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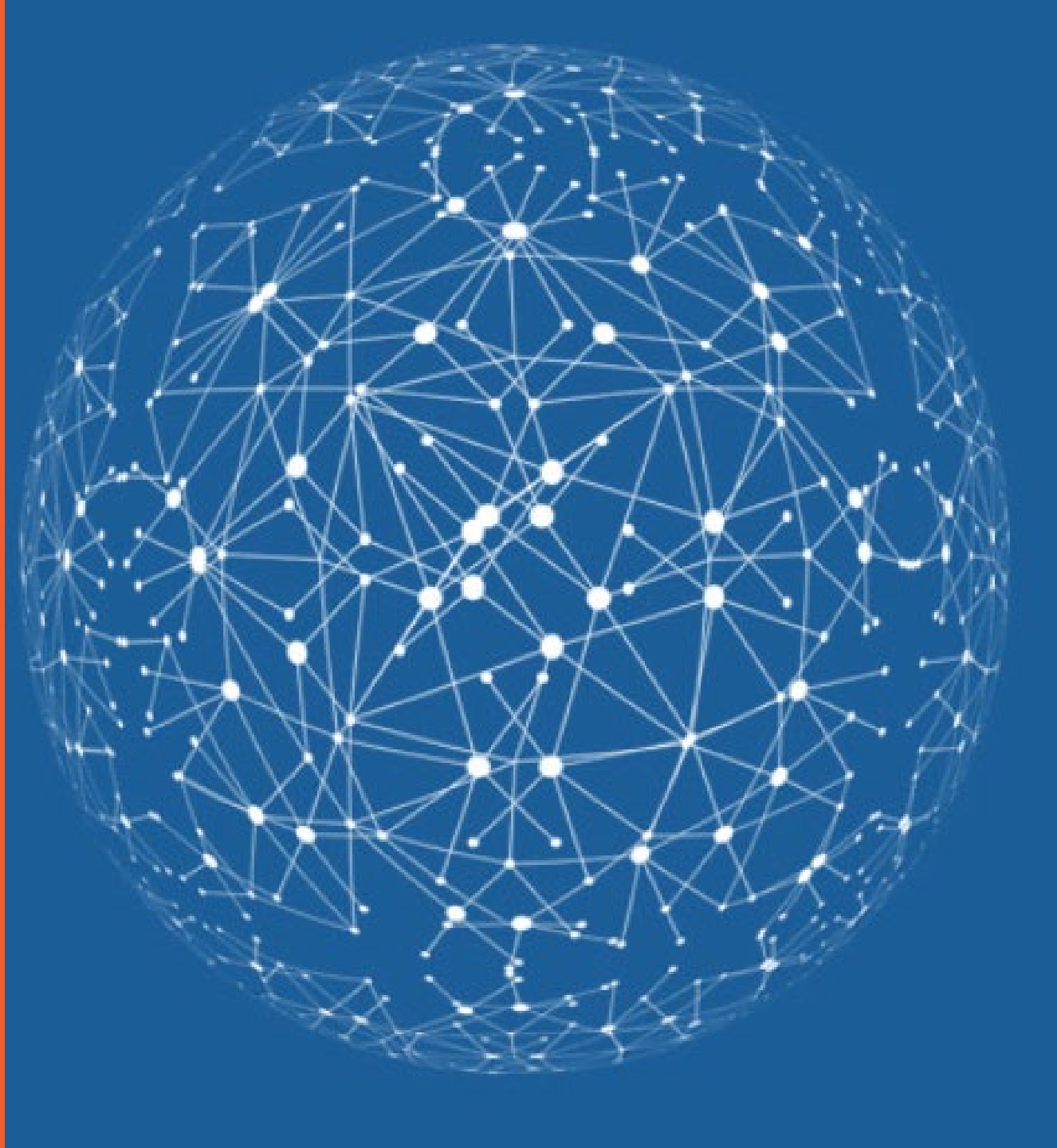
Tutorial
ELEC3506/9506
Communication Networks

School of Electrical and Computer Engineering
The University of Sydney

Tutorial 01 – Week 02



Tutorial: Communication Networks

- **Lecturer: Dr. Wibowo Hardjawana** wibowo.hardjawana@sydney.edu.au
- **Tutor: Hao Chang** hao.chang@sydney.edu.au

- **Timetable: Fri 09:00-11:00 & Fri 11:00-01:00 & Fri 1:00-03:00**
- **Class Location:** Civil Eng Lecture Theatre (1/3), 203/302, Civil Engineering Building (J05.02)

- **Important Facts:**
  - Materials covered in tutorials are assessable. Lectures and tutorials complement each other, so it's important not to miss either.
  - You will have a set of questions for each tutorial session. It is recommended that you try to solve these questions before attending the tutorial.
  - Fun Quiz to test knowledge at the end of the session
  - Tutorial solutions will be provided to you (**Canvas**) after each session.

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Weekly Schedule

Week	Lectures	Tutorials	Labs
1	Background and Preview		
2	Physical Layer	T1 - All	
3	Data Link Layer	T2 - All	
4	MAC Protocols and Wired LAN	T3 - All	
5	Network Layer – Data Transfer	T4 – Timetable if no Lab	L1 –Timetable
6	Network Layer – Routing Protocols	T4 – As above	L1- As above
7	Network Layer - Continues	T5 - As above	L2 – As above
8	Transport Layer	T5 – As above	L2- As above
9	Application Layer		
10	WAN Technologies	T6 – As above	L3 – As above
11	QoS in IP Networks	T6 – As above	L3- As above
12	Wireless Networks and Network Security	T7 - As above	L4 – As above
13	Guest Lectures from Telstra	T7 – As above	L4- As above

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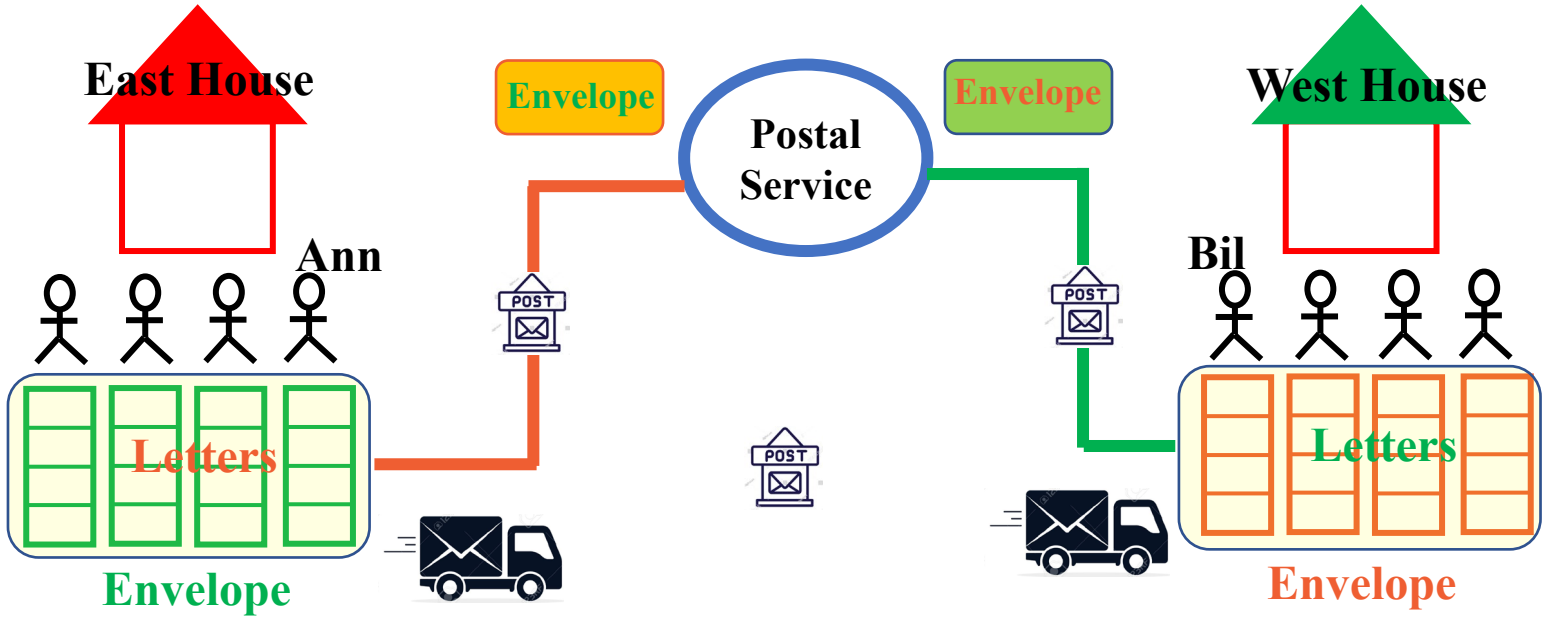
Tutorial 1 Questions

1. List the layers of the OSI model and the TCP/IP protocol suite (the Internet Model)
2. How do the layers of the OSI correlate to the layers of the TCP/IP protocol suite?
3. Which layers of the TCP/IP protocol suite are the network support layers and which layers are the user support layers?
4. What is data encapsulation (with respect to Questions 1-3)?
5. What are the responsibilities of the Data Link layer?
6. What is the difference between Network layer and Transport layer delivery?
7. If the Data link layer can detect errors between hops, why do you think we need another mechanism at the Transport layer?
8. What are the responsibilities of the Network layer?
9. What are the responsibilities of the Transport layer?
10. What is the difference between a port address, a logical address and a physical address?
11. Name some services provided by the Application layer
12. What are the advantages of combining Session, Presentation and Application layers of the OSI model to a single layer in the TCP/IP protocol suite?

