مربع می این این این کا کا کا کا این این کا کا کا کا	
الله بي مر في مر الم مر الم بي التر م مر الم مر الم مر مر مر مر مر مر مر مر الم مر الم مر مر مر مر مر مر مر الم مر الم مر مر مر مر مر مر مر الم الم الم مر مر مر مر مر مر مر	ی بی این این این این این این این این این ای			ة - العليم الجامع (عالمال) عالم العليم (عالمال) عالم العليم (عالمال) عالم العليم (عالمال) عالم العليم (عالم)	ا من المارية ا مارية المارية ا المارية المارية	العائدة بعالم العالمي العالمي في العالمي العالمي في العالمي العالمي في العالمي في العالمي	
🏭 Drive C: 🎒 File list	🔎 Search 🛃 D	rive map 🖌 🧳	Health	یا اسا ہےا ہےا ہے ایک ایک ایک ا	ین است	ا ہیں اپنی اپنی سے اپنی سے ا	
New Caset	es that contain "\$MFT'						
New Search File							
Filename		~			Fragments	Size	Path
Filename		*			Fragments 2	Size 615, 168 KB	Path C:\
New search     Hit       Filename     SMFT       Analyze     Image: Comparison of the search of	Defrag Highlighted	Pau	ise	Stop	Fragments 2	Size 615,168 KB	Path C:\

Figure 22: The NTFS MFT appears in a defragmenter program as the highlighted red blocks.



# NTFS Improvements (continued)

- Compression
  - Enables files and folders to be compressed to save space—Windows Explorer displays filenames for compressed files in blue.

#### • Encrypting file system (EFS)

- Enables files and folders to be encrypted and unreadable to anyone without the key
- Essentially has integrated security

 Files and folders can be encrypted or compressed

### NTFS Improvements (continued)

#### Disk quotas

- Can control how users can use space
- Set on a per-drive basis

#### Cluster sizes

- Can adjust cluster sizes
- Rare to do so
- NTFS supports 16 TB minus 64-KB partitions
- MBR limited to 2 TB so have to go to dynamic disk for full capacity

seneral	Tools	Hardware	Sharing	-
Security	Previous \	/ersions	Quota	
🥏 Quota S	Settings for (C:)	1101	and the	
Quota				
8	Status: Disk guotas	are disabled		
	10			
V E	Enable quota manag	ement		
V [	eny disk space to u	isers exceeding q	juota <mark>li</mark> mit	
Sele	)eny disk space to u ct the default quota	isers exceeding q limit for new user	juota limit s on this volum	ne:
Sele	Deny disk space to u ct the default quota ) Do not limit disk us	isers exceeding q limit for new user age	juota limit s on this volum	ne:
Sele	Deny disk space to u ct the default quota ) Do not limit disk us ) Limit disk space to	isers exceeding q limit for new user age 40	uota limit s on this volum GB –	ne:
Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to	limit for new user age 40 35	uota limit s on this volum GB GB	ne:
Sele © Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to ct the quota logging	limit for new user age 40 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	uota limit s on this volum GB GB olume:	ne:
Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to ct the quota logging Log event when a	limit for new user age 40 35 options for this v user exceeds the	uota limit s on this volum <u>GB</u> GB olume:	ne: •
Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to ct the quota logging Log event when a Log event when a	Imit for new user age 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	uota limit s on this volum <u>GB</u> GB olume: eir quota limit eir waming leve	ne: •
Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to ct the quota logging Log event when a Log event when a	limit for new user age 40 35 options for this v user exceeds the	uota limit s on this volum GB GB olume: eir quota limit eir warning leve	ne: ·
Sele	Deny disk space to u ct the default quota Do not limit disk us Limit disk space to Set warning level to ct the quota logging Log event when a Log event when a	limit for new user age 40 35 options for this v user exceeds the user exceeds the	GB GB GB olume: eir quota limit eir warning leve	ne: • •

Figure 23: Hard drive quotas in Windows 7

# NTFS Improvements (continued)

Drive Size	Cluster Size	Number of Sectors
512 MB or less	512 bytes	1
513 MB to 1024 MB (1 GB)	1024 bytes (1 KB)	2
1025 MB to 2048 MB (2 GB)	2048 bytes (2 KB)	4
2049 MB and larger	4096 bytes (4 KB)	8

#### Table 4: NTFS Cluster Sizes





#### • FAT64

- Today's USB drives are considerably larger, so the file system becomes an issue.
- FAT32 does not work on drives larger than 2 TB and limits file size to 4 GB.
- exFAT (or FAT64), breaks the 4-GB file-size barrier, supporting files up to 16 exabytes (EB) and a theoretical partition limit of 64 zettabytes (ZB).
- The exFAT file system extends FAT32 from 32-bit cluster entries to 64-bit cluster entries in the file table, making file structures and storage more efficient.



### FAT64 (continued)

#### • FAT64 (continued)

- Like FAT32, FAT64 does not have NTFS features (encryption, compression, etc.).
- Microsoft introduced exFAT in Windows 7, but Windows Vista with SP1 also supports exFAT.
   Microsoft has enabled Windows XP support for exFAT with a special download.

### FAT64 (continued)

Capacity:	
0.99 GB	<b>T</b>
=ile system	
NTFS	*
Allocation unit	size
4096 bytes	*
Volume label	
Volume label	
Volume label Format optio	ns
Format optio	ns mat
Format optio	ns mat MS-DOS startup disk
Volume label Format optio	<b>ns</b> nat I MS-DOS startup disk
Volume label Format optio	ns mat I MS-DOS startup disk

Figure 24: Formatting a thumb drive in Windows 7

#### The Partitioning and Formatting Process



#### **Bootable Media**

- Any removable media that has a bootable OS installed
  - Floppy, CD-ROM, USB thumb drive
  - All Windows and Linux installation CDs are bootable
  - Common to create bootable media with tools added

# Partitioning and Formatting with the Installation Disc

- The partitioning and formatting tools differ between Windows XP and Windows Vista/7.
  - Windows XP has a text-based installation tool.
  - Windows Vista and Windows 7 use a graphical tool.
  - The process of setting up drives is nearly identical.

