CompTIA A+ (220-1101) Day 5

Storage Devices - Section 3.3

Hard Disk Drives (HDD)

- Consist of a read/write head, platter, and spindle
- Store magnetically encoded data on spinning platters
- Performance indicator: rotational speed

RPM	Average Latency
5,400	5.5 ms
7,200	4.2 ms
10,000	3.0 ms
15,000	2.0 ms

Hard Drive Form Factors

- **3.5-inch HDDs:**
  - Larger (desktop)
  - Higher power consumption
  - Support higher spin speeds
  - More gigabytes per dollar
- **2.5-inch HDDs:**
  - Smaller (laptop)
  - Lower power consumption
  - Lower spin speeds
  - Fewer gigabytes per dollar

Solid-State Drives (SSD)

- Use flash memory
- Store data in arrays of chips
- No moving parts
- Communication methods:
  - SATA
  - NVMe/PCIe
- Physical connectors:
  - M.2
  - SATA and mSATA

Benefits of SSDs

- No moving parts:
  - Consume less electricity
  - More durable and shock-resistant
  - Faster access times
  - Fragmentation is not an issue
- Flexible form factors:
  - 2.5"
  - mSATA and NVMe
  - PCIe slot

Redundant Array of Independent Disks (RAID)

- Combines multiple drives for redundancy or speed
- Operations used:
  - **Mirroring:** Identical data on multiple disks (resilience)
  - **Striping:** Data distributed across multiple disks (speed)
  - **Parity:** Extra data allows recovery from disk failure (resilience)

RAID Levels to Know:

- **RAID 0 (Striping only):**
  - Data striped across two or more disks
  - High performance
  - Full capacity available
  - No resilience — one disk failure loses all data
- **RAID 1 (Mirroring only):**
  - Data mirrored across two or more disks
  - High resilience — can lose all but one disk
  - Capacity loss
- **RAID 5 (Striping + Parity):**
  - Data striped across three or more disks
  - Balance of capacity and resilience
  - Reduced available capacity
  - Can survive one disk failure
  - *Minimum three drives*
- **RAID 10 (RAID 1+0):**
  - Two RAID 1 sub-arrays combined into a parent RAID 0 array
  - Provides both performance and resilience
  - Significant capacity loss

Flash Drives and Memory Cards

- USB flash drives: most common removable storage
- Memory cards used in cameras and phones:
    - SD (32.0mm x 24.0mm)
    - MiniSD (21.5mm x 20.0mm)
    - MicroSD (11.0mm x 15.0mm)
    - CompactFlash (CF)

Optical Media

- Use lasers to read microscopic features
- Common formats:
    - CDs
    - DVDs
    - Blu-ray Discs (BD)

Media	Capacity
Compact Disc (CD)	700 MB
DVD (Single-sided, single-layer)	4.7 GB
DVD (Single-sided, dual-layer)	8.5 GB
Blu-ray (Single-layer)	25 GB
Blu-ray (Dual-layer)	50 GB
Blu-ray (Triple-layer, BD-XL)	100 GB
Blu-ray (Quad-layer, BD-XL)	128 GB

Storage Devices - Section 3.4

Motherboards

- Provide interconnections and communication channels between computer components
- The form factor dictates the dimensions and capabilities of a motherboard

Motherboard types:

- Used in the following devices:
  - Desktop
  - Server/multisocket
  - Mobile device
- Comes in three form factors:
  - ATX (12" x 9.6")
  - Micro-ATX (9.6" x 9.6")
  - Mini-ITX (6.7" x 6.7")

CPU Sockets (Usually has a lever attached to plate that needs to be removed before installation)

- Pin Grid Array (PGA) sockets place the pins on the CPU, with corresponding holes in the CPU socket. Often used by AMD.
- Land Grid Array (LGA) sockets place the pins on the motherboard, with corresponding contact pads on the CPU. Often used by Intel.