Basic of Internet Layer

- ✓ Consider two houses, name, East and West House, with each house being home to a 4 kids.
- ✓ The kids in the two households love to write to each other. Each kid writes each cousin every week.
- ✓ Each letter delivered by the traditional postal service in a separate envelope.
- ✓ Each household sends 16 letters to the other household every week.
- ✓ Ann in the East and Bill in the West house—responsible for mail collection and mail distribution.
- ✓ When letters arrive at the East, Ann has the job of distributing the mail to her brothers and sisters. Bill has a similar job on the West Coast.



Letters in envelopes = Application messages

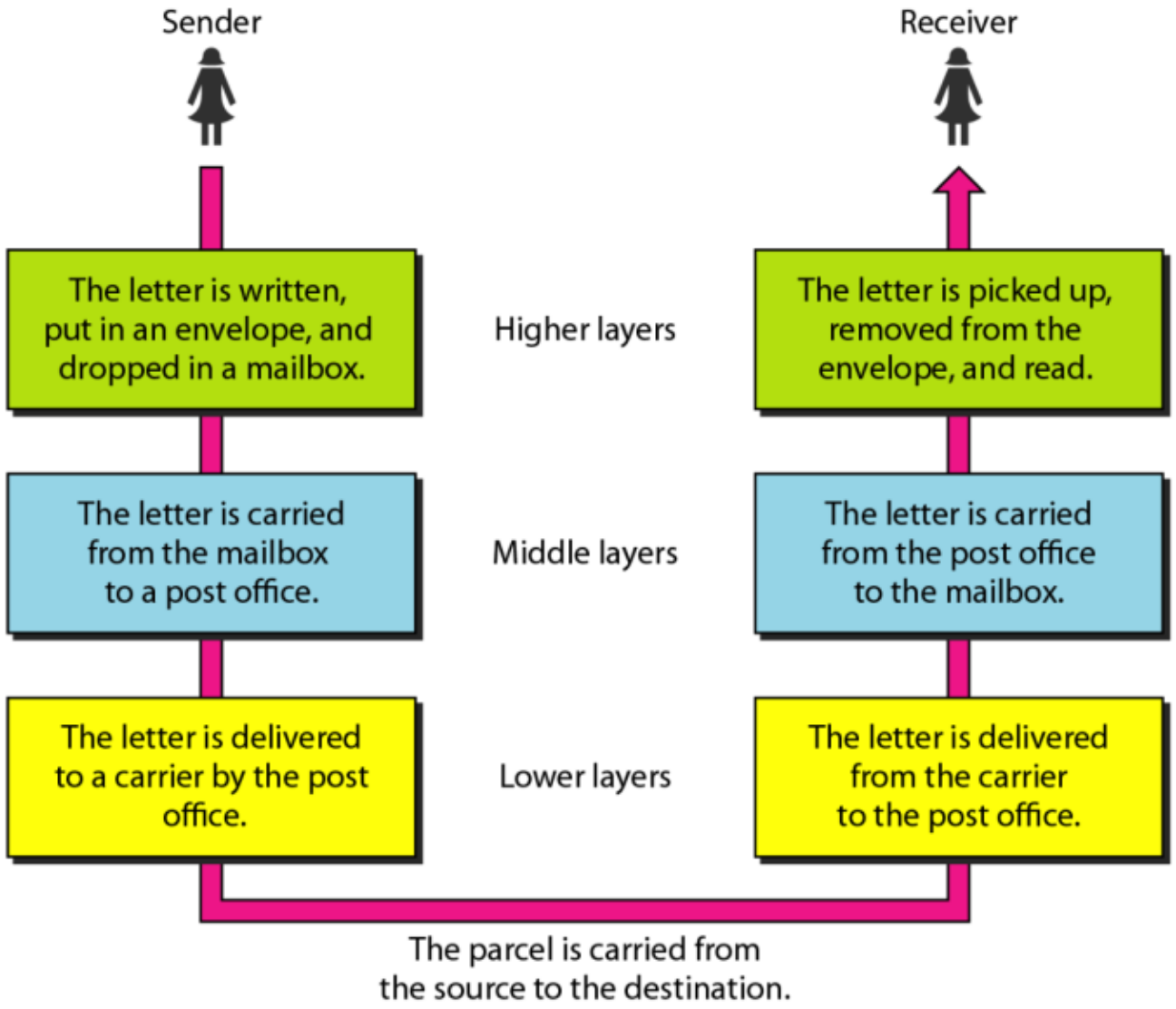
Cousins = Processes

Houses = Hosts (End systems)

Ann and Bill = Transport-layer protocol

Postal service = Network-layer protocol

Internet Layer



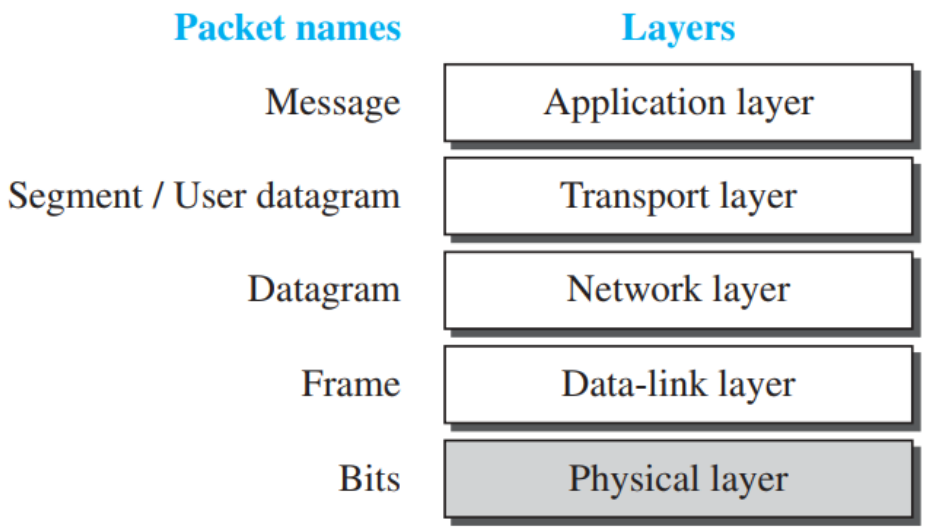
Question 01: List the layers of the OSI model and the TCP/IP protocol suite (the Internet Model)

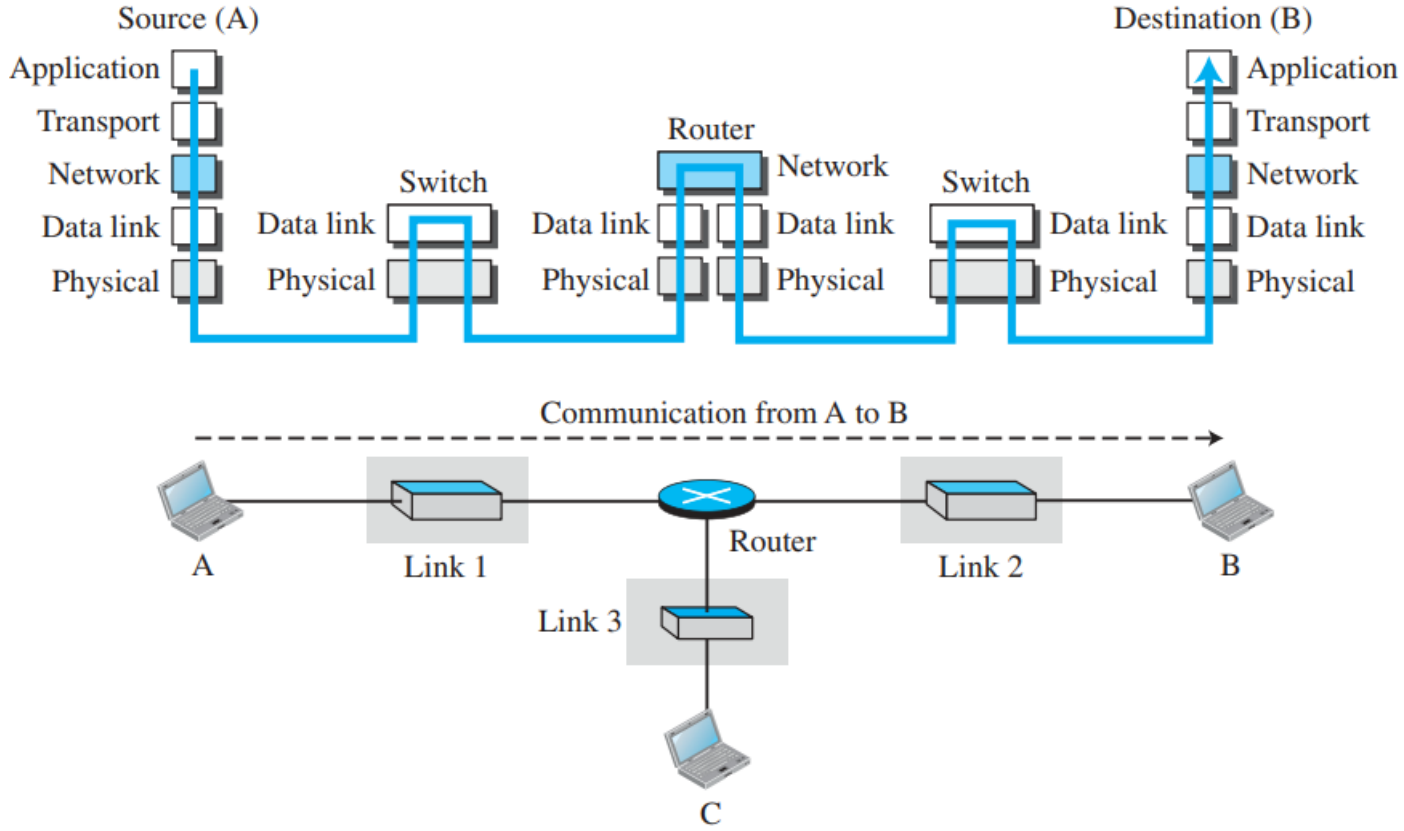
- The **OSI (Open Systems Interconnection)** Model is a conceptual framework used to understand and implement standard protocols in network communications.