## Partitioning and Formatting with the Installation Disc (continued)

#### • Partitioning During Windows XP Installation

- One primary partition is the most common way to set up a hard drive—one large active C: drive
- Text mode of Windows installation has tools to create partitions
  - Can create single partition or multiple partitions primary and extended
  - Can set size of partitions
  - Can format partitions. Quick formatting does not check drive quality. Regular formatting will try to write and then read from each sector. Bad sectors will be marked.

## Partitioning and Formatting with the Installation Disc (continued)



Figure 25: Windows installation CD

### Partitioning and Formatting with the Installation Disc (continued)



Figure 26: Welcome to Setup

## Partitioning and Formatting with the Installation Disc (continued)

#### Windows XP Professional Setup

<ul> <li>To set up Windows XP on the selected item, press ENTER.</li> <li>To create a partition in the unpartitioned space, press C.</li> <li>To delete the selected partition, press D.</li> <li>23995 MB Disk Ø at Id Ø on bus Ø on atapi [MBR]</li> </ul>	<ul> <li>To set up Windows XP on the selected item, press ENTER.</li> <li>To create a partition in the unpartitioned space, press C.</li> <li>To delete the selected partition, press D.</li> <li>23995 MB Disk Ø at Id Ø on bus Ø on atapi [MBR]</li> <li>Unpartitioned space</li> <li>1023995 MB</li> </ul>	partitioned space on this comput e the UP and DOWN ARROW keys to	ter. select an item in the list.
<ul> <li>To create a partition in the unpartitioned space, press C.</li> <li>To delete the selected partition, press D.</li> <li>023995 MB Disk 0 at Id 0 on bus 0 on atapi [MBR]</li> </ul>	<ul> <li>To create a partition in the unpartitioned space, press C.</li> <li>To delete the selected partition, press D.</li> <li>323995 MB Disk Ø at Id Ø on bus Ø on atapi [MBR]</li> <li>Unpartitioned space 1023995 MB</li> </ul>	<ul> <li>To set up Windows XP on the</li> </ul>	selected item, press ENTER.
023995 MB Disk 0 at Id 0 on bus 0 on atapi [MBR]	023995 MB Disk Ø at Id Ø on bus Ø on atapi [MBR] Unpartitioned space 1023995 MB	<ul> <li>To create a partition in the</li> <li>To delete the selected part:</li> </ul>	e unpartitioned space, press C. ition, press D.
	Unpartitioned space 1023995 MB	023995 MB Disk 0 at Id 0 on bus (	0 on atapi [MBR]
Unpartitioned space 1023995 MB		Unpartitioned space	1023995 MB

Figure 27: Partitioning screen

## Partitioning and Formatting with the Installation Disc (continued)

Windows XP Professional Setup You asked Setup to create a new partition on 1023995 MB Disk 0 at Id 0 on bus 0 on atapi [MBR]. To create the new partition, enter a size below and press ENTER. To go back to the previous screen without creating the partition, press ESC. The minimum size for the new partition is 8 megabytes (MB). The maximum size for the new partition is 1023987 megabytes (MB). Create partition of size (in MB): 1023987 ENTER=Create ESC=Cancel

Figure 28: Setting partition size

## Partitioning and Formatting with the Installation Disc (continued)

list.
ENTER.
press C.
340989 MB free)

Figure 29: A newly created partition along with unpartitioned space

## Partitioning and Formatting with the Installation Disc (continued)

#### Windows XP Professional Setup

A new partition for Windows XP has been created on

1023995 MB Disk 0 at Id 0 on bus 0 on atapi [MBR].

This partition must now be formatted.

From the list below, select a file system for the new partition. Use the UP and DOWN ARROW keys to select the file system you want, and then press ENTER.

If you want to select a different partition for Windows XP, press ESC.

Format the partition using the NTFS file system (Quick) Format the partition using the NTFS file system

ENTER=Continue ESC=Cancel

Figure 30: Format screen

## Partitioning and Formatting with the Installation Disc (continued)

Windows XP Professional Setup
You asked Setup to delete the partition
E: Partition3 [New (Raw)] 340989 MB ( 340989 MB free)
on 1023995 MB Disk 0 at Id 0 on bus 0 on atapi [MBR].
<ul> <li>To delete this partition, press L.</li> <li>CAUTION: All data on this partition will be lost.</li> </ul>
<ul> <li>To return to the previous screen without deleting the partition, press ESC.</li> </ul>
L=Delete ESC=Cancel

Figure 31: Option to delete partition

## Partitioning and Formatting with the Installation Disc (continued)

#### Partitioning During Windows Vista/7 Installation

- The partitioning and formatting process in Vista/7 installations differs from the Windows XP process primarily in looks (it's graphical)—not in function.
- The most common partitioning and formatting option is a single C: partition, making it active, and formatting it as NTFS. Note that Windows 7 creates two partitions, a 100-MB System Reserved partition and the C: partition.

## Partitioning and Formatting with the Installation Disc (continued)

- Partitioning During Windows Vista/7 Installation (continued)
  - If you want to do any custom partitioning or delete existing partitions, you click on Drive options (advanced) in the "Where do you want to install Windows?" dialog box.
  - To create a new partition, click the New button and specify the size.
  - Windows Vista and Windows 7 can read FAT and FAT32 drives, but they won't install to a FAT partition by default.

## Partitioning and Formatting with the Installation Disc (continued)



Figure 32: Starting the Windows 7 installation

## Partitioning and Formatting with the Installation Disc (continued)

Name Disk 0 Unallocated Space	Total Size	Free Space 1000.0 GB	Туре	
∲ <u>n</u> Eefresh		Drive option	s ( <u>a</u> dvanced)	
💽 Load Driver				
			(	

Figure 33: Where do you want to install Windows?

