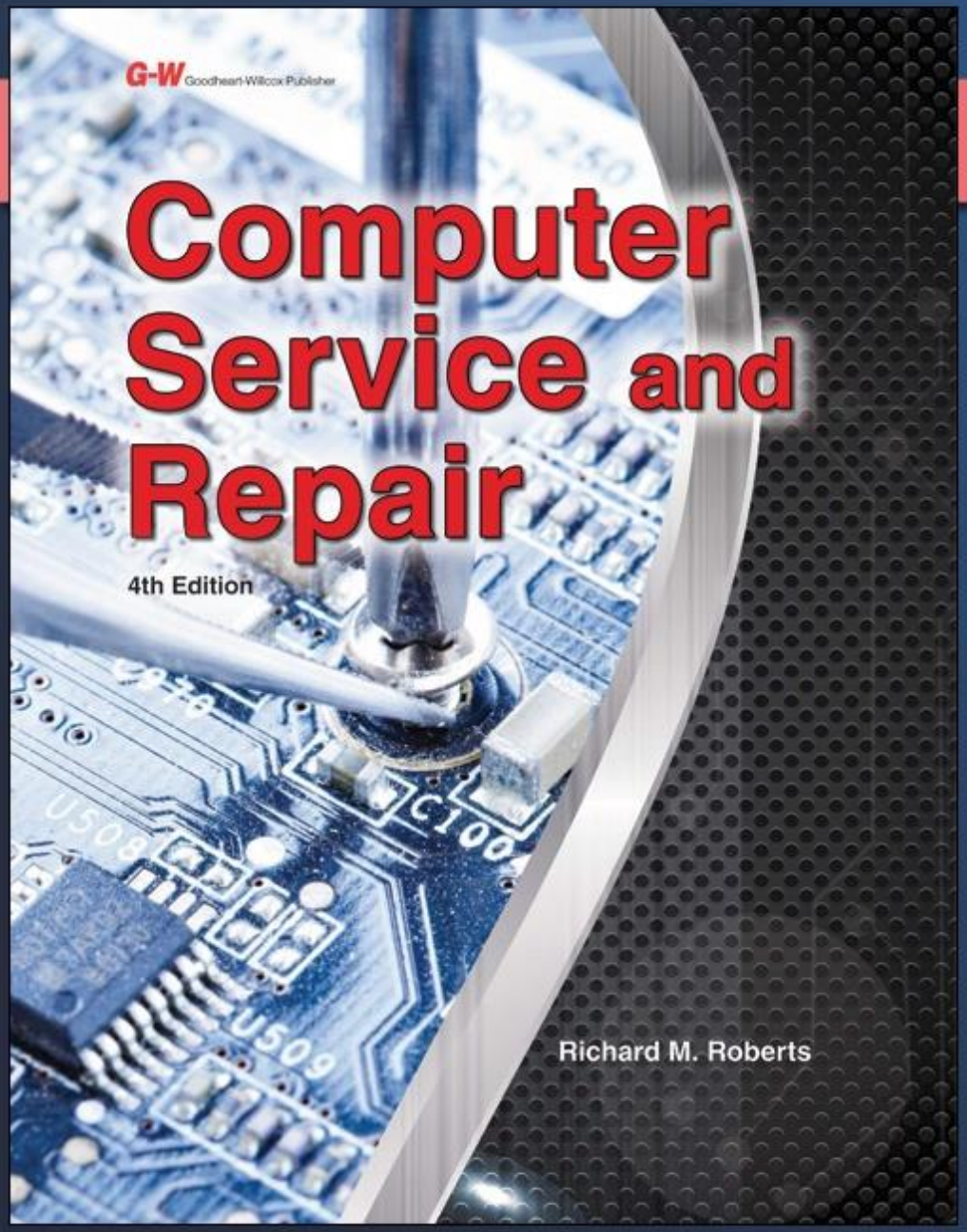

Presentations for PowerPoint

Computer Service and Repair

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Chapter

9

Magnetic and Solid-State Storage Devices

Objectives

- Explain how magnetic principles are applied to data storage.
- Explain disk geometry.
- Identify disk partition systems.
- Recall common file systems and their characteristics.
- Use Disk Defragmenter and Chkdsk.
- Carry out a PATA, a SATA, and an eSATA hard drive installation.
- Compare SAS and SCSI technologies.

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Objectives (Continued)

- Recall the uses of Solid-State Drives and their advantages over disk and disc storage devices.
- Use Computer Management to create a Virtual Hard Disk.

