



Ethical Hacking Course – Lecture 4 Notes

 Topic: OSI (Open Systems Interconnection) Model

1. Introduction to OSI Model

◆ What is OSI?

- The **OSI Model** (Open Systems Interconnection Model) is a **conceptual framework** that describes how data is transmitted from one device to another over a network.
- It divides the entire communication process into **7 layers**, each having a specific function.

◆ Purpose:

- Helps understand **how networks operate**.
 - Standardizes communication between **different systems and devices**.
 - Makes **troubleshooting easier** (you can find which layer has a problem).
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2. Overview of OSI Layers (Sender Side → Receiver Side)

Layer No.	Layer Name	Type	Function
7	Application	Software	User Interface, Email, Browser
6	Presentation	Software	Data Encoding, Encryption, Compression
5	Session	Software	Maintains Session Between Devices
4	Transport	Software/Hardware	Segmentation, Flow Control, TCP/UDP
3	Network	Hardware	IP Addressing, Routing, Packets

Layer No.	Layer Name	Type	Function
2	Data Link	Hardware	MAC Address, Frames, Error Detection
1	Physical	Hardware	Cables, Signals, Bits Transmission

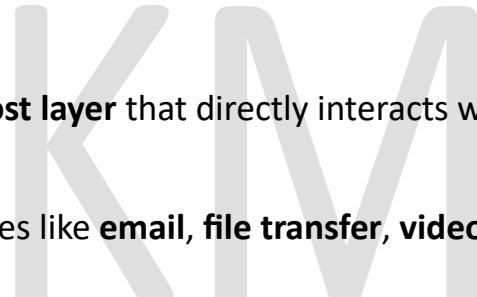
3. Sender Side – Step-by-Step Data Flow

When a sender sends data (for example, an email or file), data moves from **Application Layer (7)** down to **Physical Layer (1)**.

● **Layer 7 – Application Layer**

◆ **What it is**

- This is the **topmost layer** that directly interacts with the user or software applications.
- It provides services like **email**, **file transfer**, **video calls**, and **web browsing**.



◆ **Examples**

- **Email:** Outlook, Gmail (SMTP, POP3)
- **Web Browsing:** Chrome, Edge (HTTP, HTTPS)
- **File Transfer:** FTP (File Transfer Protocol)
- **Remote Access:** Anydesk, RDP, Teams

◆ **Function**

- Takes **user data (text, files, video)** and prepares it for network transmission.
- Human-readable data is generated here.

Layer 6 – Presentation Layer

◆ What it is

- Converts the data into a format that the receiver can understand.

◆ Functions

1. **Encoding/Decoding:** Converts data into machine-understandable format.

2. **Encryption/Decryption:** Protects data for secure transmission.

- Example: HTTPS encryption using SSL/TLS.
- Online encryption tool: <https://www.devglan.com/online-tools/text-encryption-decryption>

3. **Compression:** Reduces data size for faster transmission.

◆ Example

When sending a file, this layer **compresses** and **encrypts** it before sending.

Layer 5 – Session Layer

◆ What it is

- Manages and maintains **communication sessions** between devices.

◆ Functions

1. **Session Management:** Opens, maintains, and closes connections.

2. **Synchronization:** Adds checkpoints so if a session breaks, it can resume from that point.

3. **Session Recovery:** Handles errors and resumes communication if interrupted.

◆ Example

When using **Zoom** or **Microsoft Teams**, the session layer ensures your meeting connection remains stable.

 **Note:**

Layers 7, 6, and 5 are called **Software Layers** because they handle **application-level communication** between users.

Layer 4 – Transport Layer

◆ What it is

- Known as the **heart of the OSI model** because it controls the **flow and reliability of data**.

◆ Functions

1. **Segmentation:** Divides data into small segments.
2. **Flow Control:** Ensures data is sent at a speed the receiver can handle.
3. **Error Control:** Detects and retransmits lost data.
4. **Connection Establishment:** Manages TCP handshakes.

◆ Protocols

- **TCP (Transmission Control Protocol):** Reliable, connection-oriented.
- **UDP (User Datagram Protocol):** Fast, connectionless.

◆ Example

When sending a large file, this layer breaks it into segments and ensures all arrive correctly.

Layer 3 – Network Layer

◆ What it is

- Responsible for **routing data** from one device to another across different networks.

◆ Functions

1. **IP Addressing:** Assigns logical addresses (IPv4/IPv6).
2. **Routing:** Finds the best path for data to travel (via routers).