## Partitioning and Formatting with the Installation Disc (continued)

Type File Sy: Basic NTFS Basic NTFS	stem Status Healthy (B Healthy (S	Capacity 931.41 GB 100 MB	Free Space 419.61 GB 72 MB	% Free 45 % 72 %	Fault Tolerance No No	Overhead 0% 0%
	**************					
Active, Primary Pai	931.41 GB NTFS Healthy (Boot, Page F	File, Crash Dump, I	Primary Partition			
,						
40	tive, Primary Par	tive, Primary Par Healthy (Boot, Page)	tive, Primary Par	tive, Primary Par Healthy (Boot, Page File, Crash Dump, Primary Partition	tive, Primary Par	tive, Primary Pai Healthy (Boot, Page File, Crash Dump, Primary Partition)

Figure 34: Disk Management showing the default partitions in Windows 7

## Partitioning and Formatting with the Installation Disc (continued)

Name	Total Size	Free Space Type	
Disk 0 Partition 1: System Reser	ved 100.0 MB	86.0 MB System	
Disk 0 Partition 2	499.9 GB	499.9 GB Primary	
Refresh     X Delete       Delete     Delete       Load Driver     Delete	✓ Format	₩ N <u>e</u> w	

Figure 35:New 499-GB partition with 100-MB System Reserved partition and unallocated space


- Disk Management—primary tool for partitioning and formatting drives after installation
- Part of computer management
- The Microsoft Management Console (MMC) snap-in can be accessed directly with diskmgmt.msc



# Disk Management (continued)

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3 (C)	Simple	Pacie	NITES	Laster (P	20 00 CP	29 20 CP	76 Free 71.9/	No.	0%
■ System Reserve	d Simple	Basic	NTFS	Healthy (S	100 MB	72 MB	72 %	No	0%
Disk 0									
asic 0.00 GB Inline	System Reserve 100 MB NTFS Healthy (System	e <b>d</b> , Active, Prin	(C:) 39.90 GB NTI Healthy (Boo	FS ot, Page File, Cra	sh Dump, Prim	ary Partition)			
Disk 1 Jasic									
000.00 GB Inline	2000.00 GB Unallocated								
Disk 2									
<b>Disk 2</b> Basic 2000.00 GB Online	2000.00 GB Unallocated								
Disk 2 Basic 2000.00 GB Online	2000.00 GB Unallocated								

#### Figure 36: Disk Management



# Disk Management (continued)

#### Disk initialization

- Includes special information placed on a hard drive that identifies the hard drive and membership in different types of arrays
- To initialize a disk, right-click the icon and select Initialize.
- All drives must be initialized before you can use them.
- In Windows 7 you will get the option to select MBR or GPT as a partition style.

# Disk Management (continued)

olume	Layout	Туре	File System	Status	Capacity	Free Spa	% Free	Fault Tolerance	Overhead
≥ (C:) ∋ System Reserved	Simple J Simple	Basic Basic	NTFS NTFS	Healthy (B Healthy (S	39.90 GB 100 MB	28.64 GB 72 MB	72 % 72 %	No No	0% 0%
■Disk 0 I lasic 0.00 GB Dnline	System Reservent 100 MB NTFS Healthy (System	ed a, Active, Prima	(C:) 39.90 GB NTI Healthy (Boo	FS ot, Page File, Cra	ash Dump, Prim	nary Partition)			
Disk 1     Inknown 2000.00 GB Not Initialized	2000.00 GB Unallocated								

#### Figure 37: Unknown drive in Disk Management

# Disk Management (continued)

- You can view the status of a drive in Disk Management:
  - Healthy: just what it sounds like
  - Unallocated: space with no partition
  - Active: potentially bootable partition
  - Foreign drive: unknown dynamic disk
  - Formatting: drive is in the process of being formatted
  - Failed: indicates a drive has died or a drive has been part of a RAID array that's now broken
  - Online: normal, working drive
  - Offline: corrupted drive or problem with communicating with drive

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# Disk Management (continued)

- Creating partitions and volumes in Disk Management:
  - To create partitions or volumes, right-click the unallocated part of the drive and select New Partition in Windows XP or New Simple Volume in Windows Vista/7.
  - Disk Management runs the New Partition Wizard or the New Simple Volume Wizard.
  - In Windows XP, you'll be asked to select a primary partition or an extended partition. After that, you will specify the partition or volume size.

# Disk Management (continued)



Figure 38: The New Partition Wizard in Windows XP at the Select Partition Type dialog box

# Disk Management (continued)

- Creating partitions and volumes in Disk Management (continued):
  - Because Windows Vista and Windows 7 don't give you the option to specify whether you want primary or extended partitions, you'll go straight to the sizing screen.
  - Specify partition or volume size and click Next.
     You will choose whether you want to assign a drive letter to the partition or volume, mount it as a folder to an existing partition or volume, or do neither.

# Disk Management (continued)

Specify Volume Size Choose a volume size that is betwee	en the maximum and minimum sizes.
Maximum disk space in MB:	2047997
Minimum disk space in MB: Simple volume size in MB:	8 2047997
	< Back Next > Cancel

Figure 39: Specifying the simple volume size in the New Simple Volume Wizard

# Disk Management (continued)

- Creating partitions and volumes in Disk Management (continued):
  - Note that Windows Vista and Windows 7 do not enable you to specify whether you want a primary or extended partition when you create a volume. The first three volumes you create will be primary partitions. Every volume thereafter will be a logical drive in an extended partition.



# Disk Management (continued)

Assig F	gn Drive Letter or Path or easier access, you can assign a drive letter or drive path to your partition.
6	Assign the following drive letter: Mount in the following empty NTFS folder: Browse Do not assign a drive letter or drive path
	< Back Next > Cancel

Figure 40: Assigning a drive letter to a partition



# Disk Management (continued)

- Formatting—the last screen asks for the format type
  - If the partition is less than 4 GB, you can choose FAT, FAT32, or NTFS.
  - If the partition is 4 GB to 32 GB, you can choose FAT32 or NTFS.
  - If the partition is > 32 GB, you can choose only NTFS. While FAT32 supports partitions up to 2 TB, Microsoft supports FAT32 partitions only up to 32 GB.

