TCP/IP V/S OSI MODEL

•Layers in the TCP/IP Protocol Suite

As shown in the figure 2.6, the duty of the application, transport, and network layers is end-to-end.
However, the duty of the data-link and physical layers is hop-to-hop.
The domain of duty of the top three layers is the internet. The domain of duty of the two lower layers is the link.
In top 3 layers, the data unit should not be changed by any router or link-layer switch.
In bottom 2 layers, the data unit is changed only by the routers, not by the link-layer switches.

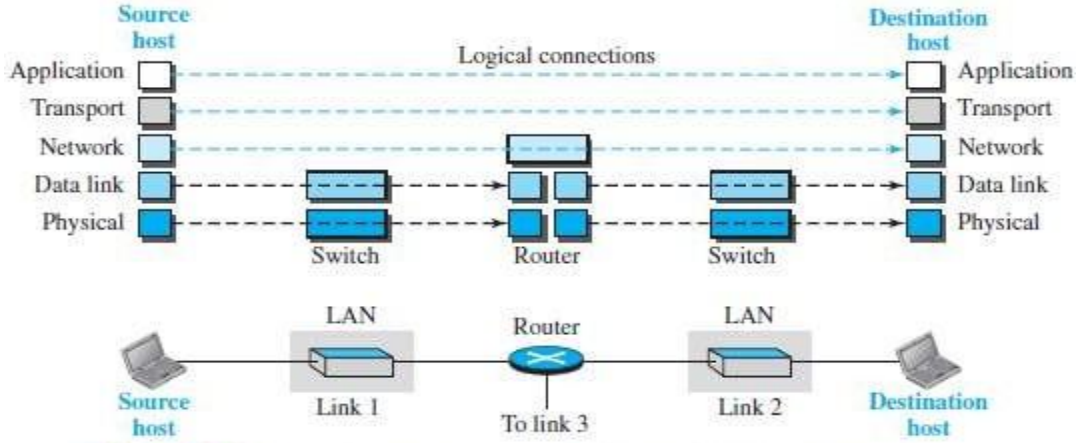

Figure 2.6 *Logical connections between layers of the TCP/IP protocol suite*

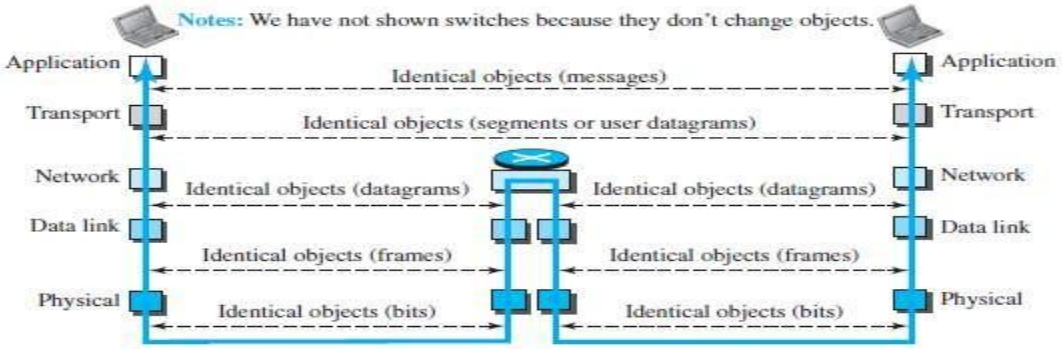

Figure 2.7 *Identical objects in the TCP/IP protocol suite*

Description of Each Layer

➢ Physical Layer

- The physical layer is responsible for movements of individual bits from one node to another node.
- Transmission media is another hidden layer under the physical layer.
- Two devices are connected by a transmission medium (cable or air).
- The transmission medium does not carry bits; it carries electrical or optical signals.
- The physical layer
- → receives bits from the data-link layer &
- → sends through the transmission media.

➢ Data Link Layer

- Data-link-layer (DLL) is responsible for moving frames from one node to another node over a link.
- The link can be wired LAN/WAN or wireless LAN/WAN.
- The data-link layer
- → gets the datagram from network layer
- → encapsulates the datagram in a packet called a frame.
- → sends the frame to physical layer.
- TCP/IP model does not define any specific protocol.
- DLL supports all the standard and proprietary protocols.

