**The OSI Model**

**Layer 7 – Application**

* **Role:** Closest to the user. Provides network services directly to applications.
* **Key Functions:**
  + Identify communication partners (who you’re talking to).
  + Provide user interfaces (HTTP requests, email apps).
  + Resource sharing (file transfer, email, remote logins).
* **Protocols/Examples:** HTTP, HTTPS, FTP, SMTP, POP3, IMAP, DNS, Telnet, SNMP.
* **Device Association:** End-user applications, web browsers, email clients.

**Layer 6 – Presentation**

* **Role:** Translator between the network and the application.
* **Key Functions:**
  + Data formatting (convert into a format the application can understand).
  + Data encryption/decryption (SSL/TLS for HTTPS).
  + Data compression (JPEG, MPEG, GIF, MP3).
* **Protocols/Examples:** SSL/TLS, JPEG, MPEG, ASCII, EBCDIC, PNG.
* **Device Association:** Application gateways, data formatters.

**Layer 5 – Session**

* **Role:** Establish, maintain, and terminate sessions (conversations) between applications.
* **Key Functions:**
  + Session setup, management, and teardown.
  + Synchronization (checkpoints in long file transfers so you don’t restart from scratch).
  + Dialog control (half-duplex vs full-duplex communication).
* **Protocols/Examples:** NetBIOS, RPC, PPTP, SAP.
* **Device Association:** Not tied to specific hardware, more about software session management.

**Layer 4 – Transport**

* **Role:** Ensures reliable data delivery between devices. Splits large data into smaller units (segments).
* **Key Functions:**
  + **Segmentation and reassembly** (break data, then put it back together).
  + **Error detection & recovery** (checks if data arrived correctly).
  + **Flow control** (avoid overwhelming the receiver).
  + **Multiplexing** (multiple conversations on one link using ports).
* **Protocols:**
  + **TCP:** Reliable, connection-oriented, error-checked.
  + **UDP:** Connectionless, fast, but no guarantee.
* **Device Association:** Firewalls, load balancers.

**Layer 3 – Network**

* **Role:** Handles logical addressing and routing of data between devices across multiple networks.
* **Key Functions:**
  + **Logical addressing:** IP addresses.
  + **Routing:** Find best path to destination.
  + **Fragmentation:** Breaking packets to fit into MTU size.
* **Protocols/Examples:** IPv4, IPv6, ICMP (ping), RIP, OSPF, BGP, IPSec.
* **Device Association:** Routers, Layer 3 switches.

**Layer 2 – Data Link**

* **Role:** Ensures reliable data transfer between devices on the same local network (node-to-node).
* **Key Functions:**
  + **Physical addressing:** Uses MAC addresses.
  + **Framing:** Wraps raw bits from Physical Layer into frames.
  + **Error detection/correction** (CRC checks).
  + **Media access control:** Who gets to use the medium (CSMA/CD in Ethernet, CSMA/CA in Wi-Fi).
* **Sublayers:**
  + **LLC (Logical Link Control):** Error checking, flow control.
  + **MAC (Media Access Control):** Defines how devices access the medium.
* **Protocols/Examples:** Ethernet (IEEE 802.3), Wi-Fi (802.11), ARP, PPP, VLANs.
* **Device Association:** Switches, Bridges, NICs.

**Layer 1 – Physical**

* **Role:** Physical transmission of raw binary data (0s and 1s).
* **Key Functions:**
  + Electrical/optical/wireless signals.
  + Hardware specs: cables, voltages, radio frequencies.
  + Bit synchronization and bit rate control.
* **Protocols/Examples:** Ethernet cabling standards (RJ45, Cat5, Cat6), Wi-Fi, Bluetooth, DSL.
* **Device Association:** Hubs, repeaters, cables, fiber optics.

**Summary**

* **Layers 7–5 (Application, Presentation, Session):** Where data is prepared for the network (user and software interaction).
* **Layer 4 (Transport):** Reliability and segmentation, ensuring the message gets through.
* **Layer 3 (Network):** Pathfinding and logical addressing.
* **Layers 2–1 (Data Link, Physical):** Actual transmission, MAC addresses, and raw signals.