# Disk Management (continued)

t to use.
t <mark>to use</mark> .

Figure 41: Choosing a file system type



# Disk Management (continued)



Figure 42: Turning on compression



## **Dynamic Disks**

- Windows 2000 and newer OSs use the Disk Management tool to offer an improved kind of disk partition called a dynamic disk.
  - Regular drives are called basic disks.
  - A dynamic disk enables you to enlarge partitions without first deleting the partitions or losing data.



🗃 Disk Managem	ent									
File Action V	iew Help									
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Volume	Layout	Туре	File System	Status	Capacity	Free Spa	% Free	Fault Tolerance	Overhead	
(C:)	Simple	Basic	NTFS	Healthy (B	39.90 GB	28.28 GB	71 %	No	0%	
System Reserve	d Simple	Basic	NIFS	Healthy (S	100 MB	12 MB	12 %	No	0%	
Disk 0 Basic	System Reserv	ed	(C:)							
40.00 GB Online	100 MB NTFS Healthy (System	n, Active, Prin	ary Healthy (I	NTFS Boot, Page File,	Crash Dump, P	rimary Partition	)			
Basic 2000.00 GB	2000.00 GB		- 14							
Online New New New New New New New New New Ne	w Spanned Volum w Striped Volume.	e								
CD- Nei DVD (D Nei	w Mirrored Volum w RAID-5 Volume.	e								
No Med Col	nvert to Dynamic I	Disk								
Con	nvert to GPT Disk	-0			_					
Off Unall	line									
Pro	perties									
Hel	lp						_			

Figure 43: Converting to a dynamic disk



- Dynamic disks do not contain primary and extended partitions. Instead, they are divided into volumes. Dynamic disks support several types of volumes:
  - Simple volume—acts just like a primary partition
  - Spanned volume—spans a volume across multiple physical disks
  - Extend a volume—extends a partition on a single drive, but only into unallocated space

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## Dynamic Disks (continued)

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/olume	Layout	Type F	File System	Status	Capacity	Free Spa	% Free	Fault Tolerance	Overhead
∋ (C:) ∋System Reserv	Simple red Simple	Basic N Basic N	NTFS NTFS	Healthy (B Healthy (S	39.90 GB 100 MB	28.28 GB 72 MB	71 % 72 %	No No	0% 0%
			1						
Basic	System Reserved	d	((-)						
40.00 GB	100 MB NTFS		39.90 GB N	NTFS					
Online	Healthy (System, A	Active, Primary	/ Healthy (B	Boot, Page File,	Crash Dump, F	rimary Partition	1)		
Disk 1									
Disk 1 Dynamic									
Disk 1 Dynamic 2000.00 GB	2000.00 GB								
Disk 1 Dynamic 2000.00 GB Dnline	2000.00 GB Unallocated	New Si	imple Volume						
Disk 1 Dynamic 2000.00 GB Online	2000.00 GB Unallocated	New Si New Sp	imple Volume panned Volume						
Disk 1 Dynamic 2000.00 GB Online	2000.00 GB Unallocated	New Si New Sp New St	imple Volume panned Volume triped Volume						
Disk 1 Dynamic 2000.00 GB Dnline	2000.00 GB Unallocated	New Si New Sp New St New M	imple Volume panned Volum triped Volume firrored Volum						
Disk 1 Dynamic 2000.00 GB Dnline CD-ROM 0 DVD (D:) Vo Media	2000.00 GB Unallocated	New Si New Si New M New M New R	imple Volume panned Volume triped Volume firrored Volum AID-5 Volume						
Disk 1 Dynamic 000.00 GB Dnline	2000.00 GB Unallocated	New St New St New Ru New Ru Propert	imple Volume panned Volume friped Volume AID-5 Volume ties						

Figure 44: Selecting to open the New Simple Volume Wizard

#### Figure 45: Simple volumes

Jume         Layout         Type         File System         Status         Capacity         Tree Spa         % Free         Free         Spa         %	ult Tolerance Overhead 0% 0% 0% 0% 0% 0% 0%		
(C.)         Simple         Basic         NTFS         Healthy         66.67 GB         666.55 GB         100 %         N           a New Volume (F)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.55 GB         100 %         N           a New Volume (G)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.55 GB         100 %         N           a New Volume (G)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.56 GB         100 %         N           a New Volume (G)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.56 GB         100 %         N           a New Volume (G)         Simple         Basic         NTFS         Healthy (S 100 MB         72 MB         72 %         N           a System Reserved         Ion MB NTFS         Ion	0 0% 0 0% 0 0% 0 0%		
New Yolume (E)         Simple         Dynamic         NTFS         Healthy         666.77 GB         666.55 GB         100 %         N           New Yolume (G)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.55 GB         100 %         N           New Yolume (G)         Simple         Dynamic         NTFS         Healthy         666.67 GB         666.55 GB         100 %         N           #System Reserved         Simple         Basic         NTFS         Healthy (S 100 MB         72 MB         72 %         N           #Disk 0         Image	0 0% 0% 0%		
	0%		
New Volume (Uc) Simple Dynamic NTFS Healthy bood Ub boods Ub 100 % N System Reserved Simple Basic NTFS Healthy (S 100 MB 72 MB 72 % N  Disk 0 System Reserved (C.) 100 MB NTFS 100 MB NTFS 100 MB NTFS 100 MB NTFS Healthy (Boot, Page File, Crash Dump, Primary Partition)	0%		
System Reserved Simple basic NTFS Healting (S 100 MB /2 MB /2 % N  System Reserved 10.00 66 100 MB NTFS 100 MB NTFS 100 MB NTFS 100 MB NTFS 130 90 GB NTFS 130 MB NTFS 130 90 GB NTFS 130 MB NTFS 130 90 GB NTFS 130	0%		
Disk 0 asic System Reserved (C.) 39.00 GB 100 MB NTFS Infine Healthy (System, Active, Primary Healthy (Boot, Page File, Crash Dump, Primary Partition)			
Disk 1         New Volume (£)           Dynamic         666 57 GB NTFS         666 57 GB NTFS           Donine         Leathw         Leathw         Leathw	v Volume (G:) 67 GB NTFS Hav		
	Healthy		
CD-ROM 0 DVD (D:)			

