

COMPUTER NETWORKS

Module 1

INTRODUCTION

- Introduction
- Types networks
- OSI model
- Functions of OSI model
- TCP/IP protocol suite
- Performance metrics of Networks
- B-ISDN reference model

Data Communication Networks

- Data is defined as facts or figures, or information that's stored in or used by a computer
- Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Questions

- Q1. What are the five components of data communication?
 - Message
 - Sender
 - Receiver
 - Transmission medium
 - Protocol
- Q2. What do you mean by Node?
 - It is Electronic devices that are connected to the networks.
- Q3. What are the four fundamental characteristics of data communication?
 - Delivery
 - Accuracy
 - Timeliness
 - Jitter

Protocols

- A protocol is a set of rules that govern data communications.
- It determines
 - what is communicated,
 - how it is communicated and
 - when it is communicated.

- The key elements of a protocol are syntax, semantics and timing
- **Syntax**
 - Structure or format of the data
 - Indicates how to read the bits
- **Semantics**
 - Interprets the meaning of the bits
- **Timing**
 - Speed at which data should be sent or speed at which it is being received.

Networks

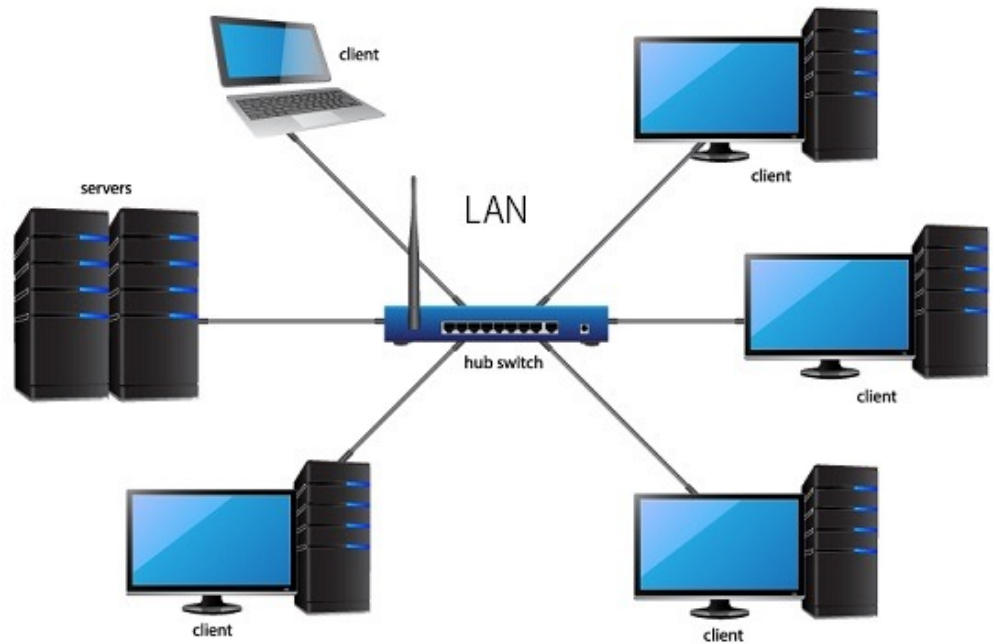
- A network is a set of devices or nodes connected by communication links.
- For example, computer, printer, or any other device are connected to a cable, air, optical fiber, or any medium which carry the information.