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Key Terms

- active partition
- actuator arm
- AT Attachment (ATA)
- basic disk
- benchmark tests
- cluster
- cylinder
- defragment
- disk signature
- dynamic disk
- EFI System Partition (ESP)
- encrypted file system (EFS)
- Enhanced Integrated Drive Electronics (EIDE)
- extended file allocation table (exFAT)

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Key Terms (Continued)

- FAT16
- FAT32
- floppy disk
- floppy disk drive
- GUID Partition Table (GPT)
- high-level format
- Integrated Drive Electronics (IDE)
- interleave factor
- logical drive
- logical unit number (LUN)
- low-level format
- Master Boot Record (MBR)
- Microsoft Reserved Partition (MSR)

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Key Terms (Continued)

- multiple zone recording (MZR)
- New Technology File System (NTFS)
- parallel ATA (PATA)
- primary partition
- proprietary recovery partition
- protective MBR
- read/write head
- Resilient File System (ReFS)
- SCSI ID number
- sector
- Serial ATA (SATA)
- Serial Attached SCSI (SAS)
- Small Computer System Interface (SCSI)

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Key Terms (Continued)

- solid-state disc caching
- Solid-State Drive (SSD)
- tracks
- virtual file allocation table (VFAT)
- Virtual Hard Disk (VHD)
- volume mount points

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Magnetic Storage Devices

- Magnetism is used to record data.
- Magnetic storage devices include three types of drives.
  - Hard drives
  - Floppy drives
  - Tape drive systems

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Magnetic Storage Devices (Continued)

- Electromagnetic principles
  - Electromagnetic principles allow hard drives and floppy disks to store volumes of data.
    - Converting data into magnetic patterns
      - Data can be stored on a magnetic disk or tape.
      - The **read/write head** is the mechanism that records information to and reads information from a magnetic medium.
    - Converting magnetic patterns into data
      - An electric signal is generated from the magnetic patterns.

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Magnetic Storage Devices (Continued)

- Hard disk drive
  - Hard disk drive consists of several platters in a stack.
  - Filters are used to catch particles produced during normal read/write operations.
  - An **actuator arm** is a device that moves the head over the disk.

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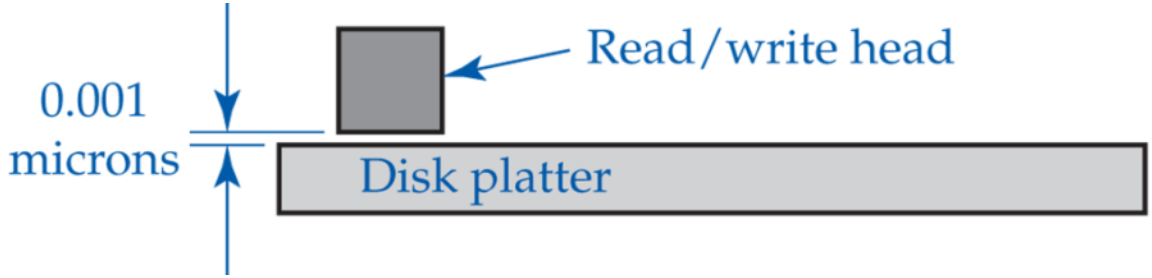
Magnetic Storage Devices (Continued)



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The read/write heads float just above the spinning disk of a hard drive.

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Magnetic Storage Devices (Continued)

- Floppy disk and drive
  - A **floppy disk** is a soft magnetic disk used for storing small to moderate amounts of information.
  - Floppy disks are rarely used today.
  - Data is stored on removable diskettes.
  - **Floppy disk drives** read and write to floppy disks and are almost completely obsolete.

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Magnetic Storage Devices (Continued)

- Tape drive
  - Earliest removable storage media used was the tape drive.
  - Read/write head transfers data to and from the tape.
  - Data is stored on the tape as a long series of magnetic pulses.

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Magnetic Storage Devices (Continued)

Typical Tape Drive

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Review

The magnetic polarity produced by a conductor is directly related to the direction of _____ through the wire.

current

The magnetic patterns left on a disk represent _____ numbers.

binary

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Disk Geometry

- Surface of the disk is divided into sections used as storage areas for data.
- **Tracks** are a set of concentric circles where data is stored on a disk.
- The tracks are subdivided into physical sections called **sectors.**
- **Cluster**, also referred to as *allocation units,* describes file storage space and usually consists of one or more sectors. The smallest sector or cluster size is 512 bytes.