3. **Packet Formation:** Adds source and destination IP to data.

◆ **Example**

- Data + IP Address = **Packet**
 - Router reads the IP header and sends packets to the next destination.
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● **Layer 2 – Data Link Layer**

◆ **What it is**

- Ensures reliable data transfer between two devices within the same network.

◆ **Functions**

1. **MAC Addressing:** Adds physical address of sender and receiver.
2. **Framing:** Converts packets into frames for transmission.
3. **Error Detection:** Uses CRC (Cyclic Redundancy Check).

◆ **Example**

- Data + MAC Address = **Frame**
 - Switch uses this layer to forward frames to the correct device in LAN.
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● **Layer 1 – Physical Layer**

◆ **What it is**

- The lowest layer; deals with **actual transmission of bits (0s and 1s)** over cables or wireless signals.

◆ **Functions**

1. Converts **frames into electrical, optical, or radio signals**.
2. Handles **network cables**, connectors, hubs, repeaters, and switches.
3. Responsible for **bit rate control** and **physical topology**.

◆ **Example**

- Ethernet cables (RJ45), Fiber optics, Wi-Fi signals.
 - Converts binary data into physical signals that travel through the medium.
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4. Receiver Side – Step-by-Step (Physical → Application)

When the data reaches the destination device, it travels **upward** through the layers:

1. **Physical Layer:** Receives binary bits from cable or signal.
 2. **Data Link Layer:** Converts bits → frames, verifies MAC address.
 3. **Network Layer:** Reads IP address and delivers to correct device.
 4. **Transport Layer:** Reassembles data segments in the correct order.
 5. **Session Layer:** Maintains session continuity.
 6. **Presentation Layer:** Decrypts and decodes data.
 7. **Application Layer:** Displays final output to user (email, webpage, etc.).
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5. Mnemonic to Remember OSI Layers

👉 **From Layer 7 to 1:**

All People Seem To Need Data Processing

👉 **From Layer 1 to 7:**

Please Do Not Throw Sausage Pizza Away

Summary Table of OSI Layers

Layer Name	Key Functions	Example Device / Protocol
7 Application	User interaction	Email, Browser, FTP
6 Presentation	Encrypt, Encode, Compress	SSL/TLS, JPEG
5 Session	Maintain sessions	NetBIOS, RPC
4 Transport	Flow control, Segmentation	TCP, UDP
3 Network	Routing, IP Addressing	Router, IP
2 Data Link	MAC, Frame creation	Switch, Ethernet
1 Physical	Signal transmission	Cable, Hub, NIC

Example Flow: Sending an Email

Sender Side:

Email (Application Layer) → Encryption (Presentation) → Session Created → Segments (Transport) → Packets (Network) → Frames (Data Link) → Bits (Physical)

Receiver Side:

Bits → Frames → Packets → Segments → Session → Decrypt → Display Email

1. Summary of OSI Model (Lecture 4)

The **OSI Model (Open Systems Interconnection Model)** is a 7-layer conceptual framework that explains **how data travels** from a sender to a receiver over a network. It standardizes communication between different devices, systems, and vendors.

The 7 layers divide networking tasks into smaller, manageable parts:

Layer 7 – Application

Human interaction, software applications, protocols like HTTP, SMTP, FTP, DNS.

Layer 6 – Presentation

Data formatting, encoding, encryption (SSL/TLS), and compression.

Layer 5 – Session

Creates, manages, and terminates communication sessions.

Layer 4 – Transport

Segmentation, flow control, error handling; protocols: **TCP/UDP**.

Layer 3 – Network

Routing, IP addressing (IPv4/IPv6), packet forwarding (Router).

Layer 2 – Data Link

MAC addressing, frame creation, error detection (Switch).

Layer 1 – Physical

Cables, signals, bits, network hardware (Hub, NIC, Fiber, RJ45).

Data flows:

Sender: Layer 7 → 1

Receiver: Layer 1 → 7

2. Conclusion (Easy & Professional)

The OSI Model is a universal networking reference that helps engineers understand **how communication works step-by-step**. Each layer has its own responsibilities, ensuring smooth, structured, and secure data flow between devices.