Types of Networks

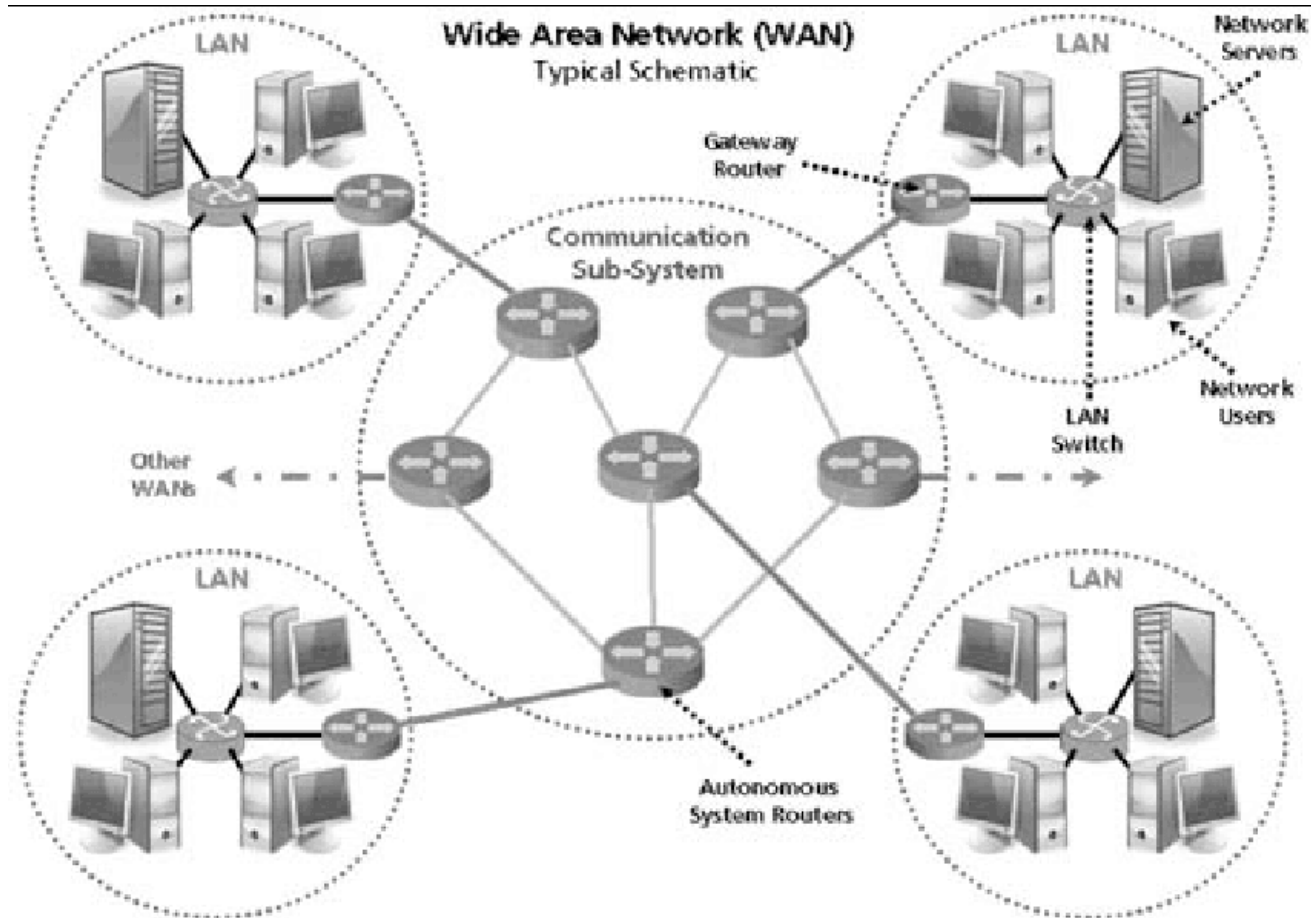
- Personal Area Networks(PANs)
 - Within the room