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Disk Geometry (Continued)

- A **cylinder** is a vertical collection of one set of tracks. There is one cylinder for every stack of tracks.
- The **GUID Partition Table (GPT**) is an area of the hard disk containing information about the disk partition and the type of storage media used.
  - Contains information about bytes per sector, sectors per cluster, and number of tracks, etc.
  - Located as a hidden, protected area in each partition.

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Disk Geometry (Continued)

- The **Master Boot Record (MBR)** is an area of the hard disk that contains information about the physical characteristics of the drive, the disk partitions, and the boot procedure.
  - Also referred to as the *boot sector.*
  - Located as a hidden protected area on the first sector.

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Disk Geometry (Continued)

- Disk geometry is created in three major steps.
  - Low-level format
  - Partitioning
  - Forming

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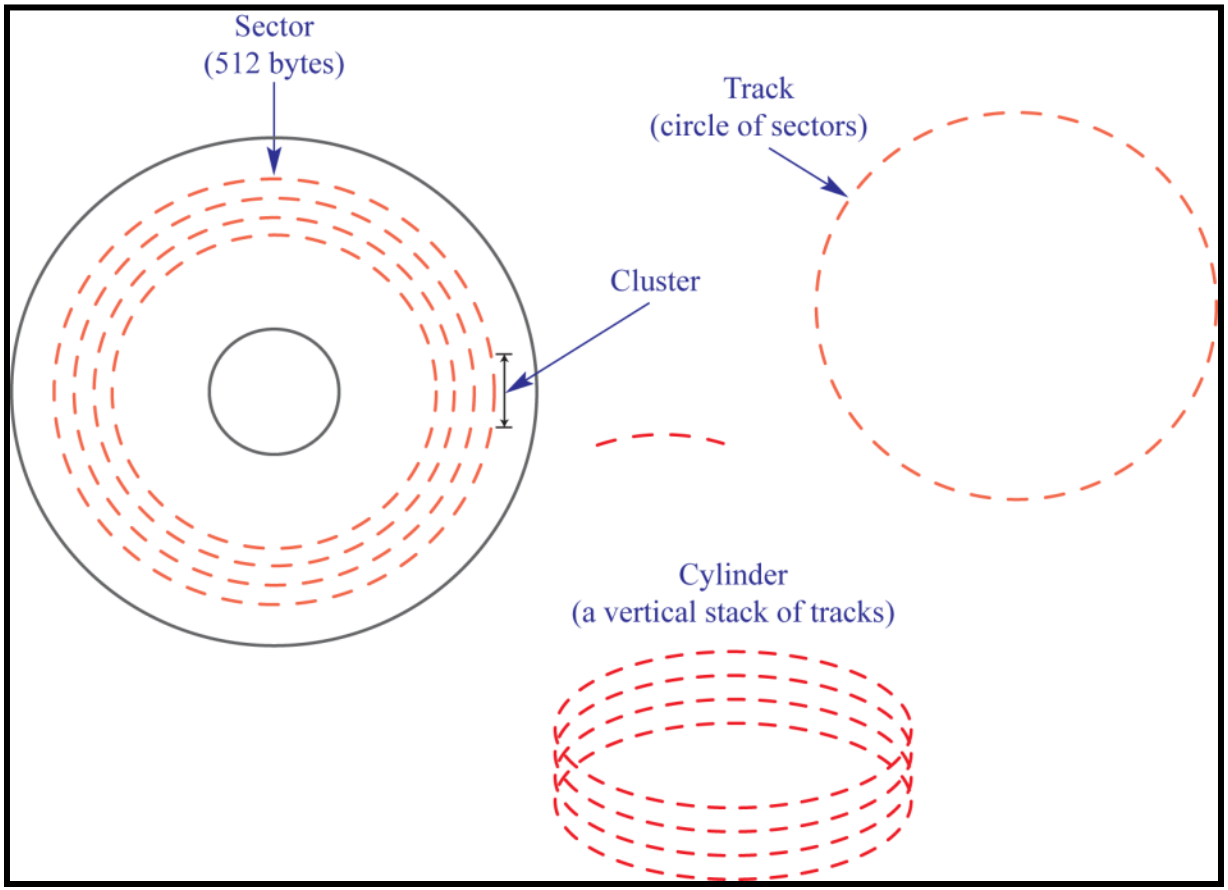
Disk Geometry (Continued)

Typical Disk Geometry



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Disk Geometry (Continued)

- Low-level format
  - The **low-level format** is a process that determines the type of encoding to be done on the disk platter and the sequence in which the read/write heads will access stored data.
    - **Interleave factor** describes the way the sectors are laid out on a disk surface.
    - Unique to each disk design.
    - Low level format arranges the locations of the sectors on the disks.

