Chapter 8 - Supporting Hard Drives

- Inside a Hard Drive
- Hard disk drive (HDD) or hard drive sizes
  - 2.5" size for laptop computers
  - 3.5" size for desktops
  - 1.8" size for low-end laptops, other equipment
- Hardware technologies inside the drive
  - Solid state or magnetic
- Support technicians need to know about:
  - Solid state and magnetic technologies
  - Data organization inside a hard drive
- Solid State, Magnetic, and Hybrid Drives
- Solid state drive (SSD) or solid state device (SSD)
  - No moving parts
  - Built using nonvolatile flash memory
  - Expensive technology
- Magnetic hard drive
  - One, two, or more platters, or disks
    - Stacked together, spinning in unison inside a sealed metal housing
    - Firmware controls data reading, writing and motherboard communication
- Hybrid hard drives use both technologies
- How Data Is Organized On a Hard Drive
- Hard drive disk surface divided into concentric circles (tracks)
  - Track divided into 512-byte segments (sector, record)
  - Cylinder
    - All tracks are the same distance from platters center
- Drive housing circuit board firmware responsibilities
  - Writing and reading data to tracks and sectors
  - Keeping track of data storage on the drive
- BIOS and OS
  - Use logical block addressing (LBA) to address all hard drive sectors
- Hard drive installation
  - Windows initializes and identifies drive as a basic disk
    - Writes Master Boot Record (MBR)
  - High-level formatting performed
    - Specifies partition size and file system used
  - Partition can be primary or extended
    - Extended can be divided into one or more logical drives
  - File system
    - Overall structure OS uses to name, store, organize files on a drive
- Primary and extended partition creation
  - When drive or OS is first installed
  - After existing partition becomes corrupted
    - Disk Management tool
- File system choices
Windows XP
- FAT32, NTFS
- exFAT if Service Packs 2 & 3 installed with download

Windows Vista with Service Pack 1 or later
- FAT32, NTFS, exFAT

Hard Drive Interface Standards
Current internal hard drives methods
- Parallel ATA (PATA), Serial ATA (SATA), SCSI

External hard drive methods
- External SATA (eSATA), SCSI, FireWire, USB, Fibre Channel
- The ATA Interface Standards

Define how hard drives and other drives interface with a computer system

Standards
- Developed by Technical Committee T13
- Published by American National Standards Institute (ANSI)

Categorized into two groups
- PATA: older, slower standard
- SATA: faster, newer standard

The ATA Interface Standards (cont’d.)
Parallel ATA or EIDE drive standards or Integrated Drive Electronics (IDE)
- Allows one or two IDE connectors on a motherboard
  - Each use 40-pin data cable
- Advanced Technology Attachment Packet Interface
  - Required by EIDE drives (e.g., CD or DVD)

Types of PATA ribbon cables
- Older cable
  - 40 pins and 40 wires
- 80-conductor IDE cable
  - 40 pins and 80 wires
- Maximum recommended length of either is 18 inches

Startup BIOS
- Autodetects drive and selects fastest mode that drive and BIOS support

Independent Device Timing
- Motherboard chipset feature
- Supported by most chipsets today
- Allows two hard drives to share same parallel ATA cable but use different standards
- Allows two drives to run at different speeds as long as motherboard supports them

Serial ATA standards
- Developed by a consortium of manufacturers
  - Serial ATA International Organization (SATA-IO)
- Uses serial data path rather than traditional parallel data path
- Advantages
  - Faster than PATA interfaces and used by all drive types
  - Multiple connectors are easy to configure
  - Supports hot-swapping (hot-plugging)
  - Internal cable length: up 1 meter
- Cable does not hinder airflow
  - Motherboard or expansion card can provide external SATA (eSATA) ports for external drives
  - External SATA (eSATA)
    - Up to six times faster than USB or FireWire
    - eSATA drives use special external shielded serial ATA cable up to 2 meters long
- Purchasing considerations
  - SATA standards for the drive and motherboard need to match for optimum speed
  - If no match, system runs at the slower speed