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## Dynamic Disks (continued)

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Volume	Layout	Туре	File System	Status	Capacity	Free Spa	% Free	Fault Tolerance	Overhead
⇒ (C:) ⇒ New Volume (E ⇒ System Reserve	Simple E:) Simple ed Simple	Basic Dynamic Basic	NTFS NTFS NTFS	Healthy (B Healthy Healthy (S	39.90 GB 976.56 GB 100 MB	28.28 GB 976.45 GB 72 MB	71 % 100 % 72 %	No No No	0% 0% 0%
Disk 0 Basic 40.00 GB	System Reserv 100 MB NTFS	red	(C:) 39.90 GB	NTFS					
Online	Healthy (System	n, Active, Prima	ary Healthy (	Boot, Page File,	Crash Dump, P	rimary Partition	)		
Online Disk 1 Dynamic 2000.00 GB Online	New Volume ( 976.56 GB NTFS Healthy	n, Active, Prima	ary Healthy (	Boot, Page File,	Crash Dump, P	1023.44 Gi Unallocate	) 3 ed		
Online  Disk 1 Dynamic 2000.00 GB Online  Disk 2 Dynamic 2000.00 GB Online	Healthy (System New Volume ( 976.56 GB NTFS Healthy Healthy 2000.00 GB Unallocated	E)	ary Healthy (	Boot, Page File, Open Explore Extend Vo Shrink Vol Add Mirro	Crash Dump, P.	1023.44 Gi Unallocate	3 2cd		
Online Disk 1 Dynamic 2000.00 GB Online Disk 2 Dynamic 2000.00 GB Online CD-ROM 0 DVD (D:)	Healthy (System New Volume ( 976.56 GB NTFS Healthy 2000.00 GB Unallocated	E)	ary Healthy (	Boot, Page File, Open Explore Extend Vo Shrink Vol Add Mirro Change D Format	Crash Dump, P.	1023.44 Gi Unallocate	3 sed		
Online  Disk 1 Dynamic 2000.00 GB Online  Dynamic 2000.00 GB Online  Conline  Conlin	Healthy (System New Volume ( 976.55 GB NTFS Healthy Healthy 2000.00 GB Unallocated	E)	Healthy (	Boot, Page File, Open Explore Extend Vo Shrink Vol Add Mirro Change D Format Reactivate	Crash Dump, P.	imary Partition 1023.44 Gi Unallocat	3 2d		
Online Disk 1 Dynamic 2000.00 GB Online Dynamic 2000.00 GB Online CD-ROM 0 DVD (D:) No Media	Healthy (System New Volume ( 976.55 GB NTFS Healthy Healthy 2000.00 GB Unallocated	ta	Healthy (	Open Explore Extend Vo Shrink Vol Add Mirro Change D Format Reactivate Delete Vol	Crash Dump, P.	imary Partition	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3		

Figure 46:Selecting the Extend Volume option

#### Figure 47: The Extend Volume Wizard

You can use space on one or more disks to ext	end the volume.
Available: Disk 2 2047997 (null) Add > < Remove	Selected: Disk 1 1047997 (null)
Total volume size in megabytes (MB): Maximum available space in MB:	All 2047997 1047997
Select the amount of space in MB:	1047997



ile Action View									
ine Accioni view	v Help								
• 🔿   📅   😰 (	<b>T</b>   🗗 👪								
/olume	Layout	Туре	File System	Status	Capacity	Free Spa	% Free	Fault Tolerance	Overhead
a (C:)	Simple	Basic	NTFS	Healthy (B	39.90 GB	28.28 GB	71 %	No	0%
Extended (E:)	Simple	Dynamic	NTFS	Healthy	1804.68 GB	1804.54	100 %	No	0%
∍System Reserved	Simple	Basic	NTFS	Healthy (S	100 MB	72 MB	72 %	No	0%
Disk 0 Basic 10.00 GB Diline	System Reserv 100 MB NTFS Healthy (System	r <b>ed</b> n, Active, Prima	(C:) 39.90 GB Healthy (	NTFS Boot, Page File,	Crash Dump, Pr	imary Partition	)		
Disk 1 Dynamic 2000.00 GB Dnline	<b>Extended (E:)</b> 488.28 GB NTFS Healthy			195.31 Unallo	GB cated			Extended (E:) 1316.40 GB NTFS Healthy	
Disk 2	2000.00 GP							, 	
2000.00 GB 2 Dnline I	Unallocated								

#### Figure 48: Extended volume



- Dynamic disk volumes (continued):
  - Striped volume—two or more dynamic disks that spread out blocks of each file across multiple disks.
     All the disks make up a striped set. This is a RAID 0 array.
  - Mirrored volume—Windows 7 Professional, Enterprise, and Ultimate editions can create a mirror set with two drives for data redundancy. Mirrors are RAID 1.



📑 Disk Management File Action View Help (= -) 🖬 🛛 🖬 🕑 📽 😼 Volume File System Status Free Spa... % Free Fault Tolerance Overhead Layout Type Capacity (C:) NTFS Healthy (B.,. 39.90 GB 28.28 GB 71 % No 0% Simple Basic G Striped (E:) Striped Dynamic NTFS Healthy 1999.99 GB 1999.85 ... 100 % No 0% System Reserved Simple NTFS Healthy (S... 100 MB 72 MB 72 % No 0% Basic Disk 0 Basic System Reserved (C:) 40.00 GB 100 MB NTFS 39.90 GB NTES Online Healthy (System, Active, Primary Healthy (Boot, Page File, Crash Dump, Primary Partition) Disk 1 Dynamic Striped (E:) 2000.00 GB 1000.00 GB NTFS 1000.00 GB Online Healthy Unallocated Disk 2 Dynamic Striped (E:) 1000.00 GB 1000.00 GB NTFS Online Healthy CD-ROM 0 DVD (D:) No Media 📕 Unallocated 📕 Primary partition 📕 Striped volume