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Disk Geometry (Continued)

- **Multiple zone recording (MZR)**, also called *zone bit recording*, provides twice as many sectors in the outermost tracks as compared to the innermost tracks.

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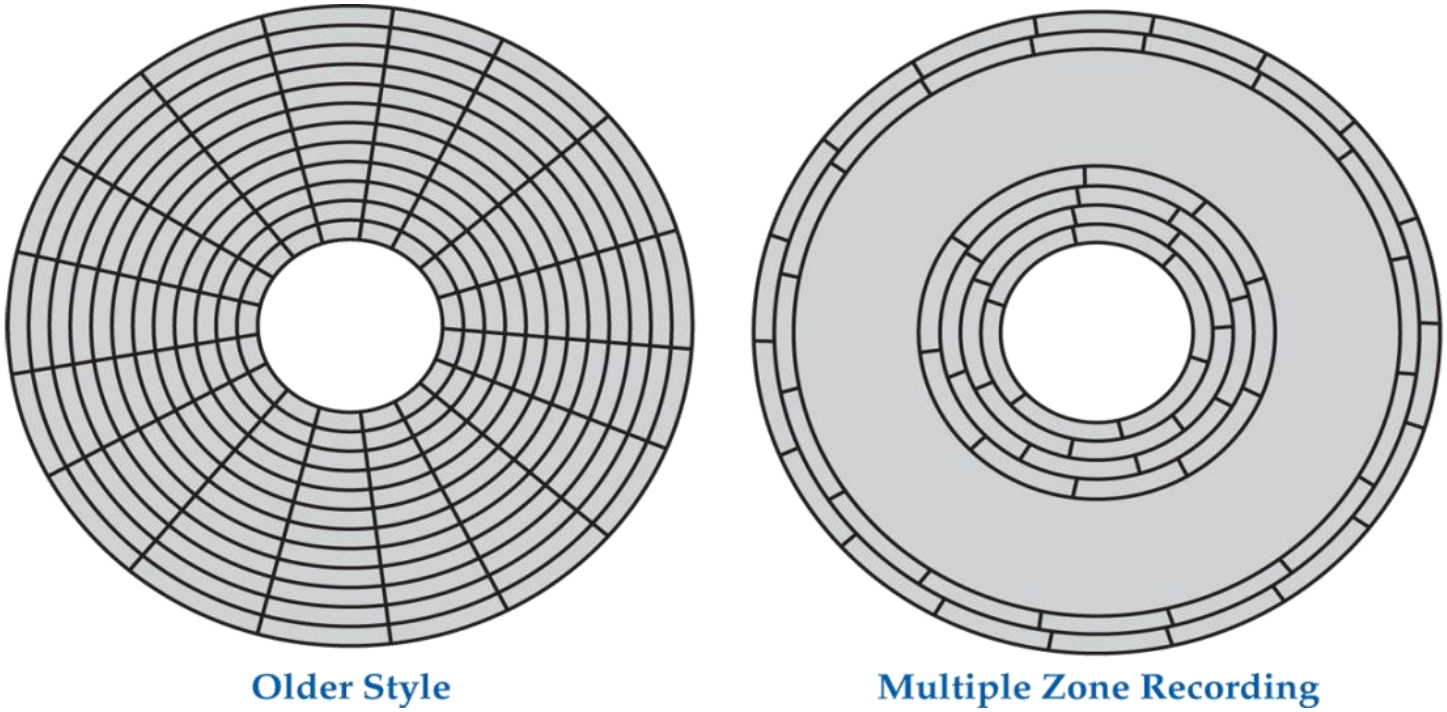
Disk Geometry (Continued)

Multiple Zone Recording Compared to Early Disk Drive



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Disk Partition Systems

- Hard drive partition systems have become complicated in recent years.
- There are several purposes for partitioning.
  - Install multiple operating systems
  - Separate file types, such as system management files and data files
  - Improve security of drives
  - Overcome operating system size limitations
  - Allow smaller cluster sizes to be used

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Disk Partition Systems (Continued)

- When a disk is partitioned, it is divided into separate storage areas often referred to as logic drives with one active partition.
  - A **logical drive** is not a physically separate drive, although, it appears to the user as a separate drive.
  - The **active partition** is the partition from which the operating system will boot.