- SCSI Technology
- Small Computer System Interface standards
  - System bus to peripheral device communication
  - Support either 7 or 15 devices (standard dependent)
  - Provides better performance than ATA standards
- SCSI subsystem
  - SCSI controller types: embedded or host adapter
  - Host adapter supports internal and external devices
  - Daisy chain: combination of host adapter and devices
  - Each device on bus assigned SCSI ID (0 - 15)
  - A physical device can embed multiple logical devices
- Terminating resistor
  - Plugged into last device at end of the chain
  - Reduces electrical noise or interference on the cable
- Various SCSI standards
  - SCSI-1, SCSI-2, and SCSI-3
    - Also known as regular SCSI, Fast SCSI, Ultra SCSI
  - Serial attached SCSI (SAS)
    - Allows for more than 15 devices on single chain
    - Uses smaller, longer, round cables
    - Uses smaller hard drive form factors, larger capacities
    - Compatible with serial ATA
- Fibre channel SCSI technology
- Advantages
  - Connects up to 126 devices on a single Fibre Channel bus
  - Faster than other SCSI implementations when more than five hard drives strung together
- Disadvantage
  - Expensive and has too much overhead
    - Except when used in high-end server solutions
- RAID: Hard Drives Working Together
- Two or more hard drives work together as an array of drives
  - Improves fault tolerance
  - Improves performance
- Most common RAID levels
  - RAID 0, RAID 1, RAID 5
- Spanning or JBOD (Just a Bunch of Disks)
  - Two hard drives configured as a single volume
- RAID is accomplished using hardware or software
• About Floppy Drives
  • Floppy disk drive (FDD)
    – Holds only 1.44 MB of data
    – Some still used today
    – Advantages
      • Useful when recovering from a failed BIOS update
      • Inexpensive and easy for transferring small amounts of data

• Floppy Drive Hardware
  • Past floppy drives sizes: 5 ¼” and 3 ½”
    – 3 ½” floppy disk format
      • High density (1.44 MB), extra-high density (2.88 MB), double density (720 K)
    – Floppy drive subsystem
      • Floppy drive, ribbon cable, power cable, connections
      • Today’s floppy drive cables have a connector at each end to accommodate a single drive
      • Older cables have an extra connector or two in the middle of the cable for a second floppy drive

• Selecting a Hard Drive
  • BIOS uses autodetection to prepare the device
    – Drive capacity and configuration selected
    – Best possible ATA standard becomes part of configuration
  • Selected device may not be supported by BIOS
    – Troubleshooting tasks (if device not recognized)
      • Flash the BIOS
      • Replace controller card
      • Replace motherboard

• Considerations:
  – Drive capacity
  – Spindle speed
  – Interface standard
  – Cache or buffer size
  – Average seek time (time to fetch data)
  – Hybrid drive
  – Manufacturer warranty (keep receipt)
  – Price range

• Steps to Install a Serial ATA Drive
  • Step 1: Prepare for installation
  • Step 2: Install the drive
    – Turn off the computer and unplug it
    – Decide which bay will hold the drive
    – Slide drive in the bay and secure it (both sides)
    – Use correct motherboard serial ATA connector
    – Connect a SATA or 4-pin power connector from the power supply to the drive
    – Check all connections and power up the system
    – Verify drive recognized correctly
  • Step 3: Use Windows to partition and format the drive
- Boot from Windows setup CD or DVD
  - Follow directions on the screen to install Windows on the new drive
- If installing a second hard drive with Windows installed on first drive use Windows to partition and format the second drive

• Installing a SATA drive in a removable bay
  - Turn handle on each locking device counterclockwise to remove it
  - Slide the bay to the front and out of the case
  - Insert hard drive in the bay
    - Use two screws on each side to anchor the drive in the bay
  - Slide the bay back into the case
  - Reinstall the locking pins

• Steps to Configure and Install a Parallel ATA Drive

• Configurations for four EIDE devices in a system:
  - Primary IDE channel, master device
  - Primary IDE channel, slave device
  - Secondary IDE channel, master device
  - Secondary IDE channel, slave device

• Master or slave designations are made by:
  - Setting jumpers or DIP switches
  - Use special cable-select data cable
  - Color-coded connectors
    - Blue end connects to motherboard; black end connects to drive

• Motherboard color-coding
  - Primary channel connector: blue
  - Secondary channel connector: black
  - Ensures ATA/66/100/133 hard drive installed on the primary IDE channel

• Step 1: Open case, decide how to configure drives
• Step 2: Set the jumpers on the drive
• Step 3: Mount the drive in the bay
  - Remove bay from case and insert hard drive in bay
  - Securely mount drive in the bay
  - Decide whether to connect data cable before or after inserting bay inside the computer case
  - Place bay back into position, secure bay with screws
  - Install a power connection to each drive
  - Connect data cable to motherboard IDE connector
  - Connect hard drive light wiring if necessary
  - Before replacing case cover verify installation

