WEEK-01

Cloud Infra and Security

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Task -01

- **Prepare R&D Document on working of all the layers in OSI Model**

Introduction

The OSI (Open Systems Interconnection) model, developed by ISO (International Organization for Standardization), is a conceptual framework used to understand and standardize the functions of a telecommunication or computing system without regard to its underlying internal structure and technology. It divides network communication into seven layers, each with specific roles and responsibilities.

There are 7 layers in OSI model:

Layer No.	Layer Name	Function
7	Application	User interface & application services
6	Presentation	Data formatting, encryption
5	Session	Session control between systems
4	Transport	End-to-end communication & reliability
3	Network	Routing and addressing
2	Data Link	Framing & MAC addressing
1	Physical	Transmission of bits over media

1. Physical Layer (Layer 1)

- Handles transmission and reception of raw bit streams over physical media (cables, radio, fiber).

- Defines hardware specs: voltages, pin layouts, data rates, etc.
- **Key devices:** cables, switches, NICs, hubs, repeaters.
- **Example:** Ethernet cables transferring digital bits via electrical pulses.

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2. Data Link Layer (Layer 2)

- Responsible for node-to-node data transfer and framing.
- Performs error detection and controls access to the transmission medium.
- **Divided into two sublayers:**
    - MAC (Media Access Control): Controls device access to the medium.
    - LLC (Logical Link Control): Manages frame synchronization and error checking.
- **Key protocols:** Ethernet, PPP, HDLC.
- **Example:** Frames with MAC addresses sent between devices on the same LAN.

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3. Network Layer (Layer 3)

- Routes packets from source to destination across multiple networks.
- Manages logical addressing (IP addresses).
- **Key protocols:** IP, ICMP, IGMP, IPsec.
- **Example:** Router determining the best path to forward packets using IP addresses.

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4. Transport Layer (Layer 4)

- Provides end-to-end communication between devices.
- Ensures reliable data transfer with sequencing and error correction.
- **Main protocols:**
    - TCP (connection-oriented, reliable)
    - UDP (connectionless, faster but unreliable)
- **Example:** TCP segments application data, guarantees order and retransmits lost packets.

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5. Session Layer (Layer 5)

- Manages sessions between applications.
- Handles session creation, maintenance, and termination.
- Responsibilities include dialog control, token management, and synchronization.
- **Example:** Maintaining login sessions on a remote server.

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6. Presentation Layer (Layer 6)

- Translates data between application and network formats.
- Handles encryption, compression, and data formatting.
- **Example:** Converting character encoding (EBCDIC to ASCII), applying SSL/TLS encryption.

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7. Application Layer (Layer 7)

- Provides network services directly to end-user applications.
- Supports protocols like HTTP/HTTPS, FTP, SMTP, DNS, SNMP.
- **Example:** Web browser using HTTP to retrieve a webpage from a server.

Data Flow: Encapsulation and Decapsulation

- **Encapsulation:** Each layer on the sender's side adds its own header as data moves down the stack.
- **Decapsulation:** Each layer on the receiver's side removes the corresponding header as data moves up.

- **Flow order:**
    - **Sender:** Application → Presentation → Session → Transport → Network → Data Link → Physical

- **Receiver:** Physical → Data Link → Network → Transport → Session → Presentation → Application

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Use Cases

Layer	Real-World Use Case
Physical	Ethernet cable transmits signals from laptop to router.
Data Link	MAC address filtering on a Wi-Fi router.
Network	IP routing across continents.
Transport	TCP ensures email arrives complete and in order.
Session	VoIP call setup and management.
Presentation	TLS encrypts sensitive banking data.
Application	Web browser fetching pages using HTTPS.