- **Network Layer**

- The network layer is responsible for source-to-destination transmission of data
- TCP/IP model defines 5 protocols:
- 1) IP (Internetworking Protocol) 2) ARP (Address Resolution Protocol)
- 3) ICMP (Internet Control Message Protocol) 4) IGMP (Internet Group Message Protocol)
- **IP**
  - IP is the main protocol of the network layer.
  - IP defines the format and the structure of addresses.
  - IP is also responsible for routing a packet from its source to its destination.
  - It is a connection-less & unreliable protocol.
- → Packets may get dropped during transmission.
  - It provides a best-effort delivery service.
  - Best effort means IP does its best to get the packet to its destination, but with no guarantees.
  - IP does not provide following services
- → flow control
- → error control
- → congestion control services.
  - If an application requires above services, the application should rely only on the transport- layer protocol.
- **ARP**
  - ARP is used to find the physical-address of the node when its Internet-address is known.
  - Physical address is the 48-bit address that is imprinted on the NIC or LAN card.
  - Internet address (IP address) is used to uniquely & universally identify a device in the internet.
- **ICMP**
  - ICMP is used to inform the sender about datagram-problems that occur during transit.
- **IGMP**
  - IGMP is used to send the same message to a group of recipients.

➢ Transport Layer

- The transport layer

→ gets the message from the application layer
→ encapsulates the message in a packet called a segment and
→ sends the segment to network layer.

- TCP/IP model defines 3 protocols:1) TCP (Transmission Control Protocol)
  UDP (User Datagram Protocol) &SCTP (Stream Control Transmission Protocol)
- **TCP**
  - TCP is a reliable connection-oriented protocol.
  - A connection is established b/w the sender and receiver before the data can be transmitted.
  - TCP provides
- → flow control
- → error control and
- → congestion control
- **UDP**
  - UDP is the simplest of the 3 transport protocols.
  - It is an unreliable, connectionless protocol.
  - It does not provide flow, error, or congestion control.
  - Each datagram is transported separately & independently.
  - It is suitable for application program that
- → needs to send short messages &
- → cannot afford the retransmission.
- **SCTP**
  - SCTP provides support for newer applications such as voice over the Internet.
  - It combines the best features of UDP and TCP.

➢ Application Layer

- Process-to-process communication is the duty of the application layer.
- TCP/IP model defines following protocols:
- SMTP is used to transport email between a source and destination.
- TELNET is used for accessing a site remotely.
- FTP is used for transferring files from one host to another.
- DNS is used to find the IP address of a computer.
- SNMP is used to manage the Internet at global and local levels.
- HTTP is used for accessing the World Wide Web (WWW).
- (FTP à File Transfer Protocol SMTP à Simple Mail Transfer Protocol)
- (DNS à Domain Name System HTTP à Hyper Text Transfer Protocol) (SNMP à Simple Network Management Protocol TELNET à Terminal Network)