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Disk Partition Systems (Continued)

- MBR partitions
  - MBR partition contains partition information and a small amount of executable code that starts the computer operating system.
  - Hard disk drives must contain at least one **primary partition**, which is used to contain the operating system, boot, and data files.
  - MBR-based hard drives can contain up to four primary partitions or three primary partitions and one extended partition.

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Disk Partition Systems (Continued)

- GPT partitions
  - GPT partitions can handle large hard disk drives better than MBR.
  - GPT partitions are designed to support hard disk drive storage sizes of up to 18 exabytes (EB).
  - Users may create 128 primary partitions on a disk system initialized with GPT.

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Disk Partition Systems (Continued)

- GPT partition arrangements
  - **EFI System Partition (ESP)** is a special area of the hard disk drive intended for use solely by the firmware, typically containing files and data required to boot the computer system; EFI stands for Extensible Firmware Interface.
  - **Microsoft Reserved Partition (MSR)**, or *System Reserved Partition*, is a partition on a data storage device and is required for GUID partition tables.

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Disk Partition Systems (Continued)

- GPT partition arrangements
  - Primary partition contains boot files and is created by the Microsoft operating system during the installation process.
  - **Proprietary recovery partition**, also known as *Original Equipment Manufacturers (OEM) partition*, is an optional partition created by the system's Original Equipment Manufacturer.

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Disk Partition Systems (Continued)

Possible Partition Arrangements

MBR	GPT
Supports a maximum of four primary partitions.	Supports a maximum of 128 primary partitions.
Can support a 2-TB partition size.	Can support an 18-EB partition size.
Has no backup partition table.	Has backup partition table.

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Disk Partition Systems (Continued)

- UEFI specification partition terminology
  - A guide for standardizing the way partitions are arranged and where files are stored.
  - **Protective MBR** is used to protect the GPT when legacy software tools are used to repair the MBR.
  - Contains the boot loader program.

UEFI Specification for Disk Partitions

Protective MBR	Primary GPT	EFI System Partition (ESP)	Partition	Partition	Partition	Backup GPT

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Disk Partition Systems (Continued)

- Initializing a disk
  - A hard drive must first be initialized before partitioning.
  - A **disk signature** identifies the disk type and properties.
  - Type of partition style is selected and created during initializing.

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Disk Partition Systems (Continued)

- Partitioning a disk can be done using utilities incorporated in modern operating systems.
- Utilities are accessed in one of two ways.
  - DiskPart command-line utility
  - Disk Management

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Disk Partition Systems (Continued)

- Partitioning a Disk
  - DiskPart Utility
    - Manages disk partitions and volumes from the command prompt.
    - More complex than Fdisk utility.
  - Disk Management
    - Located through the Computer Management feature.
    - Provides easy access to disk drives.
    - Allows information to be easily displayed about each drive and its partition.

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Review

What is the maximum number of primary partitions identified by a standard MBR-based hard disk drive?

Up to four primary partitions or three primary partitions and one extended partition.

What is the largest partition size supported by GPT?

18 EB

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File System Formats

- After a hard disk drive is partitioned, it must be formatted.
- File system formats
  - FAT16
  - FAT32
  - exFAT
  - NTFS
  - ReFS

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File System Formats (Continued)

- FAT16 and FAT32
  - **FAT 16** is a file system in which file storage information is recorded with 16 bits of data.
  - **FAT32** is a file system in which file storage information is recorded with 32 bits of data.
- **Virtual file allocation table (VFAT)** is a method of programming the FAT16 file system to allow long file capabilities similar to FAT32.
  - Used for operating systems prior to Windows 95 OSR2.
  - Total number of file names in the root directory is limited.

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File System Formats (Continued)

- The **extended file allocation table (exFAT)** is a proprietary Microsoft design for portable devices such as USB flash drives and flash memory cards.
  - Can be used to format external hard disk drives.
  - Extends the memory card capacity from 32 GB to 2TB.
  - The default file format for the Secure Digital Extended Capacity (SDXC) memory card, which is used in portable devices.

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File System Formats (Continued)

- **New Technology File System (NTFS)** is a file system found in Windows NT and Windows 2000.
  - Features improve security and storage capacity and are compatible with FAT16.
  - Supports its own file compression system.
  - Disk quotas can be set with NTFS.
  - Dynamic Disk is based on NTFS technology.