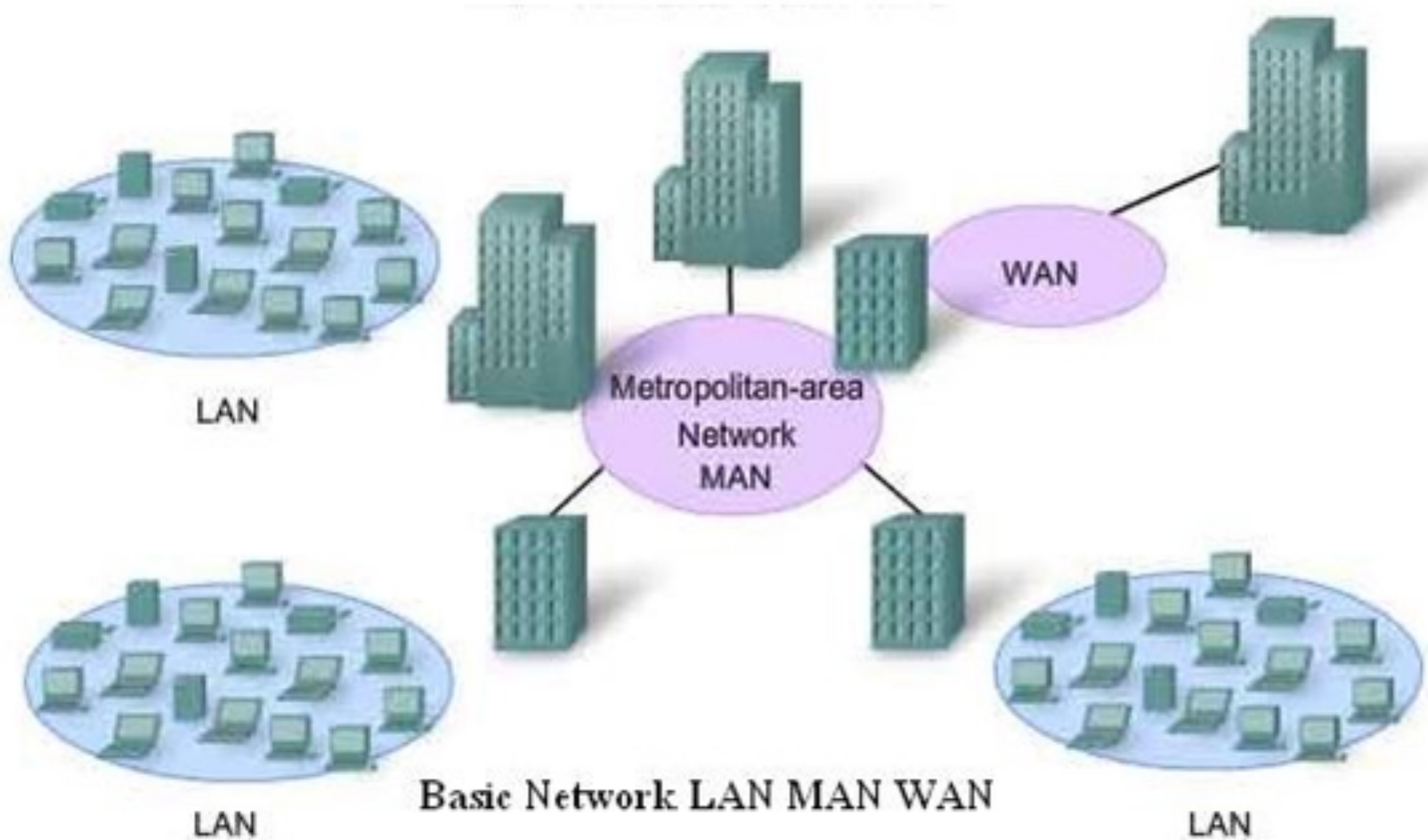
- Local Area Networks (LANs)
 - Short distances
 - Designed to provide local interconnectivity



- Wide Area Networks (WANs)
 - Long distances
 - Provide connectivity over large areas