Figure 49: Two striped drives

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### Dynamic Disks (continued)

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· · · · · · · · · · · · ·		I man	10.1		15.0	a r	In and	
olume a (C:) a System Reserve	Layout Type Simple Basic ed Simple Basic	NTFS NTFS	Healthy (B Healthy (S	29.90 GB 100 MB	28.28 GB 72 MB	% Free 71 % 72 %	Fault Tolerance No No	Overhead 0% 0%
<b>Disk 0</b> lasic 0.00 GB Dnline	System Reserved 100 MB NTFS Healthy (System, Active	Primary (C:) 39.90 GB Healthy (	NTFS Boot, Page File,	Crash Dump, P	rimary Partition	)		
Disk 1	2000.00 GB							
2000.00 GB Doline	Unallocated	New Simple New Spann	ed Volume ed Volume					
Doline Doline Doline Doline Doline Doline	Unallocated 2000.00 GB Unallocated	New Simple New Spann New Striper New Mirror New RAID-1 Properties	e Volume ed Volume I Volume ed Volume					

Figure 50: Selecting a new mirror

#### Figure 51: Selecting drives for the array

Select Disks	
You can select the disks and set the disk size f	or this volume.
Select the disks you want to use, and then click	k Add.
Available:	Selected:
Disk 2 2047997 (null) Add >	Disk 1 2047997 (null)
< Remov	e
< Remove	All
Total volume size in megabytes (MB):	0
Maximum available space in MB:	2047997
Select the amount of space in MB:	2047997
	< Back Next > Cancel



- Dynamic disk volumes (continued):
  - Striped volume with parity—Disk Management enables you to create a RAID 5 array that uses three or more disks to create a robust solution for storage.
  - This applies to all the professional versions of Windows XP, Windows Vista, and Windows 7.
  - However, for those operating systems, you can make the array only on a Windows Server machine that you access remotely across a network.



## **Mount Point**

- While partitions and volumes can be assigned a drive letter, D: through Z:, they can also be mounted as a folder on another drive, also known as a mount point.
  - This enables you to use your existing folders to store more data than can fit on a single drive or partition/volume.



# Mount Point (continued)

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# Mount Point (continued)

Assign Drive Letter or Path For easier access, you can assign a drive let	ter or drive path to your partition.
<ul> <li>Assign the following drive letter:</li> <li>Mount in the following empty NTFS folder C:\Database</li> <li>Do not assign a drive letter or drive path</li> </ul>	E 💌
	<pre></pre>

Figure 54: Choosing to create a mounted volume



## Formatting a Partition

- Can format in Windows Explorer
- Can format in Computer/Disk Management

Figure 55: Choosing Format in Computer



#### Maintaining and Troubleshooting Hard Drives

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### **Error-checking**

- Error-checking scans for bad clusters on hard drives
- Often referred to by old name of ScanDisk or Run command of CHKDSK
  - Also checks for invalid filenames and tries to fix them
  - Looks for lost clusters or chains that do not have a filename associated with them and deletes them
  - Checks the links between parent and child folders
  - Launched via error-checking tools from Windows
     Explorer

# Error-checking (continued)

- Can check the drive
- Can be set to fix errors automatically
- Can scan for and recover bad sectors

Figure 56: The Tools tab in the Properties dialog box

Jocumy	Previo	ous Versions	Quota
General	Tools	Hardware	Sharing
Error-checking This o	) option will check	the drive for errors.	ck now
This of the second s	option will defrag	ment files on the driv	ve. nt now
Backup This o	option will back	up files on the drive. Back	up now



# Error-checking (continued)

Security	Previo	ous Versions	Quota	
General	Tools	Hardware	Sharing	
Error-checking This of	ption <mark>wi</mark> ll check	the drive for errors.		
		Check Disk Lo	ocal Disk (C:)	
Defragmentatic This of Backup	n ption <mark>wi</mark> ll defrag	gme Check disk	options tically fix file system r and attempt recov	errors ery of bad sectors
This of	ption will back		Start	Cancel

Figure 57: Check Disk options



### Defragmentation

- Disk Defragmenter
  - Consider using regularly (monthly or weekly)
  - Will slow down system while running
  - If not done, system will slow down due to fragmentation
  - Can be scheduled
  - Called **DEFRAG** by many techs and by CompTIA

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# Defragmentation (continued)

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👪 Disk Defragmenter			😵 Disk Defrag	gmenter				
Dick Defragmenter	concolidator fragmented filer on your computer	s hard disk to improve system	File Action	View Help				
performance. <u>Tell 1</u>	me more about Disk Defragmenter.	s hard disk to improve system	+ +	😫 🖬				
Scheduler			Volume	Session Status	File System	Capacity	Free Space	% Free Space
Schedule:			(C:)	Analyzed	NTFS	39.99 GB	33.82 GB	84 %
Scheduled defragment	tation is turned on	Configure schedule						
Kun at 12:00 PM (noon)	every Wednesday							
ivext scheduled run: 3/2	1/2012 12:00 PM							
Current status:		20						
Disk	Last Run	Progress						
🚢 (C:)	3/21/2012 11:30 AM (0% fragmented)		Estimated disk	usage before defragmentat	ion:			
👝 (E:)	Never run							
System Reserved	3/15/2012 4:44 PM (0% fragmented)							
			Estimated disk	usade after defragmentation	<b>D</b> *			
			Esumated disk	usage arter den agmentation				
Only disks that can be defra	gmented are shown.	est an above course disks						
To best determine it your ut	sks need denagmenting right now, you need to r	ist analyze your uisks.	Analyze	Defragment	Pause Sto	View Rep	port	
	🚱 Analyze disk	🛞 Defragment disk						
			Fragmented	d files 🔳 Contiguous files	Unmovable files	Free space		
		Close						

Figure 58: Disk Defragmenter in Windows 7 (left) and Windows XP

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# Defragmentation (continued)

- Windows 7 automatically defragments disks once a week.
  - You can adjust the schedule or even turn it off.
- Don't defrag solid-state drives (SSDs), as they do not require it.
  - You could damage them by defragging them, or at least reduce their useful life.
  - Windows 7 disables scheduled defrag for SSDs.