Motherboard Connectors

- CPU socket
- RAM Slots
- M.2 Connectors (Slides in at an angle and usually is secured by a screw.)
  - M – These connectors have two slots and are typically used for SATA or PCIe x2 SSDs (Solid State Drives).
  - B – These connectors have one slot and are typically used for PCIe x4 or NVMe (Non-Volatile Memory Express) SSDs
- PCIe Slot
  - PCI vs PCIe:
    - PCI is older and comes in two voltages:
      - 3 Volts
      - 5 Volts
    - PCI Express:
      - Number of Lanes: x1, x4, x8, x16

PCIe Version	Throughput per lane	Example of x16 lanes
PCIe v1	250MBps	4GBps
PCIe v2	500MBps	8GBps
PCIe v3	1GBps	16GBps
PCIe v4	2GBps	32GBps
PCIe v5	4GBps	64GBps

Motherboard Connectors (continued)

- Power Slots:
  - 8-pin power connector
  - 24-pin power connector
- SATA (L-shape)
- Front Panel Headers (Control power buttons, lights, etc.)
- USB

Connectors visually seen on the back of the PC (attached to the motherboard):

- HDMI
- USB
- Thunderbolt
- NIC (RJ-45 connector)
- Audio
- Wi-Fi Antennae

BIOS and UEFI

BIOS – Basic Input/Output System

- Low-level firmware for booting and managing system components
- Increasingly legacy; being replaced by UEFI

UEFI – Unified Extensible Firmware Interface

- Supports drives larger than 2.2TB
- Modernized UI (Often)
- Faster boot process
- Secure boot process

BIOS and UEFI Options

- Boot options:
  - Boot order
  - One-time boot menu
- System password (Administrator/Supervisor password)
- Disable and enable USB ports
- Fan speeds (or fan curves)
- Trusted Platform Module (TPM):
  - Enable or Disable
  - Manage certificates, keys, and passwords
  - Used by Secure Boot and full-disk encryption (FDE) solutions

Hardware Security Modules (HSMs)

- Often PCIe-, USB-, or network-connected devices
- Store encryption information and perform cryptographic operations
- Commonly used to manage keys on servers

Architectures

X86 and x64 are both CISC (Complex Instruction Set Computer) architectures

x86

- Developed by Intel
- Key concern: only supports up to roughly 4GB of RAM

x64

- Developed by AMD
- Supports up to 16 exabytes of RAM
- Backward compatible with x86 operating systems and applications

ARM and RISC

Advanced RISC Machine (ARM) is an implementation of reduced instruction set computer architecture

- Simpler: fewer specialized instruction sets
- Energy efficient

Widely Adopted:

- Smartphones (Android and iPhones)
- Laptops (e.g., Apple MacBook with M1 chips)
- Low-power devices like Raspberry Pis

CPU Cores

Single-core CPUs contain just one processing unit

- The illusion of multitasking is provided by dividing processing time among processes and rapidly rotating between them
- Legacy; non-performant

Multicore CPUs contain two or more processing units which can operate somewhat independently

- Most modern CPUs are multicore
- Allows OSs and applications to process multiple items concurrently

Multithreading

Multithreaded CPUs improve the utilization of individual cores with intelligent scheduling

- Hyperthreading (Intel)
- Simultaneous Multithreading or SMT (AMD)
- Not equivalent to multicore CPUs
- Both single-core and multicore CPUs may use multithreading

Expansion Cards

Expansion cards are dedicated purpose cards added to a computer for specific processing tasks

- Sound Cards – provide advanced audio encoding, surround sound, and other features
- Video Cards – provide accelerated 2D and 3D rendering and display ports
    - AMD Radeon
    - Nvidia GTX/RTX
- Capture Cards – can be used to record or stream video from common display interfaces
- Network Interface Cards (NICs) – frequently built into motherboards, but may also be added with discrete cards

