**I. What is a Network?**

* **Definition:** A network is a collection of interconnected devices (computers, smartphones, servers, etc.) that can communicate and share resources (data, printers, storage).
* **Purpose:** Networks enable communication, resource sharing, collaboration, and centralized management.

**II. Key Network Components:**

* **End Devices (Hosts):** Devices that users interact with directly (e.g., computers, laptops, smartphones, printers).
* **Network Devices (Intermediaries):** Devices that connect end devices and facilitate communication between them (e.g., routers, switches, firewalls).
* **Media:** The physical or wireless pathways that carry data (e.g., copper cables, fiber optic cables, radio waves).
* **Rules (Protocols):** Sets of agreed-upon standards that govern how devices communicate (e.g., TCP/IP, HTTP, DNS).

**III. Network Types:**

* **LAN (Local Area Network):** Connects devices within a limited area (e.g., home, office, school). High bandwidth, low latency.
* **WAN (Wide Area Network):** Connects LANs over a larger geographical area (e.g., the Internet). Lower bandwidth, higher latency than LANs.
* **MAN (Metropolitan Area Network):** Larger than a LAN but smaller than a WAN, often covering a city or region.
* **PAN (Personal Area Network):** Connects devices within a small personal area (e.g., Bluetooth connection between a phone and headphones).

**IV. Network Topologies:**

* **Bus:** All devices connected to a single cable. Simple but prone to collisions and single point of failure.
* **Star:** All devices connected to a central hub or switch. Most common topology, easy to troubleshoot.
* **Ring:** Devices connected in a closed loop. Less common today.
* **Mesh:** Multiple paths between devices. Highly redundant, used in critical environments.
* **Hybrid:** Combination of different topologies.

**V. Network Models:**

* **OSI (Open Systems Interconnection) Model:** A seven-layer model that describes how network communication occurs. Conceptual model, not implemented directly.
  + **Application (Layer 7):** Provides network services to applications (e.g., HTTP, SMTP).
  + **Presentation (Layer 6):** Handles data formatting and encryption.
  + **Session (Layer 5):** Manages communication sessions between applications.
  + **Transport (Layer 4):** Provides reliable or unreliable data delivery (e.g., TCP, UDP).
  + **Network (Layer 3):** Handles logical addressing (IP addresses) and routing.
  + **Data Link (Layer 2):** Handles physical addressing (MAC addresses) and frame formatting.
  + **Physical (Layer 1):** Defines the physical characteristics of the network media.
* **TCP/IP (Transmission Control Protocol/Internet Protocol) Model:** A four-layer model that is the foundation of the Internet. Practical model.
  + **Application (Layer 4):** Combines the functions of the OSI Application, Presentation, and Session layers.
  + **Transport (Layer 3):** Similar to the OSI Transport layer (TCP, UDP).
  + **Internet (Layer 2):** Similar to the OSI Network layer (IP).
  + **Network Interface (Layer 1):** Combines the functions of the OSI Data Link and Physical layers.

**VI. Encapsulation:** The process of adding header information to data as it moves down the protocol stack. Each layer adds its own header. Crucial for network communication.

**VII. Addressing:**

* **IP Address (Layer 3):** Logical address that identifies a device on a network (e.g., 192.168.1.1). Used for routing.
* **MAC Address (Layer 2):** Physical address that identifies a device on a network (e.g., aabb.cc00.1122). Used for communication within a LAN.

**VIII. Key Protocols:**

* **TCP (Transmission Control Protocol):** Reliable, connection-oriented protocol. Guarantees delivery of data.
* **UDP (User Datagram Protocol):** Unreliable, connectionless protocol. Faster than TCP, but does not guarantee delivery.
* **IP (Internet Protocol):** Responsible for routing packets across networks.
* **HTTP (Hypertext Transfer Protocol):** Used for web browsing.
* **DNS (Domain Name System):** Translates domain names (e.g., [google.com](https://www.google.com/search?q=google.com)) to IP addresses.

**Think of DNS as the "phone book" of the internet.** You look up a name (domain name) to find the number (IP address) to make a call (connect to a website).