#### **Disk Cleanup**

#### • Allows you to purge system of unneeded files

- Files in the Recycle Bin
- Temporary Internet files
- Downloaded program files
- Temporary files

Figure 59: Mike's Recycle Bin

Organize 🔻 Empty the Recycle Bin	Restore all items		· · ·
🔶 Favorites	Name	Original Location	Date Deleted
	I.net ff extention	C:\Users\michaels\Documents	3/29/2012 4:05 PM
词 Libraries	2010	C:\Users\michaels\Pictures	3/29/2012 4:05 PM
	2011	C:\Users\michaels\Pictures	3/29/2012 4:05 PM
P Computer	2012	C:\Users\michaels\Pictures	3/29/2012 4:05 PM
	aplusphotos	C:\Users\michaels\Documents	3/29/2012 4:05 PM
wetwork	automysqlbackup.sh	C:\Users\michaels\Documents	3/29/2012 4:05 PM
	🍌 Bear	C:\Users\michaels\Pictures	3/29/2012 4:05 PM
	Carpevaca.org	C:\Users\michaels\Documents	3/29/2012 4:05 PM
	checkemon	C:\Users\michaels\Documents	3/29/2012 4:05 PM
	Current EQ.feq	C:\Users\michaels\Documents	3/29/2012 4:05 PM
	< [		


### Disk Cleanup (continued)

**Fourth Edition** 

Organize 🔻			•••• •	
-	041-2207.English	041-3330.English		
😭 Favorites	041-3560.English	041-3561.English	041-4796.English	
Marktop	041-4798.English	041-5173.English	061-3418.English	
📕 Downloads	061-3452.English	061-4200.English	061-4249.English	
🍰 Dropbox	061-4512.English	061-4513.English	061-4514.English	
🕮 Recent Places	061-5790.English	061-5850.English	061-6867.English	
NTALFS3	061-7306.English	061-7340.English	061-7509.English	
🖵 Research	061-7511.English	061-8153.English	061-8155.English	
🖵 Software	061-9537.English	061-9539.English	061-9848.English	
🖵 Dev	12373114	161226667	161226667	
NetBeans Projects	2068469	2068729	2068781	
🍶 Code	2074283	2077575	💽 360 cities	
SEC 3.111	3rd_party	AC_OETags	actionactionlist	
词 Libraries	actionairappexists	actionairappinstall	actionairruntimeexists	
N. 7	actioncheckuninstall	actiondownload	action download a dobe	
🖻 🌉 Computer	actiongccheck	actiongtbcheck	actionlaunch	
	actionlaunchadobe	actionlaunchchrome	actionlaunchflashplayer	
⊳ 🗣 Network	actionlist	actionregistrykeypathcheck	actionregistryvaluecheck	
	adobe 3	] algo	algo	
	algo	algo	 ]] algo	
		algo	algo	
	algo	announcement	app	
	Autocomplete	Autocomplete	Due_star_l	
	S bundleloader	Chart bar	P. controls	

Figure 60: Lots of temporary Internet files

## Disk Cleanup (continued)

You can use Disk Cleanup to free up space on (C:).	to 1.33 GB of disk	
les to delete:		
🗹 🃗 Downloaded Program Files	0 bytes	*
🔽 📄 Temporary Internet Files	161 KB	=
🗹 🔯 Recycle Bin	0 bytes	1
Setup Log Files	45.8 KB	
Temporary files	663 MB	÷
otal amount of disk space you gain:	1.33 G	В
Downloaded Program Files are ActiveX contri downloaded automatically from the Internet w pages. They are temporarily stored in the Dow Files folder on your hard disk.	ols and Java applets when you view certain wnloaded Program	1
Clean up system files	View Files	]

Figure 61: Disk Cleanup



### **Troubleshooting Hard Drive Implementation**

- Four broad categories of hard drive failures:
  - 1. Installation errors
  - 2. Data corruption
  - 3. Dying hard drives
  - 4. RAID Issues



### **Troubleshooting Installation**

#### • Connectivity

- Hard drive error
- No fixed disks present
- HDD controller failure
- No boot device available
- Drive not found

#### Solutions include

- Checking the cables to make sure they connect properly
- Reseating the hard drive controller (if an expansion card)
- Using autodetection in CMOS
- Checking the jumper settings
- Some PATA drives are incompatible on the same controller



# Troubleshooting Installation (continued)

#### • CMOS

- CMOS configuration mismatch
- No boot device available
- Drive not found
- Missing OS
- Solutions
  - Always run autodetect in CMOS
  - Always select LBA



# Troubleshooting Installation (continued)

#### Partitions

- Failing to partition
  - Invalid drive specification error
- Making the wrong size or type of partition

#### • Format

- Failing to format
  - Drive is not accessible
  - Invalid media type

Figure 62: The "Trying to recover lost allocation unit" error

#### A:\>format C:/s

WARNING: ALL DATA ON NON-REMOVABLE DISK DRIVE C: WILL BE LOST! Proceed with Format (Y/N)?y

Formatting 30709.65M Trying to recover lost allocation unit 37,925

 "Trying to recover lost allocation unit" indicates the drive is dying



## **Troubleshooting Corruption**

- Data corruption
  - Caused by many things such as power surges, accidental shutdowns, viruses, and more
  - Show up as
    - File is missing or corrupt
    - Download location information is damaged
    - Unable to load file
    - Cannot find command.com
    - Error loading operating system
    - Invalid boot.ini
  - Try running error-checking utility

#### Figure 63: A corrupted data error



### **Troubleshooting Corruption** (continued)



Figure 64: SpinRite at work



### **Troubleshooting Corruption** (*continued*)

- Corrupted data on bad sectors
  - The built-in error correction code (ECC) checks the drive for bad sectors
  - Disk checkers can be used to fix problems pertaining to corrupted data
  - Windows will give you error messages with read/write failures. Good hard drives don't fail to read or write. Only dying ones have these problems.