It helps with:

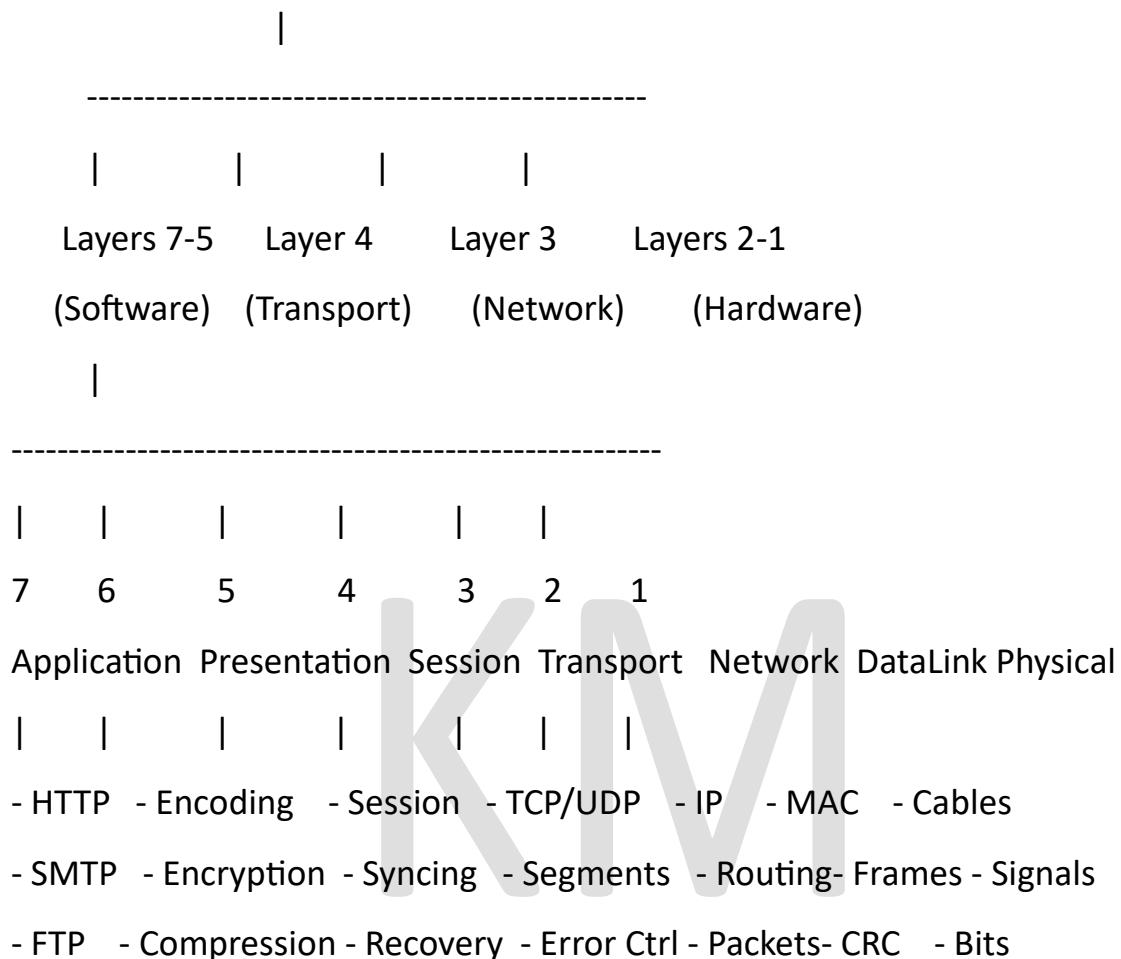
- Troubleshooting (find which layer is failing)
- Standardization (all vendors follow the same structure)
- Learning networking in a clear, layered approach
- Understanding real protocols like TCP/IP, HTTP, SSL, Routing, MAC, etc.

Mastering the OSI Model builds a strong foundation for **ethical hacking, cybersecurity, penetration testing, and networking jobs**.



3. Mindmap (Detailed & Clear)

OSI MODEL



Flow:

Sender = 7 → 6 → 5 → 4 → 3 → 2 → 1

Receiver = 1 → 2 → 3 → 4 → 5 → 6 → 7

Example:

Sending Email → App → Encrypt → Session → Segments → Packets →
Frames → Bits → Receiver (reverse process)

4. All Possible Interview Questions (40+) with Answers

Below are ALL questions asked in networking/cybersecurity interviews **based on OSI Model.**

BASIC INTERVIEW QUESTIONS

1. What is the OSI Model?

The OSI Model is a 7-layer conceptual framework that defines how data travels between two network devices. It helps standardize communication, design networks, and troubleshoot issues.