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File System Formats (Continued)

- New Technology File System (NTFS)
  - The **encrypted file system (EFS)** is the native encryption system used with NTFS.
  - NTFS supports its own file compression system.
  - Disk quotas can be set using NTFS.

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File System Formats (Continued)

- New Technology File System (NTFS)
  - **Dynamic disk** is an improved version of the NTFS file system.
    - **Basic disk** refers to the traditional FAT16, FAT32, exFAT, and NTFS file storage system.
    - **Volume mount points** allow a volume to be attached to a directory structure.
  - Storage Spaces is a feature that allows drives to be configured into a pool of storage devices.

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File System Formats (Continued)

- **Resilient File System (ReFS)** is a Microsoft file system with the capability to more likely recover after a major catastrophe such as a power outage or system failure.
  - ReFS is the newest Microsoft file system.
  - Maintains copies of the file contents on two or more disks.
  - Intended for use on a network server designed for data storage.

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File System Formats (Continued)

- Formatting a disk
  - A disk must be formatted before it can be used.
  - **High-level format** is a process used to prepare the disk for file storage.
  - Data can be recovered after a high-level format takes place.
  - The Disk Management tool is typically used.

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Disk and File Maintenance

- Two common tools are used to perform routine maintenance required on disk drives.
  - Disk Defragmenter
  - Chkdsk
- Before using the tools, the user must know how files become fragmented.

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Disk and File Maintenance (Continued)

- Disk Defragmenter
  - **Defragment** is the rearranging of clusters on the disk so each file is stored in consecutive clusters.
  - This feature can be scheduled by default but can be reconfigured.
- Chkdsk
  - Chkdsk checks and repairs the integrity of the file system on a hard drive.
  - Chkdsk will run as a GUI.

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Disk and File Maintenance (Continued)

- Performance measures
  - **Benchmark tests** are conducted to compare different hardware and software.
  - Hard drive performance is judged on such items as *access time, latency,* or *seek time*.
    - Refer to the amount of time taken to position the read/write head over the proper sector.
    - Measured in microseconds.
  - Data transfer rate is also a standard of measurement; measured in megabytes per second (MBps).

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Review

What is the purpose of Disk Defragmenter?

To defragment files, or to organize file clusters in sequential order.

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PATA and SATA Hard Disk Interface

- **AT Attachment (ATA)** is the standard for disk drive interface that integrates the controller into the disk drive.
- **Parallel ATA (PATA)** is an interface standard for the connection of storage devices. PATA is in use today and is referred to as *IDE or EIDE.*
- **Integrated Drive Electronics (IDE)** was an early standard for a disk drive interface that integrated the controller into the disk drive.

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PATA and SATA Hard Disk Interface (Continued)

- **Enhanced Integrated Drive Electronics (EIDE)** is a term introduced by the Western Digital Corporation to describe hard drives that originally used ATA standard known as *ATA-2, Fast ATA,* or *Fast* ATA-2.
- **Serial ATA (SATA)** is an interface standard developed to overcome the limitations of the ATA drive.

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PATA and SATA Hard Disk Interface (Continued)

- PATA drive installation
  - Two hard drives are connected to the motherboard.
  - Jumper settings are required.
- SATA drive installation
  - Cable connectors are keyed.
  - SATA drive installation includes two sets of connectors: power and data.