L. NO	Layer Name	Description	Data Type
7	Application Layer	Human-computer interaction layer, where applications can access the network services	Data
6	Presentation Layer	Ensures that data is in a usable format and is where data encryption occurs	Data
5	Session Layer	Maintains connections and is responsible for controlling ports and sessions	Data
4	Transport Layer	Transmits data using transmission protocols including TCP and UDP	Segment
3	Network Layer	Decides which physical path the data will take	Packets
2	Data Link Layer	Defines the format of data on the network	Frames
1	Physical Layer	Transmits raw bit stream over the physical medium	Bits

Question 01: List the layers of the OSI model and the TCP/IP protocol suite (the Internet Model)

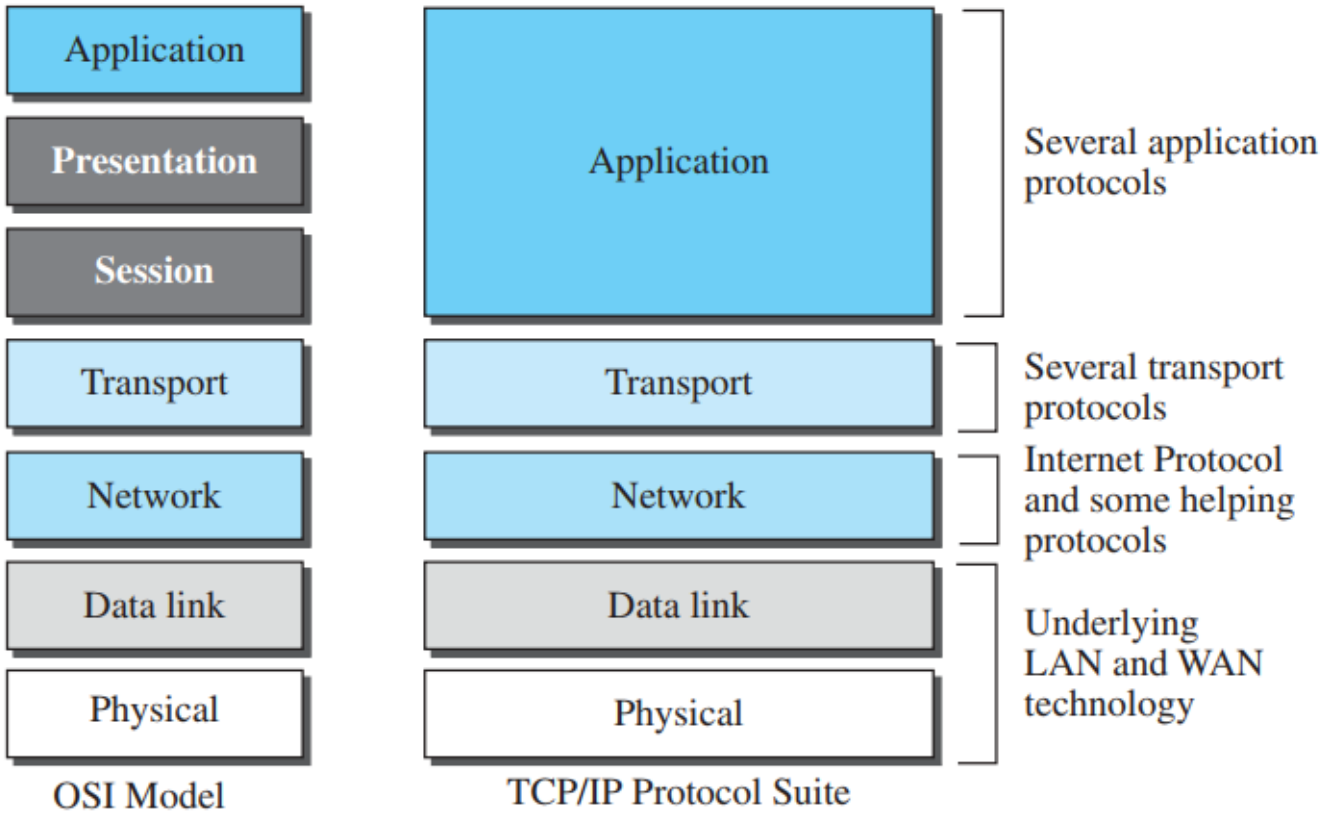
- The **TCP/IP model** was developed by the U.S. Department of Defense (DoD) to interconnect various networks and ensure the integrity of data.
- The TCP/IP protocol model was developed prior to the OSI model, and it features a different number of layers compared to the OSI model.





Question 02: How do the layers of the OSI correlate to the layers of the TCP/IP protocol suite?

- **TCP/IP and OSI model**: The application, presentation, and session layers of the OSI model are roughly equivalent to the application layer in the TCP/IP (Internet) model.

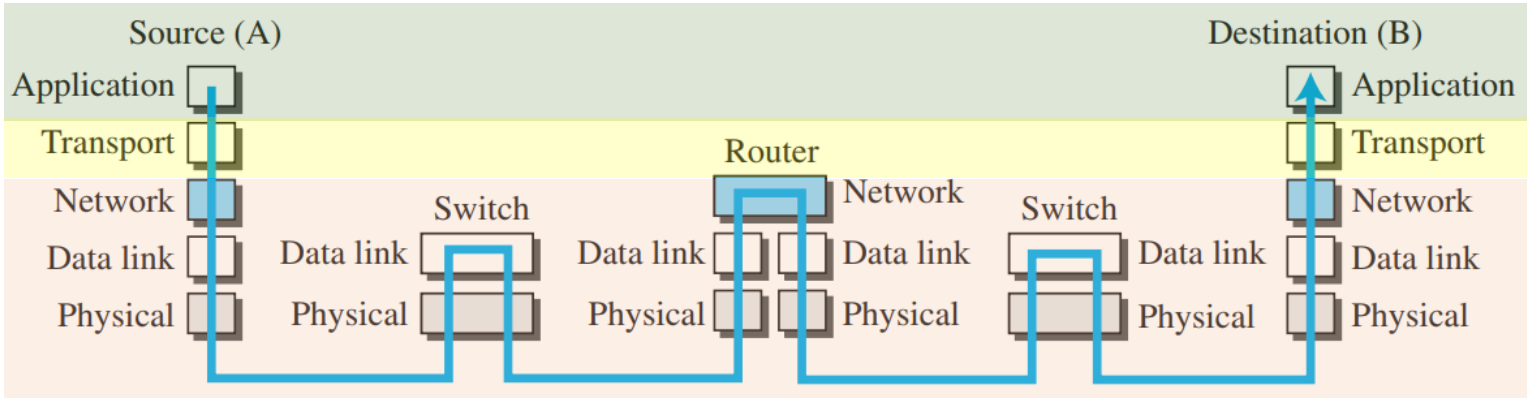


- The application layer in the suite is usually considered to be the combination of **three layers in the OSI model**

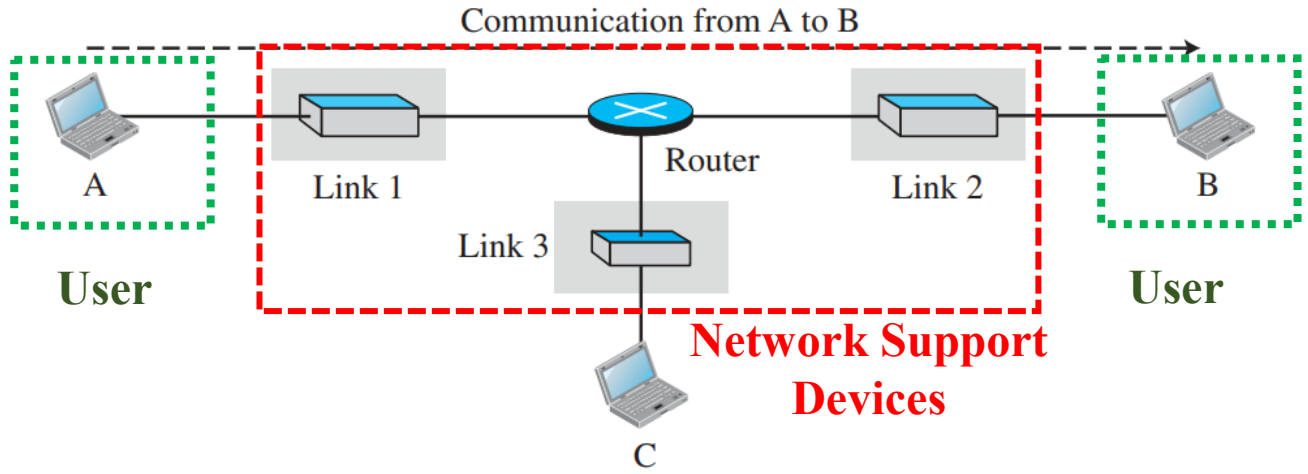
- In the TCP/IP model, these three OSI layers (Application, Presentation, and Session) are combined into a single layer known as the Application Layer.
- This is because the TCP/IP model is more simplified and streamlined, focusing on the most critical aspects of network communication.