- **Encapsulation and Decapsulation**

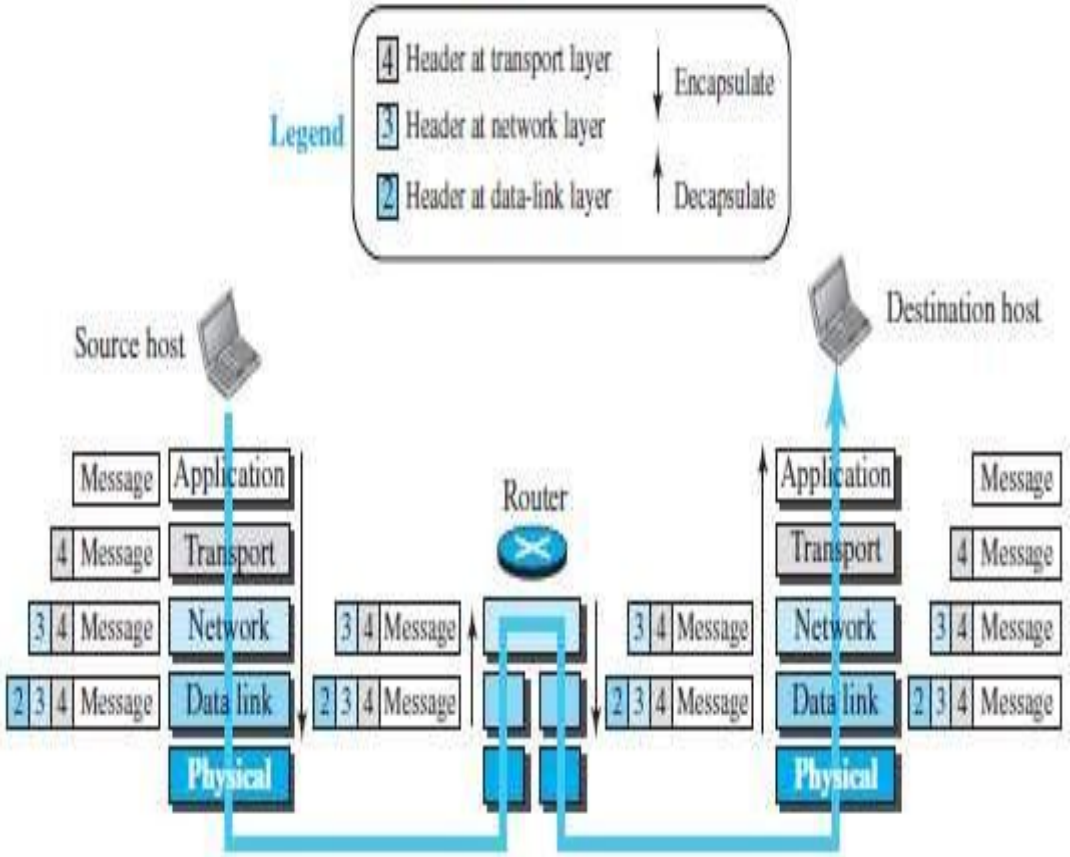

Figure 2.8 *Encapsulation/Decapsulation*

- **Addressing**

- We have logical communication between pairs of layers.
- Any communication that involves 2 parties needs 2 addresses: source address and destination address.
- We need 4 pairs of addresses (Figure 2.9):
- At the application layer, we normally use names to define
- → site that provides services, such as vtunotesbysri.com, or
- → e-mail address
- At the transport layer, addresses are called port numbers.
  - Port numbers define the application-layer programs at the source and destination.
  - Port numbers are local addresses that distinguish between several programs running at the same time.
- At the network-layer, addresses are called IP addresses.
  - IP address uniquely defines the connection of a device to the Internet.
  - The IP addresses are global, with the whole Internet as the scope.
- At the data link-layer, addresses are called MAC addresses
  - The MAC addresses defines a specific host or router in a network (LAN or WAN).
  - The MAC addresses are locally defined addresses