2. Why do we need the OSI Model?

Simple Answer:

- For standardization (so all devices communicate)
 - For troubleshooting (identify problem layer)
 - For understanding networking structure
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3. How many layers are there in the OSI Model?

Seven layers:

Application, Presentation, Session, Transport, Network, Data Link, Physical.

4. What is the difference between OSI and TCP/IP model?

- OSI has **7 layers**, TCP/IP has **4 layers**
 - OSI is theoretical, TCP/IP is practical and used in real networks
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LAYER-WISE INTERVIEW QUESTIONS (DETAILED)

● Layer 7 – Application Layer

5. What happens in the Application Layer?

It provides the interface to the user and applications, using protocols like HTTP, HTTPS, SMTP, FTP.

6. Give examples of Application Layer protocols.

- HTTP / HTTPS
 - SMTP
 - DNS
 - FTP
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● Layer 6 – Presentation Layer

7. What does the Presentation Layer do?

It converts data into a format the receiver understands. It performs:

- Encryption (SSL/TLS)
 - Compression
 - Encoding/Decoding
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8. What is encryption?

Encryption converts readable data into unreadable form to secure it during transmission. Example: HTTPS.

Layer 5 – Session Layer

9. What is the function of the Session Layer?

It creates, manages, and terminates communication sessions between devices.

10. What is session management?

Maintaining communication between two systems, like during a video call.

Layer 4 – Transport Layer

11. What is the responsibility of the Transport Layer?

- Segmentation
 - Error control
 - Flow control
 - TCP/UDP communication
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12. What is the difference between TCP and UDP?

TCP = Reliable, connection-oriented, slower

UDP = Unreliable, connectionless, faster

13. What is segmentation?

Breaking data into smaller segments for efficient transmission.

Layer 3 – Network Layer

14. What does the Network Layer do?

Handles IP addressing, routing, and packet forwarding.

15. What device works at Layer 3?

Router.

16. What is a packet?

Data + IP address information.

 **Layer 2 – Data Link Layer****17. What is the role of the Data Link Layer?**

- Uses MAC addresses
 - Converts packets into frames
 - Error detection using CRC
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18. Which device works at Data Link Layer?

Switch.

19. What is a frame?

Packet + MAC address + CRC.

 **Layer 1 – Physical Layer****20. What does the Physical Layer do?**

Transmits raw bits through cables, fiber, or wireless signals.

21. Give examples of Physical Layer components.

- Ethernet cable (RJ45)
- Fiber optic cable
- Hub

- Repeater
 - NIC
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🔥 ADVANCED INTERVIEW QUESTIONS

22. Explain the data flow in OSI Model.

Sender: Layer 7 → 1

Receiver: Layer 1 → 7

23. In which layer does encryption happen?

Presentation Layer (Layer 6).

24. Which layer handles routing?

Network Layer (Layer 3).

25. In which layer does TCP handshake occur?

Transport Layer (Layer 4).

26. In which layer does MAC address work?

Data Link Layer (Layer 2).

27. In which layer does IP address work?

Network Layer (Layer 3).

28. What is flow control?

Controlling the speed of data so the receiver is not overloaded.

29. What is error control?

Detecting and retransmitting lost data.

30. Which layer converts bits into signals?

Physical Layer (Layer 1).

31. What is encapsulation?

Adding headers as data moves from Layer 7 → 1.

32. What is decapsulation?

Removing headers as data moves Layer 1 → 7.

33. Why is OSI called a conceptual model?

Because it explains how communication should happen, not how it actually happens in real networks.

34. What is CRC?

Cyclic Redundancy Check — used for error detection at the Data Link Layer.

35. What is the difference between packet, frame, and segment?

- **Segment** → Transport Layer
 - **Packet** → Network Layer
 - **Frame** → Data Link Layer
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36. What layer does DNS work on?

Application Layer.

37. What layer does switching work on?

Layer 2 (Switch).

38. What layer does routing work on?

Layer 3 (Router).

39. What layer does encoding happen?

Presentation Layer.

40. What layer does video calling rely on?

Session Layer (session control) + Transport Layer (TCP/UDP).

41. Where do hubs work?

Physical Layer.

42. What layer is responsible for compression?

Presentation Layer.

43. In which layer is SSL/TLS used?

Presentation Layer.

44. What is the main purpose of OSI?

Standardization and troubleshooting.