Question 3: **Which layers of the TCP/IP protocol suite are the network support layers and which layers are the user support layers?**

- Network support layers: Physical, Datalink, and Network layers.
- They deal with the physical aspects of moving data from one device to another(such as electrical specifications, physical connections, physical addressing, transport timing, and reliability, etc.)



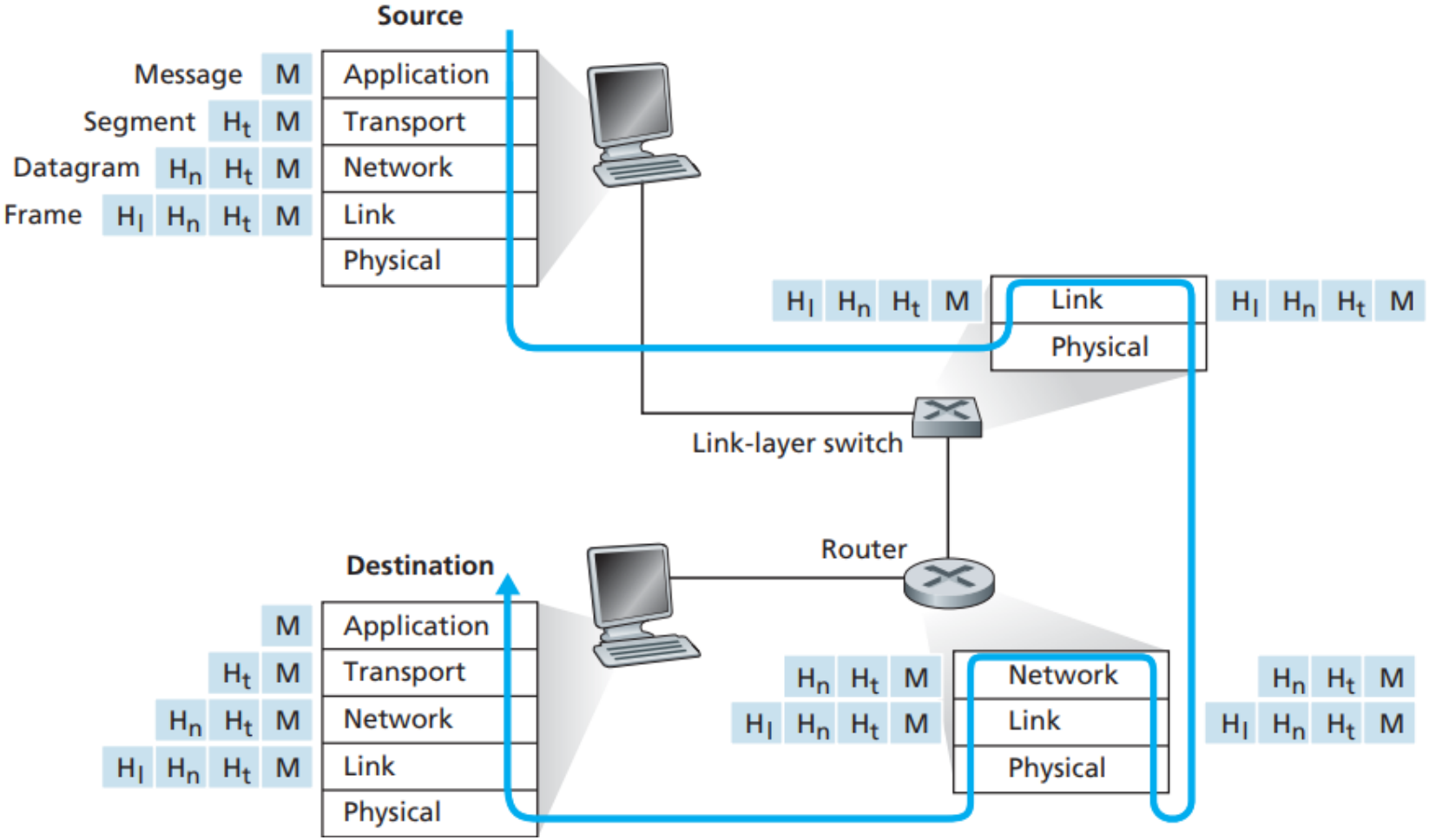
- User support layer: Application Layer.
- It is the interface with the users. It allows interoperability among unrelated software systems used by the users.

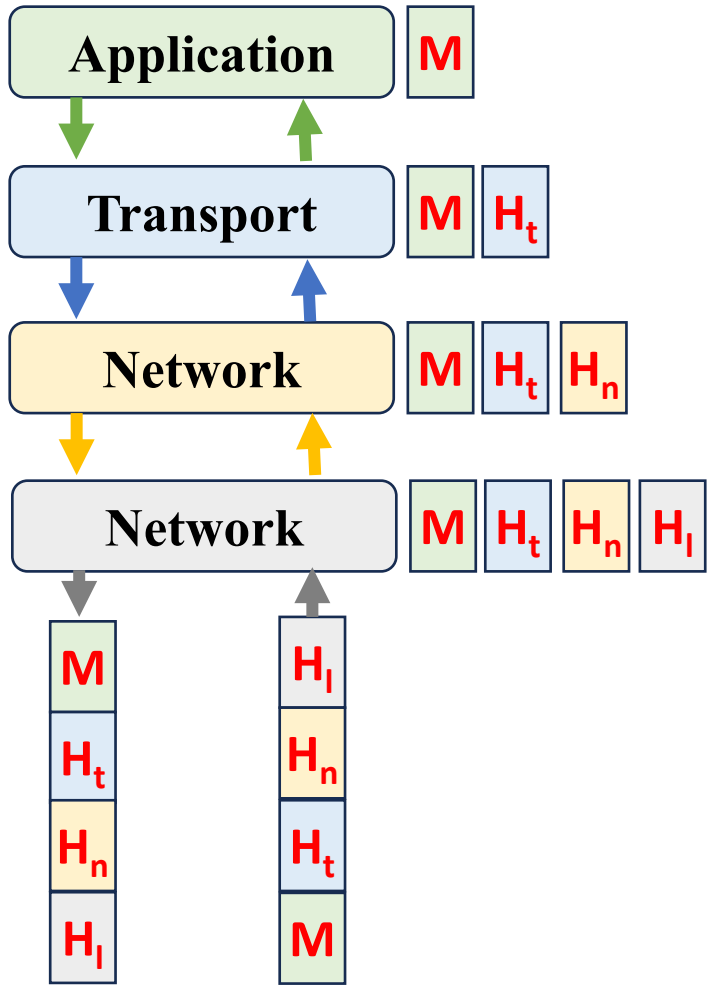


- **Transport Layer** links the two subgroups and ensures that what the lower layers have transmitted is in a form that the upper layer can use.

Question 4: What is data encapsulation (with respect to Questions 1-3)?