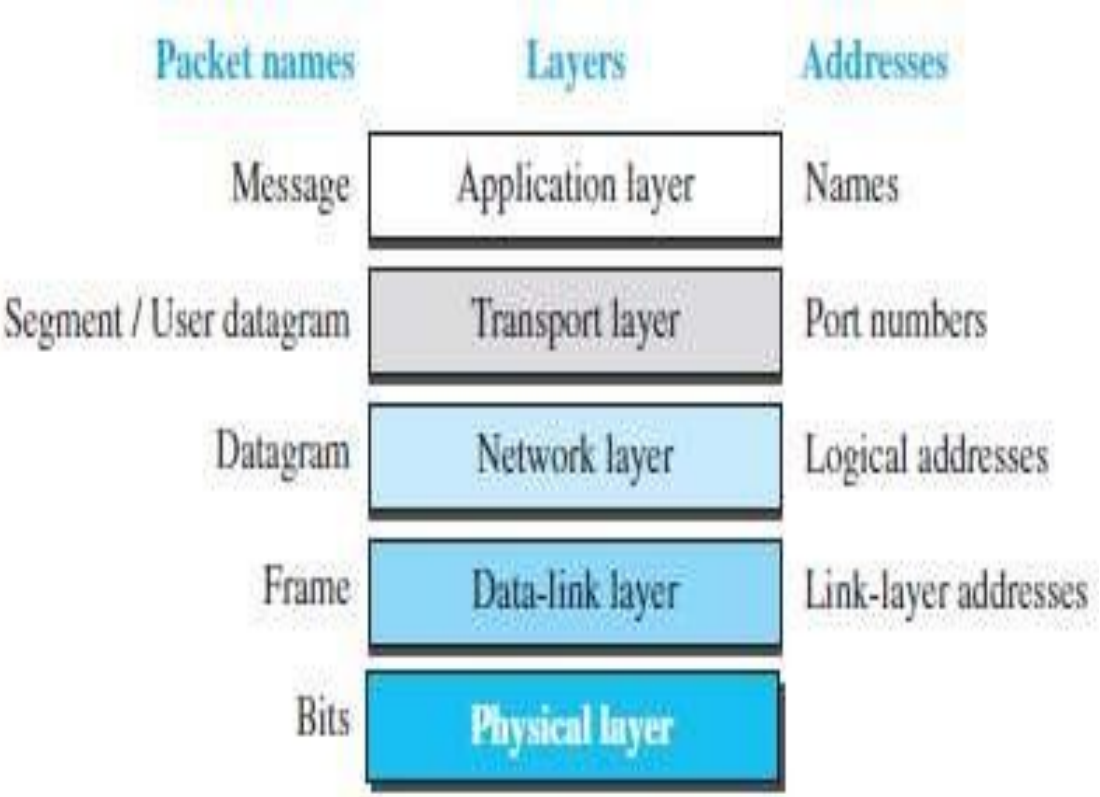

Figure 2.9 *Addressing in the TCP/IP protocol suite*

• Multiplexing and Demultiplexing

- Multiplexing means a protocol at a layer can encapsulate a packet from several next-higher layer protocols (one at a time) (Figure 2.10).
- Demultiplexing means a protocol can decapsulate and deliver a packet to several next-higher layer protocols (one at a time).
- At transport layer, either UDP or TCP can accept a message from several application-layer protocols.
- At network layer, IP can accept
- → a segment from TCP or a user datagram from UDP.
- → a packet from ICMP or IGMP.
- At data-link layer, a frame may carry the payload coming from IP or ARP.

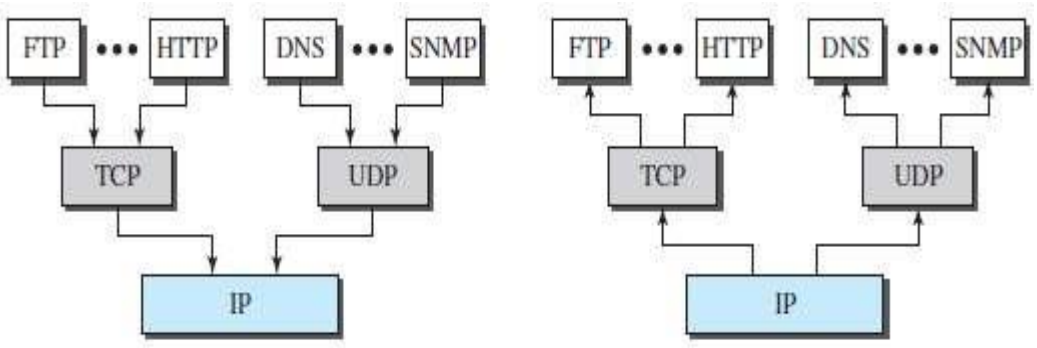

Figure 2.10 *Multiplexing and demultiplexing*

- **OSI MODEL**

- OSI model was developed by ISO.
- ISO is the organization, OSI is the model.
- Purpose: OSI was developed to allow systems with diff. platforms to communicate with each other.
- Platform means hardware, software or operating system.
- OSI is a network-model that defines the protocols for network communications.
- OSI has 7 layers as follows (Figure 2.11):
- Application Layer
- Presentation Layer
- Session Layer
- Transport Layer
- Network Layer
- Data Link Layer
- Physical Layer
- Each layer has specific duties to perform and has to co-operate with the layers above & below it.