Modern cards use PCIe; older cards may use PCI or AGP

Computer Cooling

- Case Fans – ensure heat generated within a computer case is exchanged with the surrounding environment
    - 120mm
    - 140mm
    - 180mm
        - Intake and exhaust fans should be placed to ensure consistent airflow across the components
- CPU Heatsinks:
    - Carry heat away from the CPU
    - Waste heat is conducted into metal fins
    - Airflow over the fins then transfers thermal energy to the air
    - Thermal paste is critical to efficiently transfer heat from the CPU
- Liquid Cooling:
    - A fluid is passed over components to absorb the heat, then flows through radiators to dissipate it
    - Can be:
        - More effective (depending on radiator size)
        - More silent (depending on fan speed)
        - More flexible (can cool CPU, GPU, RAM)
- Thermal paste fills microscopic imperfections that would otherwise create pockets of air

Power Supplies - Section 3.5

Power Supply Voltages

Power Supply Units (PSUs) transform high-voltage AC currents to lower-voltage DC currents

- Input voltages:
    - 110-120 VAC (North America)
    - 220-240 VAC (Europe)
- Output voltages:
    - 3.3 VDC (Volts Direct Current)
    - 5 VDC
    - 12 VDC

Power Supply Connectors

- **20, 20+4, or 24-pin ATX connector, 8-pin CPU/EPS connector, and 6+2 pin PCIe connector**
    - +4 may be optional depending on motherboard

Redundant Power Supplies

Many servers and some high-end workstations support dual PSUs

- Failover if a power supply dies
- Hot-swappable

Power Supply Modularity

- Non-modular power supplies have all cables permanently attached
- Semi-modular power supplies have some permanently attached and some removable cables
- Fully modular power supplies use only detachable cables

Power Supply Wattage

Considerations when determining wattage needs:

- It is critical to purchase a power supply for a system's wattage requirements
    - If a PSU can't supply enough wattage, the computer may randomly reboot during intensive workloads
    - Various online wattage calculators are available
    - Add up all components and get 20–30% more than required for future additions

Printer Configuration - Section 3.6

Unboxing and Placing Printers

1. Prepare a clean area to unbox and organize printer components
2. Consult the printer manual or quick start guide:
    - Printers often come with tape or stickers that must be removed before use
    - Many printers require toner or ink cartridges to be installed on setup
3. Place the printer in an appropriate location:
    - Away from liquids (short circuits)
    - Away from dust and debris (interferes with internal components)

Printer Drivers

The correct printer driver may be installed:

- Automatically
- By downloading from the vendor's support portal

Print Control Language (PCL) drivers:

- Widely supported
- Faster print processing
- Device dependent

PostScript:

- More consistent print quality
- Slower print processing
- Device independent
- Common on macOS devices

Printer Connectivity

- **USB**
  - Direct printer-to-computer connection
  - USB Type A (computer) to USB Type B (printer)
- **Ethernet**
  - Twisted-pair cable connection
  - IP address statically or dynamically assigned
  - Computers connect via IP to send print jobs
- **Wireless**
  - Wi-Fi is functionally similar to Ethernet
  - Bluetooth enables ad-hoc device pairing

Printer Shares and Print Servers

- Clients can share directly attached printers over a network
- Printer servers work similarly but are dedicated to the task

Common Configuration Settings

- Simplex: one-sided
- Duplex: two-sided
- Orientation: portrait or landscape
- Tray selection
- Quality settings: DPI, speed vs. quality

Printer Security Concepts

- **User Authentication**
  - Vendor-integrated authentication
  - Active Directory authentication
- **Badging** – user authentication via badge reader
- **Audit Logs** – tracks device events and user actions
- **Secure Print** – jobs held until user provides PIN/authentication

Network Scan Services

Many scanners and MFDs allow flexible scan delivery

- **Scan to email** – sends image to specified address
- **Scan to folder (SMB)** – sends file to network share
- **Cloud scan** – uploads to cloud provider
- Available features vary by make/model (check documentation!)

Scanner Concepts

- **Automatic Document Feeder (ADF)** – Paper passes over light and sensor
  - Smaller, more convenient
- **Flatbed Scanner** – Light and sensor pass under paper
  - Larger, requires more manual interaction