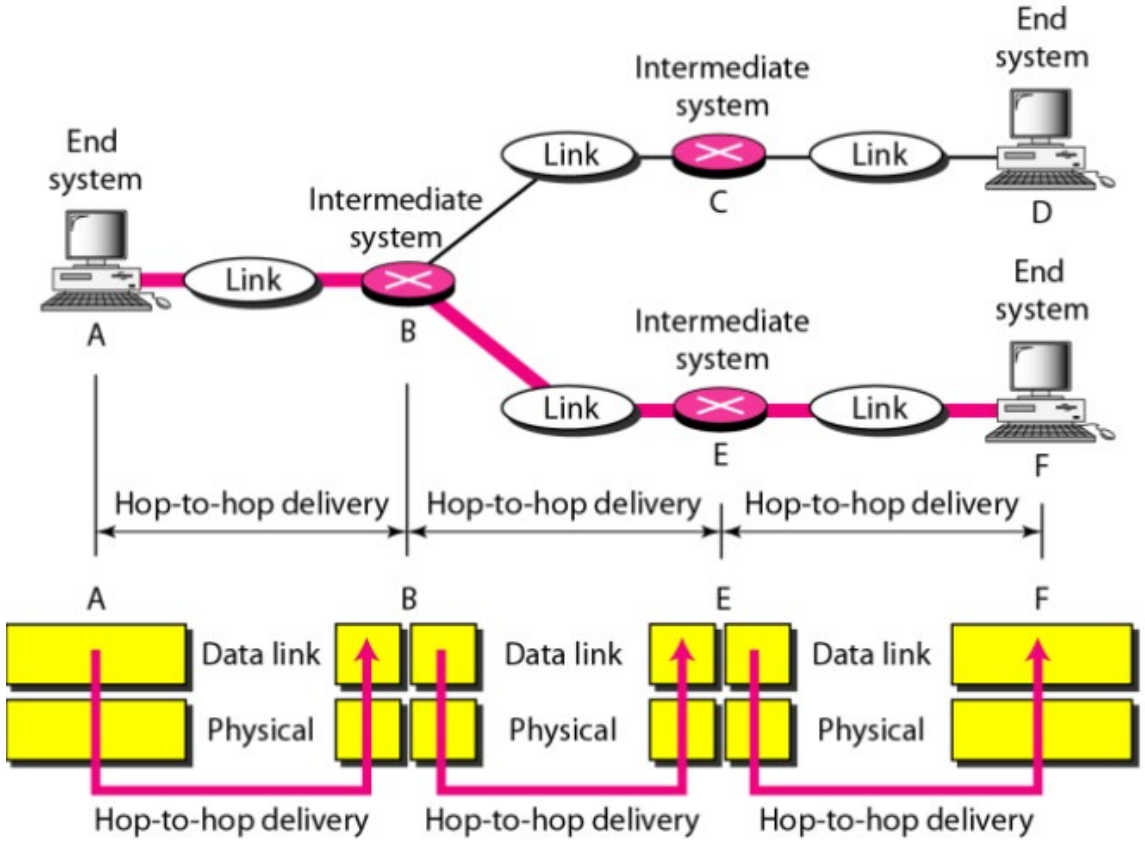
- Each layer in the sending device adds its own information (header and trailer) to the message received from the layer above it, then passes the entire package to the layer below. This process is known as data encapsulation.





Question 5: What are the responsibilities of the Data Link layer?

- **Framing Data Bits**: Divides the stream of bits received from the network layer into manageable frames.
- **Moving Frames**: Transfers frames from one hop (node) to the next in the network.
- **Physical Addressing**: Provides physical addresses (MAC addresses) for identifying the sender and receiver.
- **Flow Control**: Prevents the sender from overwhelming the receiver with too much data too quickly.
- **Error Control**: Adds reliability by detecting and correcting errors in the data transmitted over the physical layer.
- **Access Control**: Manages which device has control over the network link at any given time to avoid conflicts.



Question 06: What is the difference between Network layer and Transport layer delivery?

- Transport-layer protocol provides logical communication between processes running on different hosts.
- Network-layer protocol provides logical communication between hosts.

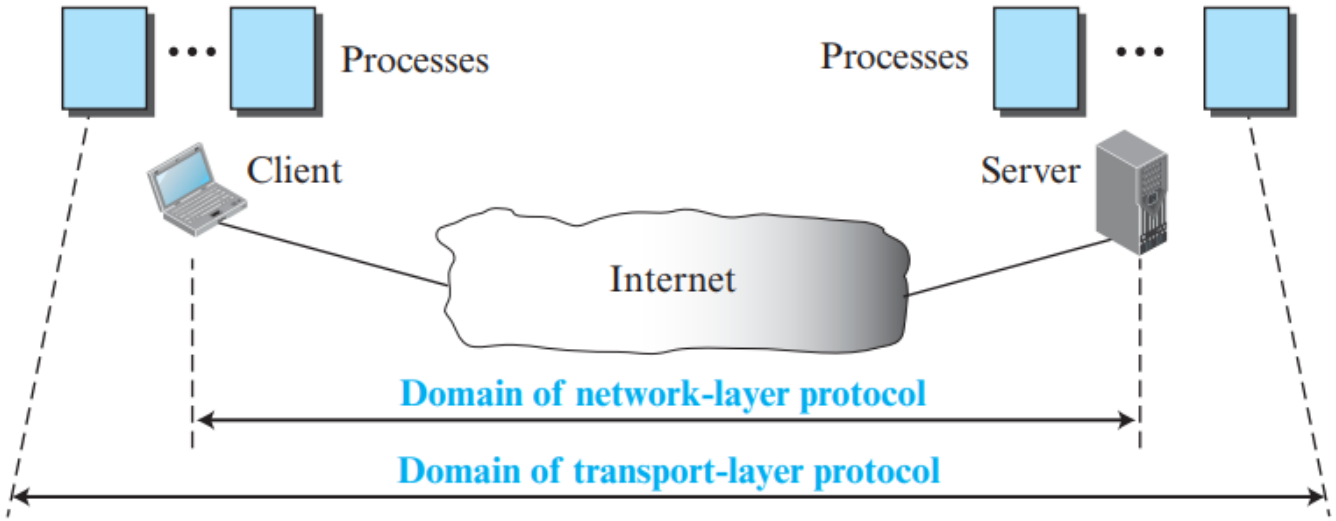


Fig 1.2: Domains of a network layer and a transport layer.

A network-layer protocol can deliver the message only to the destination computer.

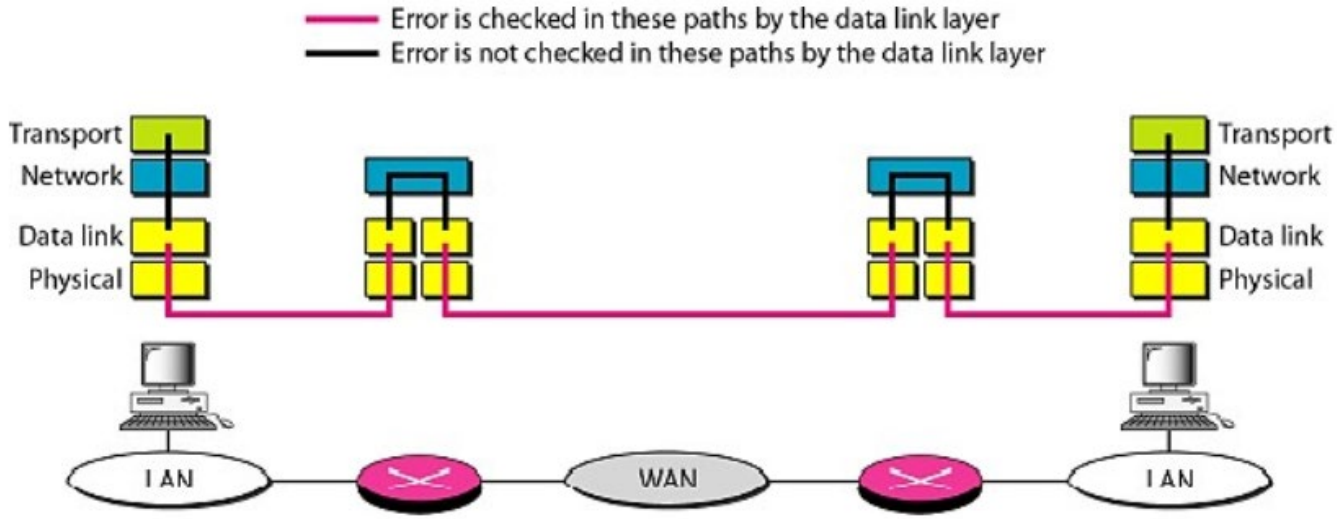
A transport-layer protocol is responsible for delivery of the message to the appropriate process.

Network Layer uses Logical Address (IP)

Transport Layer uses Port Address

Question 07: **If the Data link layer can detect errors between hops, why do you think we need another mechanism at the Transport layer?**