• Installing a Hard Drive in a Wide Bay
• Use universal bay kit to securely fit drive into the bay
• How to Implement Hardware Raid
• Hardware implementation
  - Motherboard RAID controller or RAID controller card
    - Motherboard does the work, Windows unaware of hardware RAID implementation
• Software implementation uses operating system
• Best RAID performance
  - All hard drives in an array should be identical in brand, size, speed, other features
- If Windows installed on a RAID hard drive RAID must be implemented before Windows installed
- Steps to Install a Floppy Drive
  - Turn off the computer, unplug power cord, press power button, and remove cover
  - Unplug power cable and data cable from old drive
  - Unscrew and dismount drive
  - Slide new drive into the bay
    - Screw new drive down with the same screws
- Connect floppy drive data cable to motherboard
- Connect data cable and power cord to the drive
- Replace cover, turn on computer, and enter BIOS setup to verify installation
- Troubleshooting Hard Drives
  - Problems:
    - With hard drive installations
    - Occurring after the installation with hard drives and floppy drives
    - With booting the PC
      - Caused by hard drive hardware
  - Problems with Hard Drive Installations
    - BIOS setup does not reflect new hard drive
      - Enable autodetection and reboot system
    - “Hard drive not found”
      - Reseat data cable and reboot PC
    - POST beeped three times and stopped
      - Reseat memory modules and boot again
    - “No boot device available”
      - Insert bootable disk and reboot PC
    - “Hard drive not present”
      - Restore jumpers to original state
  - If BIOS setup does not recognize newly installed hard drive:
    - Has BIOS setup been correctly configured for autodetection?
    - Are jumpers on the drive set correctly?
    - Power cord and data cable properly connected?
      - Verify solid connection both ends
    - Check drive manufacturer web site for suggestions
      - Look for diagnostic software downloadable from manufacturer web site
  - How to Approach a Hard Drive Problem after the Installation
    - Some post-installation problems
      - Corrupted data files
      - Corrupted Windows installation
      - Hardware issue preventing system from booting
    - Preparation steps
      - Start with end user: conduct an interview
      - Prioritize what has been learned
        - Example: make data backup a first priority
      - Be aware of available resources
        - Documentation, Internet, software tools, technical support
  - Boot Problems Caused By Hard Drive Hardware
• Causes of problems present during boot:
  – Hard drive subsystem
  – Partition table
  – File system on the drive
  – Files required for the OS to boot
• Problems at POST
  – Caused by drive, data cable, electrical system, motherboard, controller card (if one is present), or loose connection
• Problems at POST, checks:
  – BIOS manufacturer website for error code explanation
  – BIOS utility RAID utility
  – BIOS setup: ability to disable block mode
  – Remove and reattach all drive cables
    • Check for correct pin-1 orientation
  – Remove and reseat controller card
  – Check drive jumper settings
  – Inspect drive for damage
  – Determine if the hard drive is spinning
  – Check cable for frayed edges or other damage
  – Check the installation manual
  – Be sure power cable, drive data cable connections are good
  – Check BIOS setup for errors in the hard drive configuration
  – Try booting from another media
  – Check drive manufacturer Web site for diagnostic software
  – Create a boot CD with hard drive diagnostic software
  – Exchange three field replaceable units
    • Data cable, adapter card (optional), hard drive
  – If hard drive refuses to work but its light stays
    • Problem might be a faulty controller
• Bumps are bad
  – A scratched surface may cause a hard drive crash
  – Data may be recovered, even if drive is inaccessible
• Invalid drive or drive specification
  – System BIOS cannot read partition table information
  – Boot from recovery CD and check partition table
• Bad sector errors
  – Problem due to fading tracks and sectors
    • Replace the drive
• Solid state drives
  – No concerns with bumping the drive while it is in use
  – May or may not need formatting
  – If drive gives errors:
    • Try using manufacturer diagnostic software
    • Check manufacturer Web site support section for troubleshooting tips
  – SATA and PATA connections and BIOS settings for solid state drives
    • Look and work the same as for other drives
• Troubleshooting Floppy Drives and Disks
• Summary
• Hardware technologies inside the drive
  – Solid state or magnetic
• Hard drive disk surface divided into concentric circles (tracks)
  – Track divided into 512-byte segments (sector, record)
• Current internal hard drives methods
  – Parallel ATA (PATA), Serial ATA (SATA), SCSI
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• Summary (cont’d.)
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  – Improves fault tolerance and performance
• Floppy disk drive (FDD) holds only 1.44 MB of data
  – Useful when recovering from a failed BIOS update
  – Inexpensive, easy transfer of small data amounts
• Hard drive must match OS and motherboard
  – BIOS uses autodetection to prepare the device
• Installing a hard drive
  – Usually not difficult, keep a cool head