OSI Model (Open Systems Interconnection)

- 7 layers used in computer systems to communicate over a network

7. Application Layer

- Human-computer interaction layer, where applications can access network services
- offers end-to-end service
- Key Functionality: (Resource sharing / remote file access / network managment)
- Protocols:
  - → HTTP (HyperText Transfer Protocol)
  - → FTP (File Transfer Protocol)
  - → SMTP (Simple Mail Transfer Protocol)
  - → DNS (Domain Name System)

Absent in TCP/IP Model These 2 layers are added For data Security purpose

6. Presentation Layer

- Ensures that data is in usable format and is where data encryption occurs
- Key Functionality: data Formating / encryption / decryption / compression / description
- Example: SSL / TLS, JPEG, ASCII

5. Session Layer

- Maintains connections and is responsible for controlling ports and sessions
- Key Funct.:
  - → Delimiting / Synchronization of data exchange
  - → opening & closing / managing a session between end-user app processes
  - → session checkpointing / recovery

- protocols: NetBIOS, RPC (Remote Procedure Call), PPTP

4- Transport Layer

- Establish logical end-to-end connection between 2 systems in a network
- Implementation of process-to-process delivery using ports (port-to-port delivery)
- Key functions:
  - → data Transfer
  - → Flow control
  - → error recovery
  - → data segmentation
- Protocols:
  - → TCP (Transmission control protocol)
  - → UDP (User Datagram Protocol)
  - → SCTP (Stream control transmission protocol)
- It links network support layers and user support layers

3- Network Layer

- Handles logical addressing and routing of packets across networks
- Key Functionalites
  - → data routing / Forwarding (packet) / addressing (logical)
  - → Inter networking
  - → Congestion Control
- Protocols:
  - → IP (internet protocol) / ICMP (Internet Control Message Protocol) / RIP (Routing Information Protocol)

2. Data Link Layer

- Takes packets from network layer and encapsulate them into frames for transmission
- Key func.
  - → node-to-node data transfer
  - → data framing / media access control (MAC) addressing
  - → error control
  - → Flow control
  - → Frame synchronization bytes
  - → Frame identifiers addresses
- Protocols :
  - → Ethernet
  - → Point-to-Point Protocol (PPP)
  - → HDLC
- Convert from machine to user language

1. Physical Layer

- Responsible for the physical connection between devices
- Decides transmission data rate / speed
- Translate communication request from data link layer into hardware operations
- bit-by-bit delivery
- Channel coding / modulation / bit synchronization raw data transmission over physical medium

- Application / Presentation / Session / Transport: are implemented in the end system
- Network: implemented on the routers
- Physical: " on the medium

- In OSI model when data packets moves:
  1) From lower to upper layers: headers are removed
  2) From upper to lower: headers are added
- Headers contain essential control info. for the protocols used on the specific layer.

- In OSI model functionality at one layer doesn't requires info from another layer

- Physical / data link / network: network support layers
- Session / presentation / application: user support layers
- Transport: link between them

	Layer Name	Unit Name
7	Application	Data / Message
6	Presentation	"
5	Session	"
4	Transport	Segment
3	Network	Packet
2	Data Link	Frame
1	Physical	Bits

TCP (Transmission Control Protocol) vs. UDP (User Datagram Protocol)

Feature	TCP	UDP
Connection Type	Connection-oriented (3 way handshake)	Connectionless (no handshake)
Reliability	Reliable (ensures all packets are delivered and in order)	Unreliable (no guarantee of delivery or order)
Error Checking	Uses checksums, acknowledgment & retransmissions	Uses only checksums
Speed	Slower due to error checking	Faster
Header Size	Larger (20-60 bytes) due to extra fields	Smaller (8 bytes) for lower overhead
Use Cases	File Transfer, web browsing (HTTP, FTP, SMTP)	Gaming, Streaming (DNS, DHPC, VoIP, live video