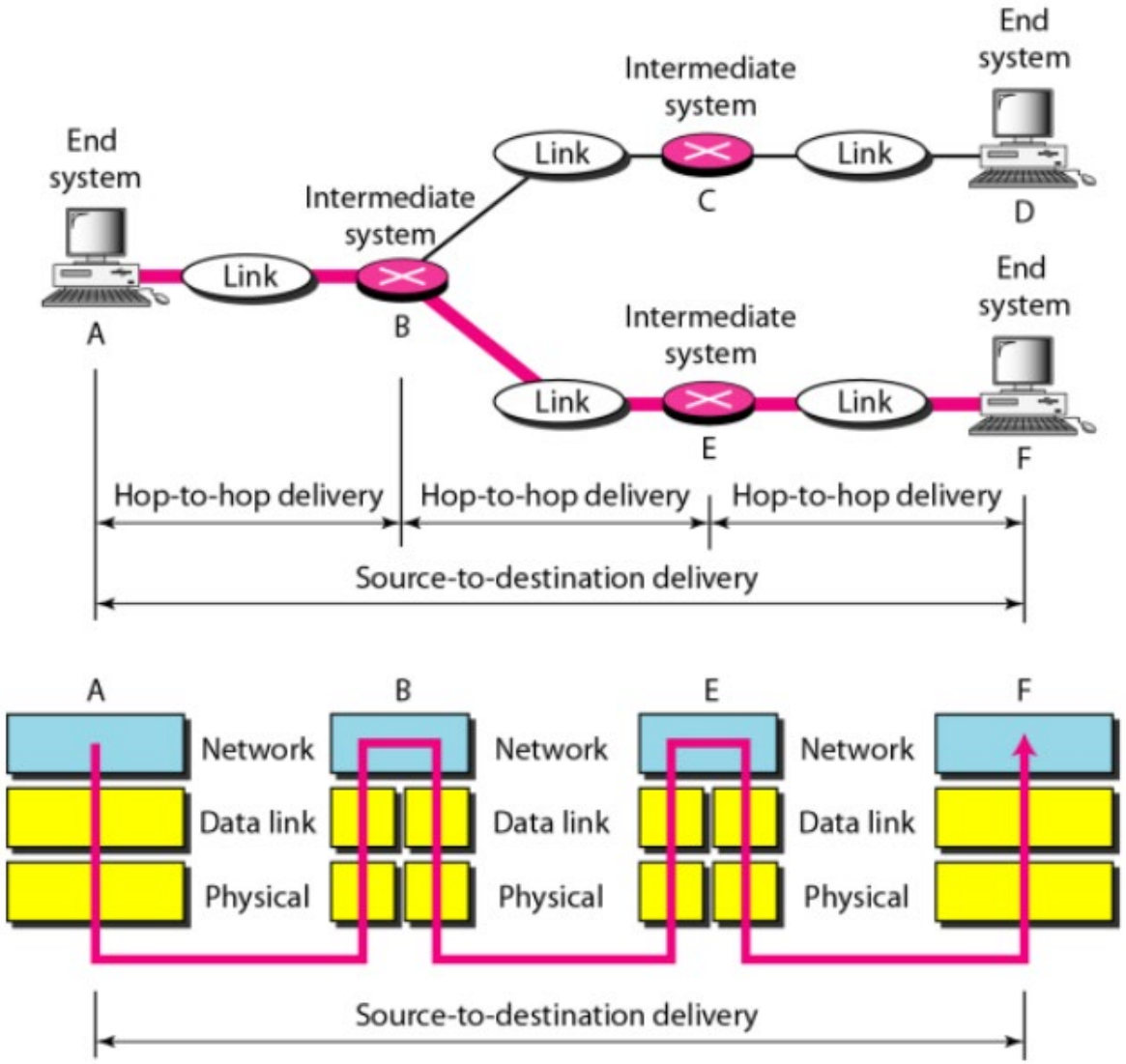
- ❑ Error Control is the issue that occurs at data link layer and transport level as well.
- ❑ The errors between the nodes can be detected by the data link layer control, but the error occurred in the paths (black color) can't be detected by the data link layer.
- ❑ The network layer on the Internet is unreliable and hence it is required to implement error control at the transport layer also.



- ➢ The error control in the data link layer, works at the packet or stream level.
- ➢ The error control in the transport layer, works at the message level.
- ➢ The data link layer is not concerned with ordering of packets, while the transport layer is.

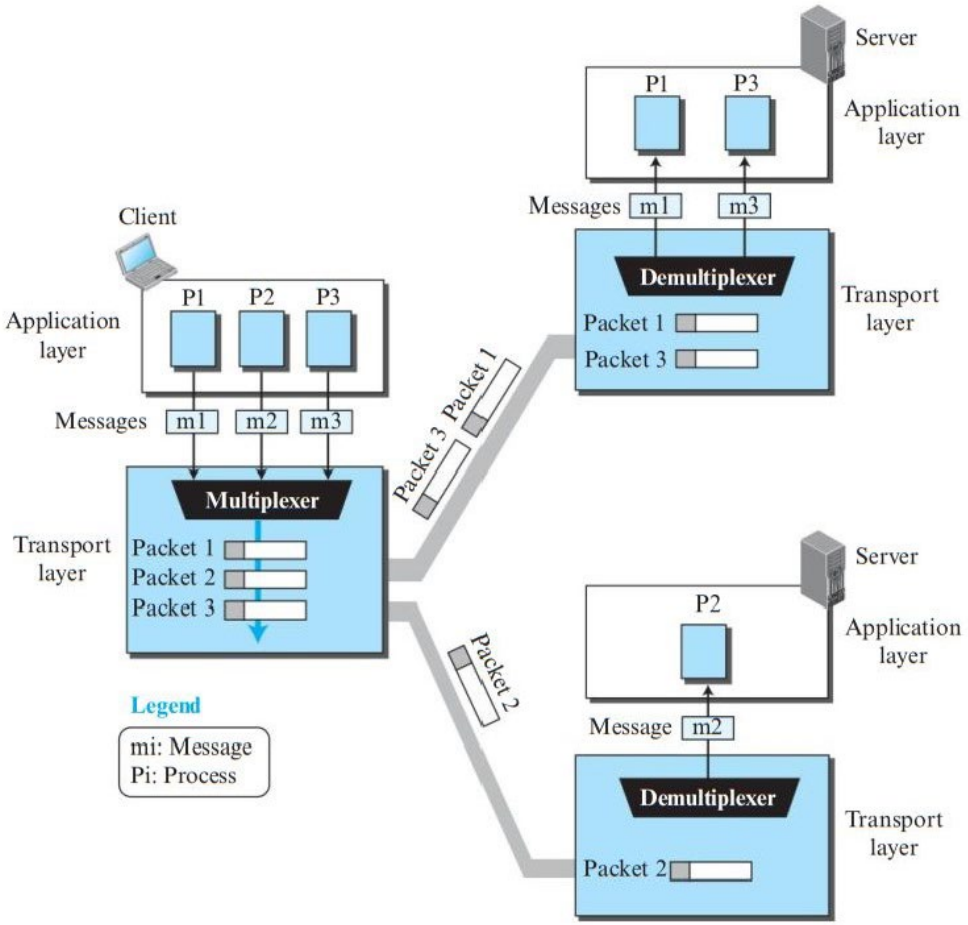
Question 8: What are the responsibilities of the Network layer?

- **Moving Packets**: The network layer is responsible for delivering individual packets from the source host to the destination host.
- **Logical Addressing**: This layer uses logical addresses to differentiate between source and destination systems. It adds a header to each packet containing the sender's and receiver's addresses.
- **Routing**: In large networks formed by connecting multiple independent networks or links, the network layer handles the routing of packets to ensure they reach their final destination.



Question 09: What are the responsibilities of the Transport layer?

Some of the responsibilities of Transport layer are as follows:



1. Moving Message: Delivers message from one process to another**.**

2. Port Addressing: As many processes may be running on the communicating hosts, it is necessary to identify the desired process out of many processes. For this, the transport layer header must include a service port address in each segment. (HTTP: 80, SMTP: 25).

3. Segmentation and Reassembly: A message is divided into segments by the transport layer with each segment being given a sequence number. These sequence numbers enable the destination transport layer to reassemble the segments in exact order as they were sent by the sender.

4. Flow Control: The-transport layer is responsible for controlling the flow of data such that no sending process should send segments at a rate faster than the receiving process can process.

5. Error Control: The transport layer provides process-to-process error control rather than across a single link as provided by the data link layer.

Question 10: What is the difference between a port address, a logical address, and a physical address?

Physical and Data link layer relates to **Physical address**.

Physical Address: The physical address is the local address of a node; it is used by the data link layer to deliver data from one node to another within the same network.

Physical address is also known by other names including **Link address, Media Access Control (MAC) address** and **Hardware address**.

Example: MAC address is 6 bytes long as shown in Fig. 1.4. One interesting property of MAC addresses is that no two adapters have the same address.

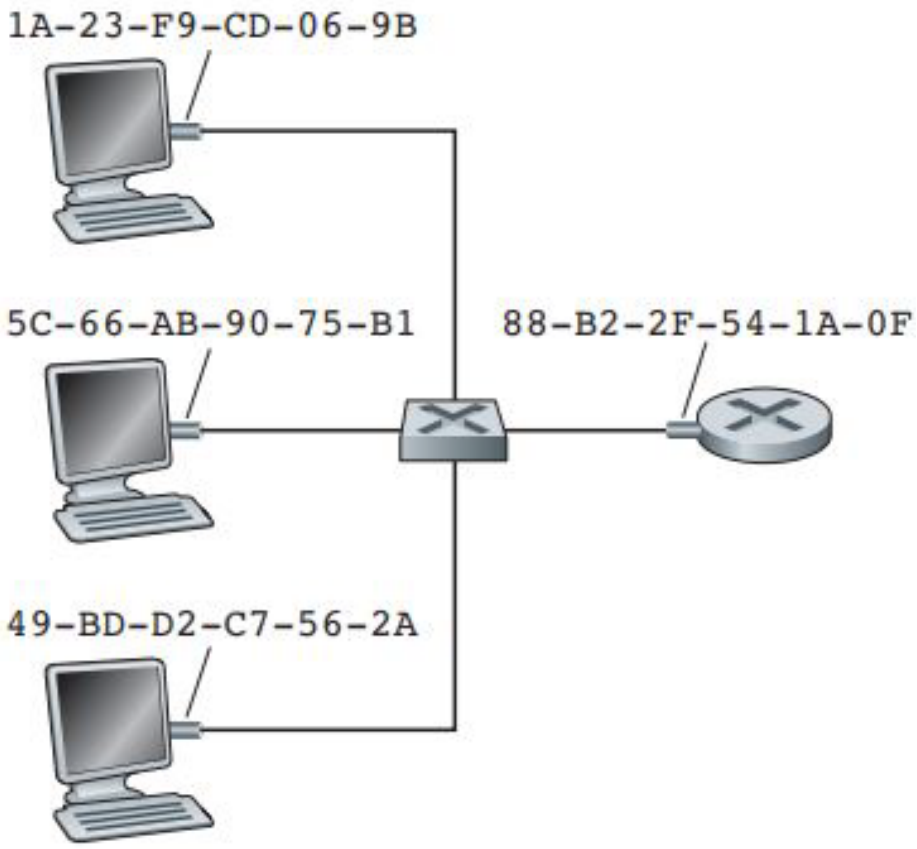


Fig. 1.4: Each interface connected to a LAN has a unique MAC address

Question 10: What is the difference between a port address, a logical address, and a physical address?