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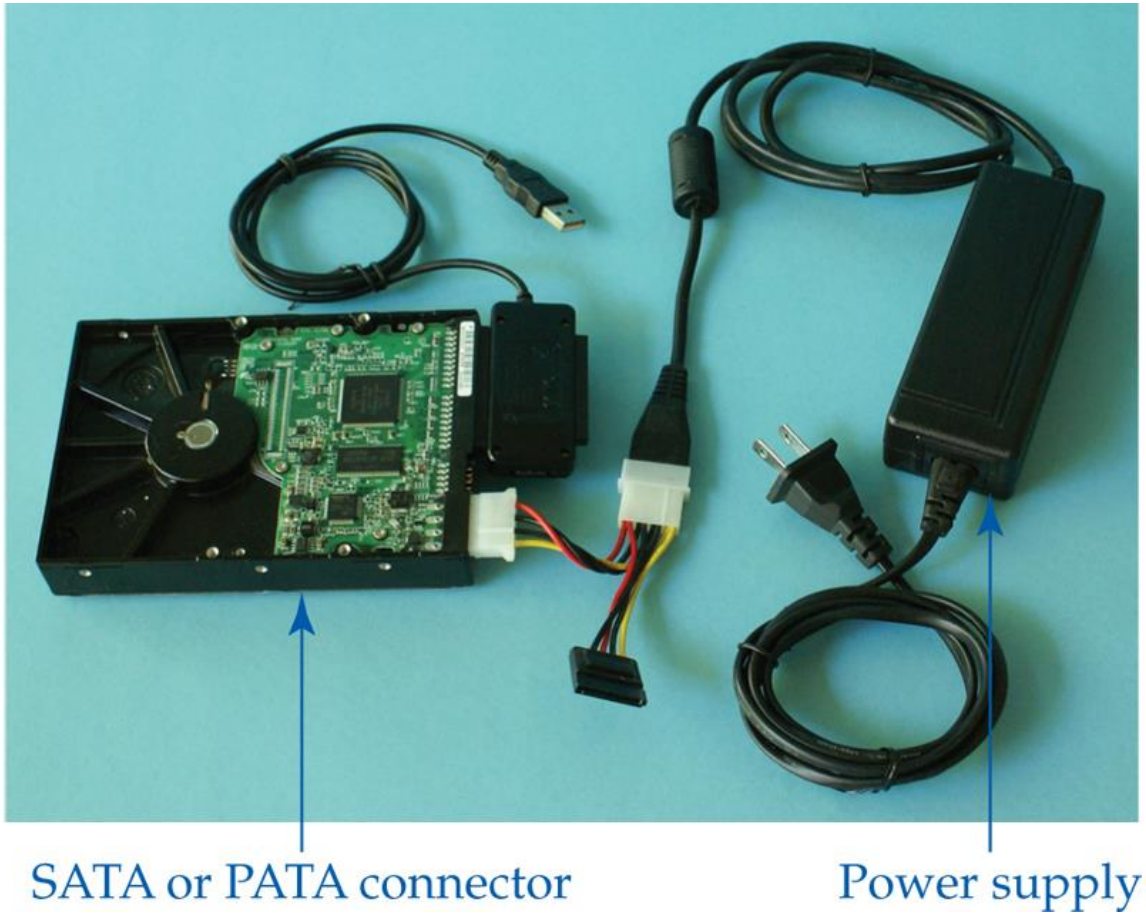
PATA and SATA Hard Disk Interface (Continued)

SATA/PATA External Adapter



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PATA and SATA Hard Disk Interface (Continued)

- eSATA drive installation
  - eSATA can be connected through SATA bays.
  - An adapter kit allows for drive to be connected to an external USB port.

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SCSI Interface System

- **Small Computer System Interface (SCSI)** is the standard system used by Macintosh/Apple and many UNIX mainframe systems to connect peripherals.
  - SCSI was developed to remedy compatibility problems.
  - SCSI is designed to free the CPS from processing all data transactions.
  - Many SCSI systems are not compatible with each other.

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SCSI Interface System (Continued)

- Advantages of SCSI
  - It can be connected inside or outside the computer.
  - It can disconnect communication between devices when needed.
  - Equipment can be easily exchanged.
- SCSI ID
  - SCSI devices must have a unique **SCSI ID number**, which is used to identify that device.
  - The ID range for typical SCSI-1 is from *0 to 7*.
  - Additional devices are identified using a **logical unit number (LUN)** between *0* to *7*.

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SCSI Interface System (Continued)

- SCSI ID jumpers
  - Older SCSI systems used jumpers to identify devices.
  - Jumpers are used to make an electrical connection across a pair of pins.
  - Jumpers are set in the binary pattern that represents the SCSI ID number.
- SCSI commands and terminology
  - Commands are used to control the flow of data and the communications between targets and initiators.
  - Nine special control signals are used in a SCSI system.

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SCSI Interface System (Continued)

- SCSI cable
  - SCSI cable is designed in many variations.
  - Differentials are single-ended or double-ended.
- SCSI termination
  - Cable termination is classified as either passive or active.
  - Each end of cable must be terminated immediately after the last device on the end of the cable.

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SCSI Interface System (Continued)

- SCSI bus operation
  - Control can only be attempted while there is no active BSY or SEL signal on the bus.
  - The device that has control is the *initiator*.
  - The *arbitration phase* is when a device attempted to take control of the bus; the *selection phase* is when the device has taken control and identifies the target device.
- **Serial Attached SCSI** is the latest development for SCSI technology.

