Report File of

Network Layer of OSI Model

(BATCH:2024-2026)

SUBMITTED TO:

XXXXX

(Faculty of Science and Technology)

SUBMITTED BY:

Nikita kumari

MCA, (2nd Sem)

THE ICFAI UNIVERSITY

5, HIMUDA Education Hub, Kalujhanda, P.O. Mandhala, Via Barotiwala,

Baddi, District Solan, Himachal Pradesh - 174103

Website: www.iuhimachal.edu.in

CONTENTS:

1. Introduction

The OSI (Open Systems Interconnection) model is a conceptual framework used to understand and design how data travels

through a network. It has **seven layers**, and the **Network Layer** is the **third layer** from the bottom.

The primary role of the Network Layer is to determine how data is transferred between devices across different networks. It is responsible for **routing**, **addressing**, **packet forwarding**, and **logical addressing**.

---

2. Functions of the Network Layer

- **Logical Addressing**: Assigns logical addresses (like IP addresses) to devices.
- **Routing**: Determines the best path for data to travel across the network.
- **Packet Forwarding**: Transfers data packets from one node to another.
- **Fragmentation and Reassembly**: Breaks data into smaller packets and reassembles them at the destination.
- **Error Handling and Diagnostics**: Ensures data reaches the correct destination and helps detect transmission issues.

---

3. Real-Life Example

Imagine you're sending a letter from **Delhi to New York**. You write the recipient's address on the envelope. Similarly, in a network:

- Your computer adds the **destination IP address** to the data packet.

- The **Network Layer** finds the best route (like postal services choosing air, land, or sea) to send the data.
- Routers along the way act like **post offices**, directing the data to the next hop.

A more technical example is using **Google Maps** to find the best route to your destination. The app finds the optimal path just like routers find the best path for data.

---

4. Features of the Network Layer

Feature	Description
Routing	Determines the optimal path to send data.
IP Addressing	Assigns logical addresses to identify source and destination.
Inter-networking	Connects different types of networks (e.g., LAN to WAN).
Packet Switching	Breaks down data into packets for efficient transfer.
Traffic Control	Manages data congestion and avoids overload.

5. Advantages of the Network Layer

Advantage	Explanation
Efficient Routing	Finds the most efficient path, reducing delays.
Network Scalability	Supports growth by managing large and complex networks.
Error Detection	Identifies and manages routing and delivery issues.
Interconnection	Allows different networks and devices to communicate seamlessly.

6. Disadvantages of the Network Layer

Disadvantage	Explanation
Complexity	Routing and addressing can be complex in large networks.
Security Risks	Exposed to attacks such as IP spoofing and route hijacking.
Resource Intensive	Requires significant processing and memory in routers.
Latency	Routing through multiple hops can introduce delay.

7. Uses of the Network Layer

Use	Example
Internet Communication	Browsing websites using IP routing.
Email and Messaging	Emails pass through routers using network layer logic.
Online Streaming	Video data is routed from servers to users worldwide.
Virtual Private Networks (VPNs)	Transfers data between clients and remote servers.
Cloud Computing	Transfers data between clients and remote servers

8.1 Common Protocols in the Network Layer – Detailed Explanation

1. IP (Internet Protocol)

- **Full Form**: Internet Protocol
- **Type**: Core network layer protocol
- **Versions**: IPv4 and IPv6
- **Function**: Provides logical addressing and routing of packets.

***Working**:*

- Every device on a network is assigned a **logical IP address**.
- When data is sent, IP splits it into **packets**.
- Each packet has a **source IP** and a **destination IP**.
- Routers use this IP information to **route the packet** through the best path to the destination.
- IP is **connectionless** and **unreliable** by itself—no guarantee of delivery.

***Example**:*

If your device has IP 192.168.1.5 and you are accessing a server at 172.217.0.46 (like google.com), the IP protocol ensures packets are routed from your address to the server using multiple hops.

2. ICMP (Internet Control Message Protocol)

- **Purpose**: Sends error messages and operational information.
- **Used by**: Network devices like routers and hosts.

***Working**:*

- ICMP is used **not to send data**, but to report **issues in packet delivery**.
- If a router can’t deliver a packet (e.g., destination unreachable), it uses ICMP to inform the sender. ▫ **Ping** and **traceroute** commands use ICMP.

***Example**:*

When you type ping google.com, your computer sends ICMP echo requests. The server replies with ICMP echo replies, confirming connectivity.

3. IGMP (Internet Group Management Protocol)

- **Purpose**: Manages multicast group memberships.
- **Used in**: IPv4 networks to manage **multicast traffic**.

***Working**:*

- Devices use IGMP to **join or leave multicast groups**.
- A multicast address sends a single data stream to **multiple interested hosts**.
- Routers use IGMP to **track which devices** want multicast data.

***Example**:*

In live video streaming (like an online class), if multiple students are viewing the same stream, IGMP ensures data is sent only once and received by all interested participants, instead of sending separate streams to each one.

4. ARP (Address Resolution Protocol)

- **Purpose**: Maps **IP addresses to MAC addresses**.

- **Layer Used**: Technically works between Network Layer and Data Link Layer.

Working:

- When a device wants to communicate on a local network, it needs the **MAC address** of the destination.
- If it knows the **IP address**, it sends an ARP Request: "Who has IP 192.168.1.10? Tell 192.168.1.1."
- The device with that IP replies with an ARP Reply containing its MAC address.
- The sender saves this in its **ARP cache** for future communication.

Example:

If your PC (192.168.1.2) wants to send data to your printer (192.168.1.100), it first sends an ARP request to get the printer's MAC address, and then sends the actual data.

Summary Table

Protocol	**Purpose**	**Key Function**	**Real-Life Analogy**
IP	Routing and addressing	Sends data packets between devices	Addressing a letter with sender and receiver addresses
ICMP	Error reporting	Reports delivery issues or network problems	Post office returns a letter if the address is wrong

IGMP	Multicast group management	Manages who receives group data	Broadcasting news to all subscribers
ARP	Address resolution	Maps IP to MAC for local delivery	Asking “Who lives at this address?” to deliver a package

9. Conclusion

The **Network Layer** is essential in ensuring that data is sent from one device to another across different networks. It plays a critical role in **addressing**, **routing**, and **delivering** data packets accurately and efficiently.

Understanding the Network Layer helps in grasping how largescale communication like the **Internet** works. Despite some disadvantages, its advantages and capabilities make it a cornerstone of modern computer networking.