Network layer relates to **Logical address**

Logical Address: The logical address defines the sender and receiver at the network layer and is used to deliver messages across multiple networks. IPv4: 32 bit and IPv6: 128 bit.

Example: Each host has a single IP address and single MAC address shown in Fig 1.4. The router has multiple IP/MAC addresses

IP addresses **dotted-decimal** notation.
MAC addresses **hexadecimal** notation.
This address is used by network layer to identify a particular network.

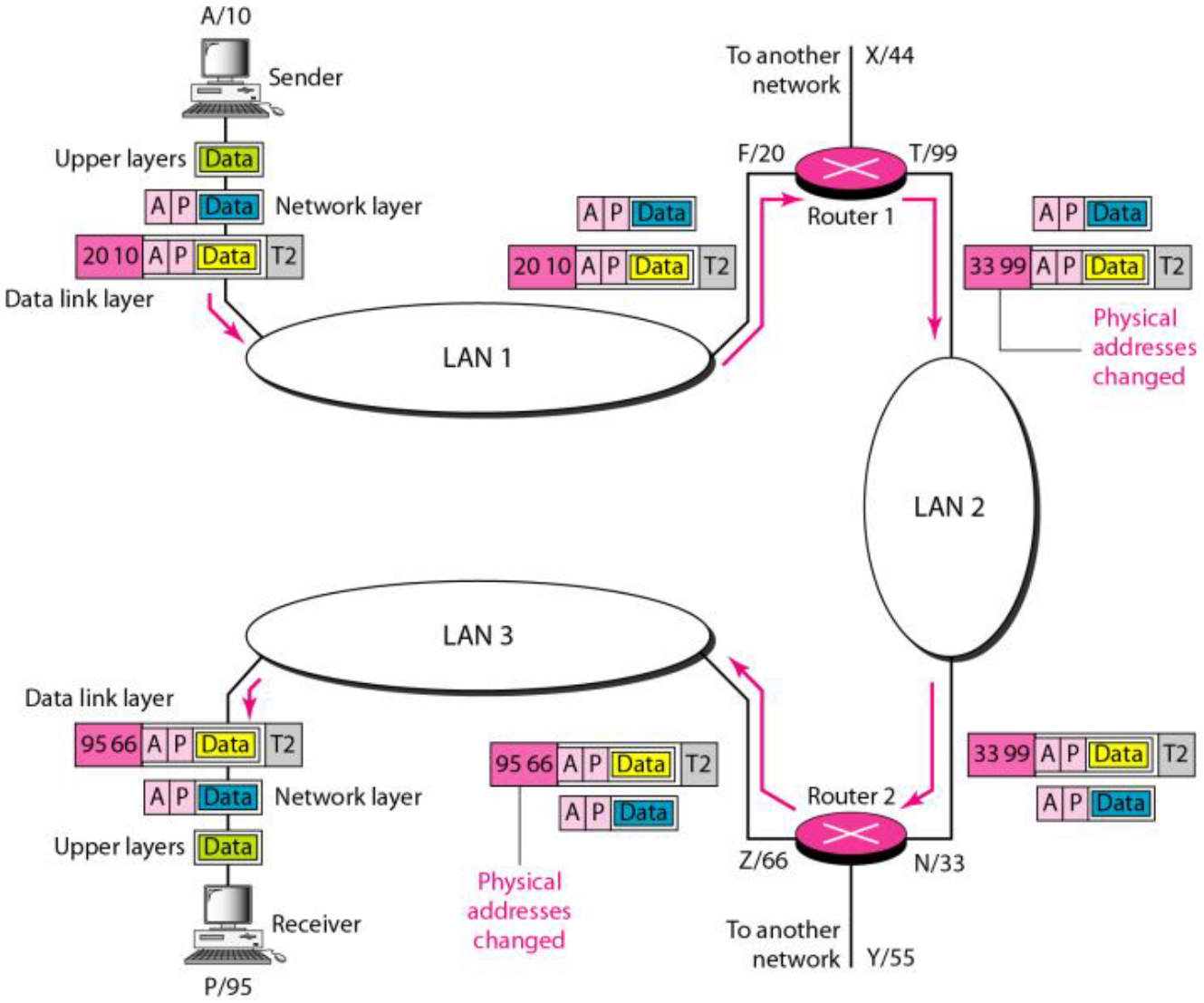


Fig. 1.4: Logical Addressing

Question 10: What is the difference between a port address, a logical address, and a physical address?

Data Link layer relates to **Physical address**

Physical Address: MAC Physical address defines the sender and receiver at the data link layer and is used to deliver messages in the same LAN.

Example: Each Ethernet port on the router has its own unique hardware MAC address (3 in Fig. 1.4).

MAC addresses are used to identify which physical Ethernet port to use to reach the next destination (see "Physical address changed" in Fig. 1.4) which might not be the final destination.

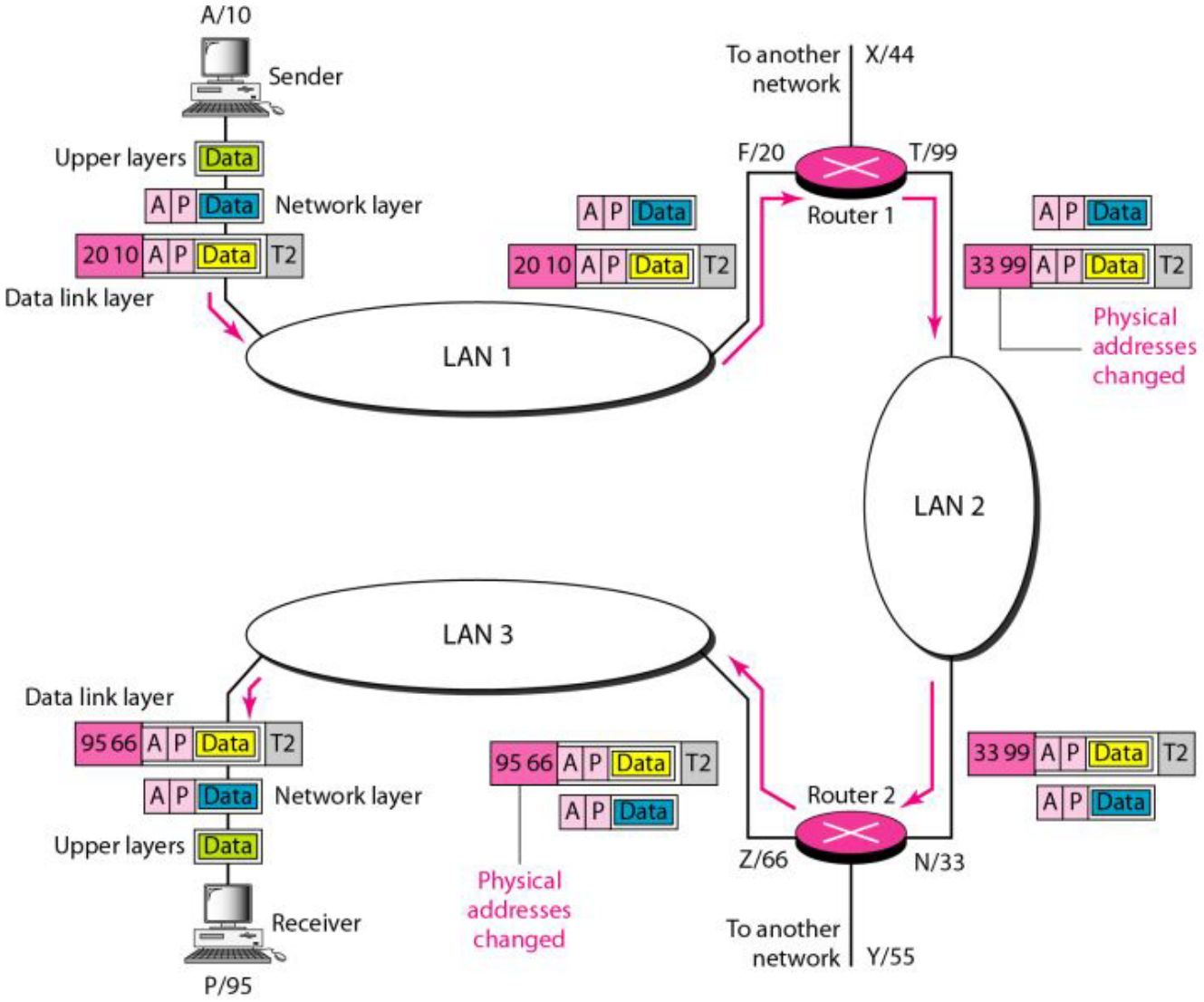


Fig. 1.4: Logical Addressing

Question 10: **What is the difference between a port address, a logical address, and a physical address?**

Transport layer concerns with **Port address**.