# **Troubleshooting Dying HDD**

- Dying hard drive
  - The following sounds indicate a drive about to die
    - Continuous high-pitched squeal
    - Series of clacks, a short pause, and then more clacks
    - Continuous grinding or rumbling
  - Boot drive issue would show up as "no boot device present"
  - Second drives simply do not show up



### **RAID Issues**

- Drive problems in a RAID array are almost identical to those seen on an individual drive.
- If the configuration firmware doesn't recognize one of the drives, first check to make sure the drives are powered and that they are connected to the proper connections.
  - This is especially true of motherboards with onboard RAID that require you to use only certain special RAID connectors.

## **RAID Issues (continued)**

- When one of the drives in a RAID array fails, several things can happen depending on the type of array and the RAID controller.
  - With RAID 0, the effect is a critical stop error, or a Blue Screen of Death (BSoD). On reboot, the computer will fail to boot or you'll get a message that the OS can't be found. You will normally lose all data.
  - With all other RAID levels, you will get a notification of the drive failure, and performance will suffer. You usually won't lose data, but you must replace the failed drive.

### **RAID Issues (continued)**

- "RAID Not Found" errors will vary greatly depending on the make and model of hardware RAID or if you used software RAID
  - A properly functioning hardware RAID array will always show up in the configuration utility.
  - If an existing array stops working and you enter the configuration utility only to find the array is gone, this points to either dead drives or faulty controllers.
  - In either case they must be replaced. If the array is gone but you can still see the drives, then the controller may have broken the array on its own.



### **Beyond A+**

- Third-party partition tools enable you to create, change, and delete partitions without destroying the data:
  - PartitionMagic
  - VCOM's Partition Commander
  - GParted
    - Free (open source) license
    - Linux only



### Beyond A+ (continued)

Fourth Edition

<complex-block></complex-block>	Redistribute Free Space Wizard								
Verthed dak before the changes:isse: fared bak 0 (FUIITSU MHY20000H)isse: fared bak 0 (FUIITSU MHY2000H)isse: fared bak 0 (FUIITSU MHY200H)isse: fared bak 0 (FUIITSU MHY	Review the changes On this page you can review the changes that have been made.								
Basic Hard Dak 0 (FUIITSU MHY2080BH)         Vorme (F): FAT2- gained 155 GB         Sos dare changes: 24.4 GB, free gaoce: 24.4 GB         Sos dare change	Your hard disk before the changes:								
Your hard disk after the changes:         Image: Basic Hard Disk. 0 (FULITSU MHY2080BH)         Image: Start	Basic Hard Disk 0 (FLUITSU MHV2080BH)								
Basic Hard Disk 0 (FUJITSU MHV2080BH)       ● (F)         ● (F)       ● (F)         ● (F)       ● (F)         Size bfore change: 24.4 GB.       ● (E)         Size after change: 33.9 GB. free space: 33.9 GB.       ● (E)         To accept the changes, click Next       ● (E)         ● (Back   Mext) Cancel       ● (	Your hard disk after the changes:								
CParted Edit View Device Partition Help     CParted Edit View Device Partition Help     CParted Edit View Device Partition Help     (dev/sdb1     1.95 TiB     Device Information     (dev/sdb1     0.00 CiB     Device Information     (dev/sdb1     Device Information     (devised Pointer     (devised Pointer     (devised Pointer     (devised Pointer     (devised Pointer     (devised Pointer	Basic Hard Disk 0 (FUJITSU MHV2080BH)	🛇 🖨 🕘 /dev/sdb - GParted							
Volume (F), FAT32 - gained 15.5 GB Size after changes: 24.4 GB, free space: 23.9 GB To accept the changes, click Next	(F:) 27.9 GB NTFS 39.9 GB FAT32	GParted Edit View Device Partition Help           Image: Operation of the state of							
Device Information Size after changes: 39.9 GB, free space: 39.9 GB To accept the changes, click Next	Volume (F:), FAT32 - gained 15.5 GB	/dev/sdb1 1.95 TiB							
To accept the changes, click Next CBack Next> Cancel Size: 1.95 TiB Path: /dev/sdb Partition table: msdos Heads: 255 Sector size: 512 Partition table: msdos Heads: 255 Sector size: 512 Minimum size: 3073 MiB Maximum size: 20479 Free space preceding (MiB): 626688 © Free space preceding (MiB): 1421311 © Align to: MiB ©	Size after changes: 39.9 GB, free space: 39.9 GB	Device Information	Partition	File System	Label	Size	Used	Unused	
✓ Back Next> Cancel Partition table: msdos Editadis: 255 Sectors/track: 63 Cylinders: 261083 Codal sectors: 4194304000 Sector size: 512 Minimum size: 3073 MiB Maximum size: 20479 Free space preceding (MiB): 1421311 I Shrink /dev/sda2 from 39.90 GiB to 17.08 GiB	Fo accept the changes, click Next	Size: 1.95 TiB Path: /dev/sdb	/dev/sdb1 unallocated	unallocated	New Volume	1.95 TiB 2.00 MiB	3.00 GiB	1.95 TiB	
> Shrink /dev/sda2 from 39.90 GiB to 17.08 GiB     Align to:     MiB       Cancel	Figure 65: Partition Commander	Partition table: msdos Heads: 255 Sectors/track: 63 Cylinders: 261083 Total sectors: 4194304000 Sector size: 512		Resize/Move / Minimur F	dev/sdb1	Maximur ling (MiB): [ ing (MiP))	m size: 204799 2 626688 1421211	99 MiB	
		Shrink /dev/sda2 from 39.90 GiB to 17.0	D8 GIB	A	Align to:		MiB ‡	<mark>≫</mark> Resize/M	M
1 operation pending		1 operation pending							

#### Figure 66: GParted in action