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Solid-State Drives

- A **Solid-State Drive (SSD)** uses flash memory chips in place of disks for storage.
  - SSDs transfer data quicker than disk storage.
  - SSDs are commonly found in portable computers.
  - SSDs are quicker than traditional hard drives and can be used to augment the hard drive system in desktop computers.
- When the SSD is used as a temporary storage location for frequently accessed files or programs, it is referred to as **solid-state disc caching**.

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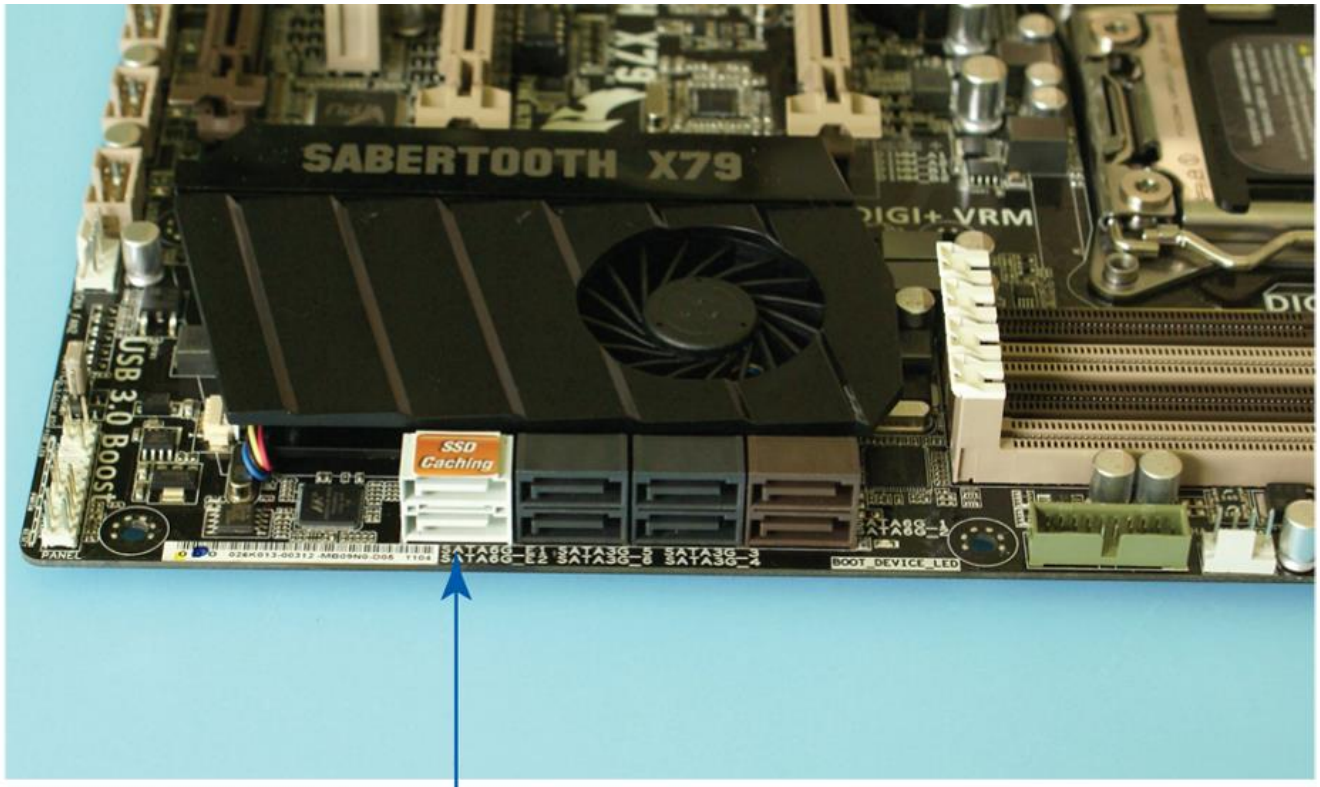
Solid-State Drives (Continued)

Motherboard that Supports SSD Caching



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SSD Caching port

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Virtual Hard Disk

- A **Virtual Hard Disk (VHD)** is a file that behaves exactly like a physical hard disk.
  - A VHD is used as backup location for the existing operating system.
  - A VHD is used to run another operating system.
  - A VHD is used to test a new operating system.

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Review

What Windows utility is used to create a VHD?

Disk Management in Computer Management or the MMC.

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