Port Address: The port address (service-point) identifies the application process on the station. Since multiple processes may be running simultaneously on the host machine, there should be some means to identify the process to which data is to be communicated.

Each running process is assigned with a label what is known as port address.

In TCP/IP architecture, port address is of 16 bits.

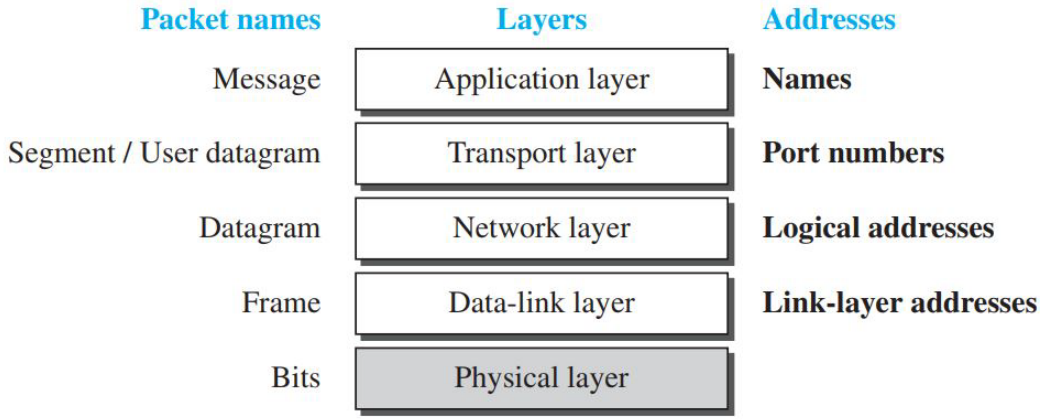
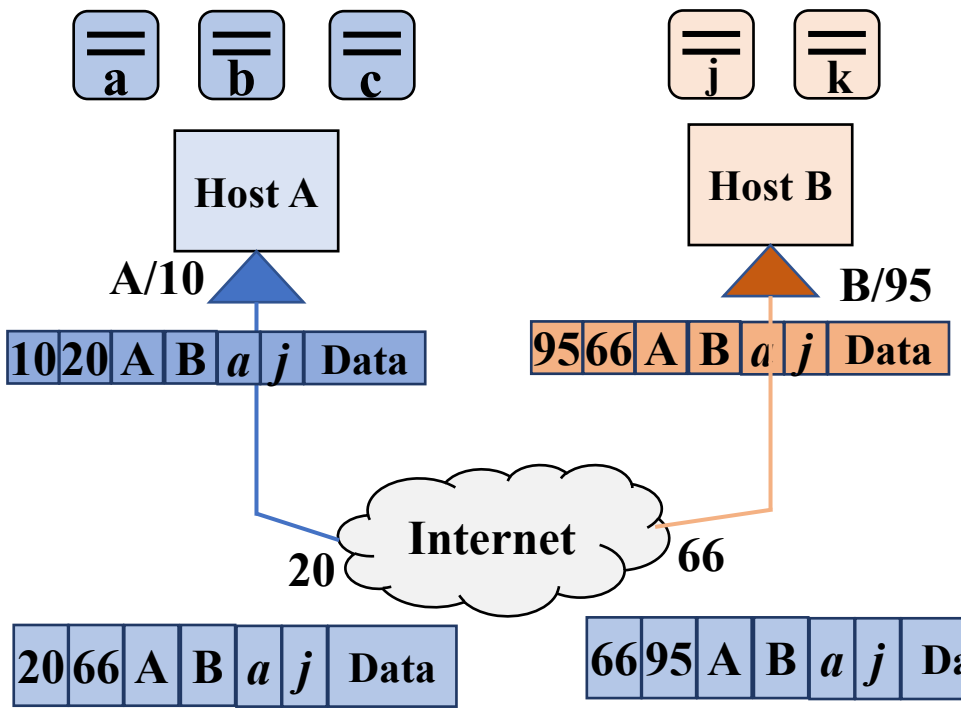


Fig. 1.5: Addressing in the TCP/IP protocol suite

Port #	Protocol
21	FTP Control
20	FTP Data
23	Telnet
25	SMTP
53	DNS
80	HTTP
110	POP3
143	IMAP

Question 10: **What is the difference between a port address, a logical address, and a physical address?**



Consider Host A and B are connected through Internet.

A/10 : Logical/Physical Address

Host A: 3 processes *a, b, c*; Host B: 2 processes *j* and *k*

Process *a* generates some data and should be transmitted to process *j* of Host B. **Data**

To ensure the process delivery, Transport Layer encapsulates the source and destination **port address** to the data and creates Segment. ***a*** ***j*** **Data**

Then, Network layer adds the **logical address** (IP Add) of Host A and B to the Segment and creates Datagram (Packets)

A **B** ***a*** ***j*** **Data**

After that, Data Link Layer add **the physical address** of the Source and Next Hop, which creates Frame.

10 **20** **A** **B** ***a*** ***j*** **Data**

Question 11: Name some services provided by the Application layer.

Application Layer: The Application Layer is the seventh layer of the seven-layer OSI model. Application layer provides services to the user through logical communication.

Application layer interface directly interacts with the application and provides common web application services, includes

✓ Remote file Access and Transfer (FTP) service.

✓ Electronic mail services (SMTP).

✓ Network virtual terminal services (TELNET)

✓ Web browsing services (HTTP)

✓ To resolve hostnames to IP addresses (DNS)

✓ Management and monitor the network-connected devices in Internet (SNMP)

Question 11: Name some services provided by the Application layer.

Application layer port numbers are assigned to different services and protocols at the application layer of the TCP/IP or OSI models. Here are some common application layer protocols and their associated port numbers

Port #	Application Layer Protocol	Type	Description
20	FTP	TCP	File Transfer Protocol - data
21	FTP	TCP	File Transfer Protocol - control
22	SSH	TCP/UDP	Secure Shell for secure login
23	Telnet	TCP	Unencrypted login
25	SMTP	TCP	Simple Mail Transfer Protocol
53	DNS	TCP/UDP	Domain Name Server
67/68	DHCP	UDP	Dynamic Host
80	HTTP	TCP	HyperText Transfer Protocol
123	NTP	UDP	Network Time Protocol
161,162	SNMP	TCP/UDP	Simple Network Management Protocol
389	LDAP	TCP/UDP	Lightweight Directory Authentication Protocol
443	HTTPS	TCP/UDP	HTTP with Secure Socket Layer

Question 12: What are the advantages of combining Session, Presentation and Application layers of the OSI model to a single layer in the TCP/IP protocol suite.

Compared to OSI model, **Session** and **Presentation** are missing from the TCP/IP protocol suite.

The application layer in the suite is usually considered to be the combination of three layers in the OSI model. **Two reasons were mentioned for this decision:**

First, Some of the functionalities of the session layer are available in some of the transport-layer protocols.

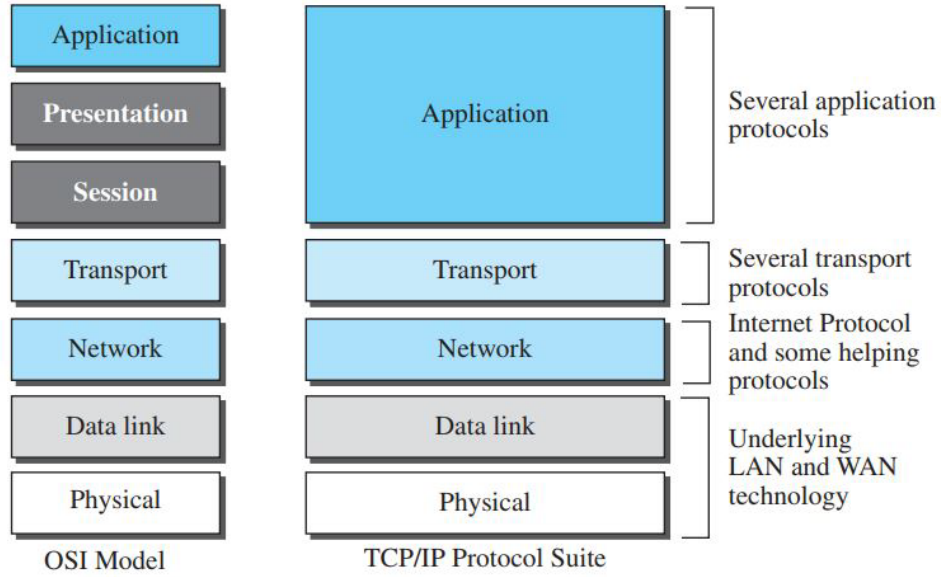


Fig. 1.7: TCP/IP and OSI model

Second, Applications and protocols at the application layer in the TCP/IP model can handle specific tasks related to data formatting, encryption, and session management as needed, without the need for separate layers. Which advantages:

- ✓ Flexibility
- ✓ Reduced redundancy
- ✓ Faster processing

- ✓ Less processing and energy consumption
- ✓ Simpler