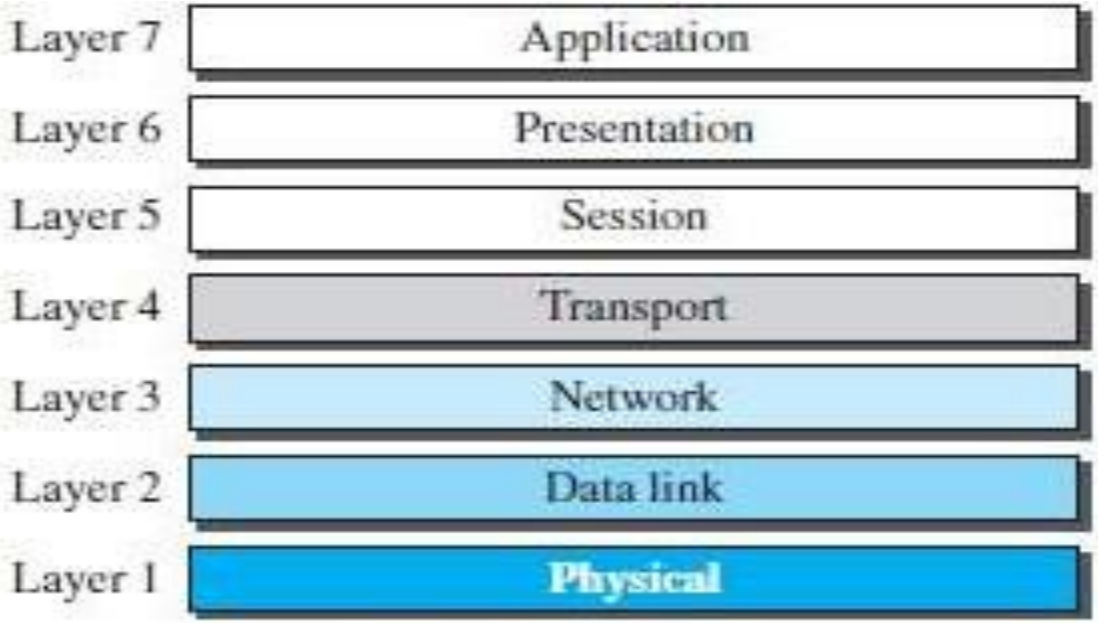

Figure 2.11 *The OSI model*

LAYER 7: APPLICATION

- It provides network services to the user's applications.
- It differs from the other layers in that it does not provide services to any other OSI layer, but rather, only to applications outside the OSI model.
- Examples of such applications are spreadsheet programs, word processing programs, and bank terminal programs.
- The application layer establishes the availability of intended communication partners, synchronizes and establishes agreement on procedures for error recovery and control of data integrity.

LAYER 6: PRESENTATION

- The presentation layer ensures that the information that the application layer of one system sends out is readable by the application layer of another system.
- If necessary, the presentation layer translates between multiple data formats by using a common format.
- Provides encryption and compression of data.
- Examples :- JPEG, MPEG, ASCII, EBCDIC, HTML

LAYER 5: SESSION • The session layer defines how to start, control and end conversations (called sessions) between applications.
• This includes the control and management of multiple bi-directional messages using dialogue control.
• It also synchronizes dialogue between two hosts' presentation layers and manages their data exchange.
• The session layer offers provisions for efficient data transfer. • Examples :- SQL, ASP(AppleTalk Session Protocol).

LAYER 4: TRANSPORT
• The transport layer regulates information flow to ensure end-to-end connectivity between host applications reliably and accurately.
• The transport layer segments data from the sending host's system and reassembles the data into a data stream on the receiving host's system.
• The boundary between the transport layer and the session layer can be thought of as the boundary between application protocols and data-flow protocols.
• Layer 4 protocols include TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

- LAYER 3: NETWORK • Defines end-to-end delivery of packets. • Defines logical addressing so that any endpoint can be identified. • Defines how routing works and how routes are learned so that the packets can be delivered. • The network layer also defines how to fragment a packet into smaller packets to accommodate different media. • Routers operate at Layer 3. • Examples :- IP, IPX, AppleTalk

- LAYER 2: DATA LINK • The data link layer provides access to the networking media and physical transmission across the media and this enables the data to locate its intended destination on a network. • The data link layer provides reliable transit of data across a physical link by using the Media Access Control (MAC) addresses. • The data link layer uses the MAC address to define a hardware or data link address in order for multiple stations to share the same medium and still uniquely identify each other. • Concerned with network topology, network access, error notification, ordered delivery of frames, and flow control. • Examples :- Ethernet, Frame Relay, FDDI.

- LAYER 1: PHYSICAL • The physical layer deals with the physical characteristics of the transmission medium.
- • It defines the electrical, mechanical, procedural, and functional specifications for activating, maintaining, and deactivating the physical link between end systems.
- • Such characteristics as voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, physical connectors, and other similar attributes are defined by physical layer specifications. • Examples :- EIA/TIA-232, RJ45, NRZ.