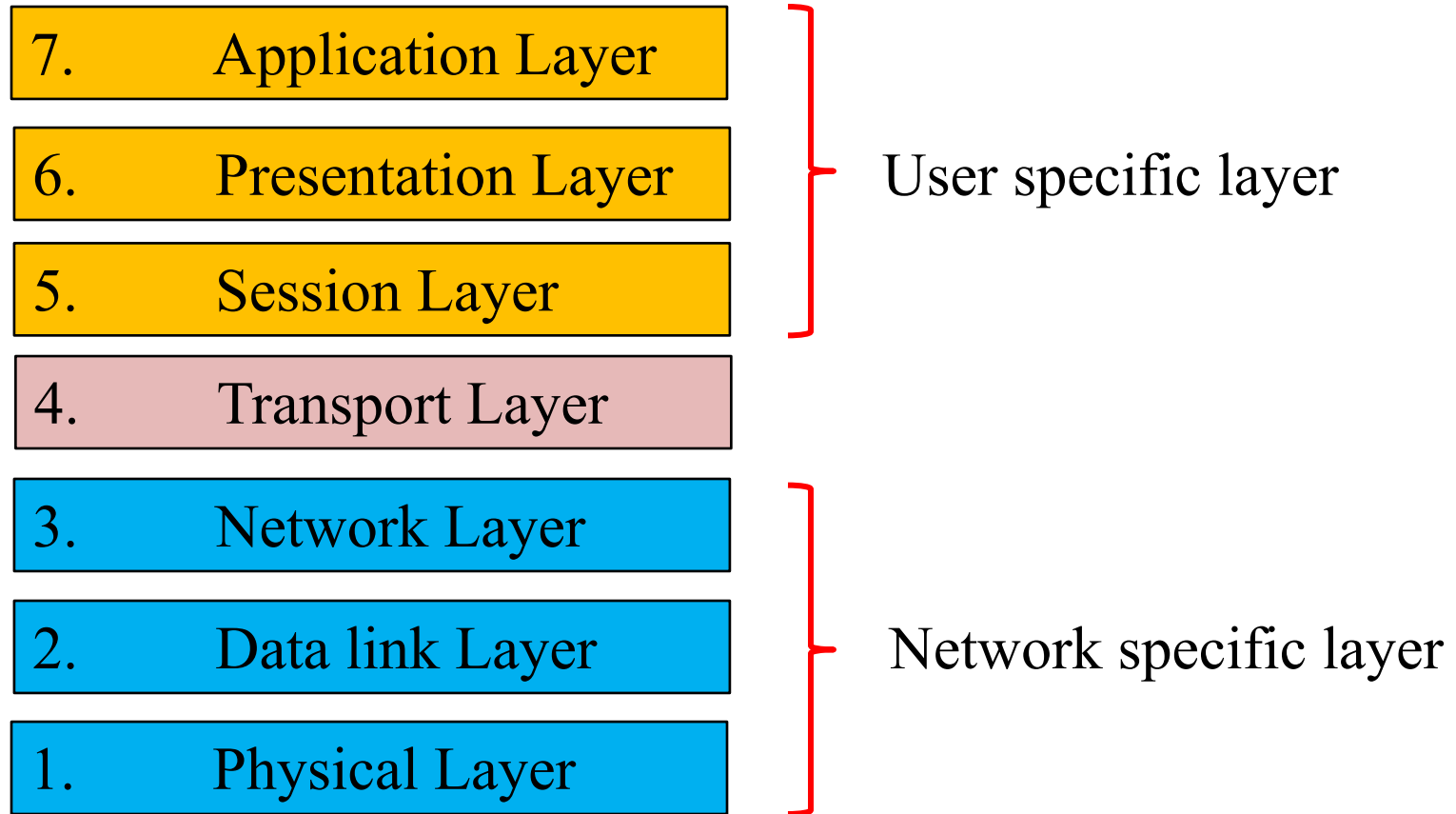
- Metropolitan Area Networks (MANs)
 - Provide connectivity over areas such as a city, a campus



OSI model

- Established in 1947, the International Standards Organization (**ISO**) is a multinational body dedicated to worldwide agreement on international standards.
- An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (**OSI**) model.

Seven layer of OSI model



Traditional letter sending process

- **Send a letter**

- 1. Write a letter, add the TO and FROM address to the envelope.
- 2. sending a registered post with acknowledgement
- 3. sending a letter to head post office, branch post office based on postal code. And also map the postal code into TO address.
- 4. every intermediate post office check the TO address.
- 5. Train, buses, airplane etc., carries the letter.

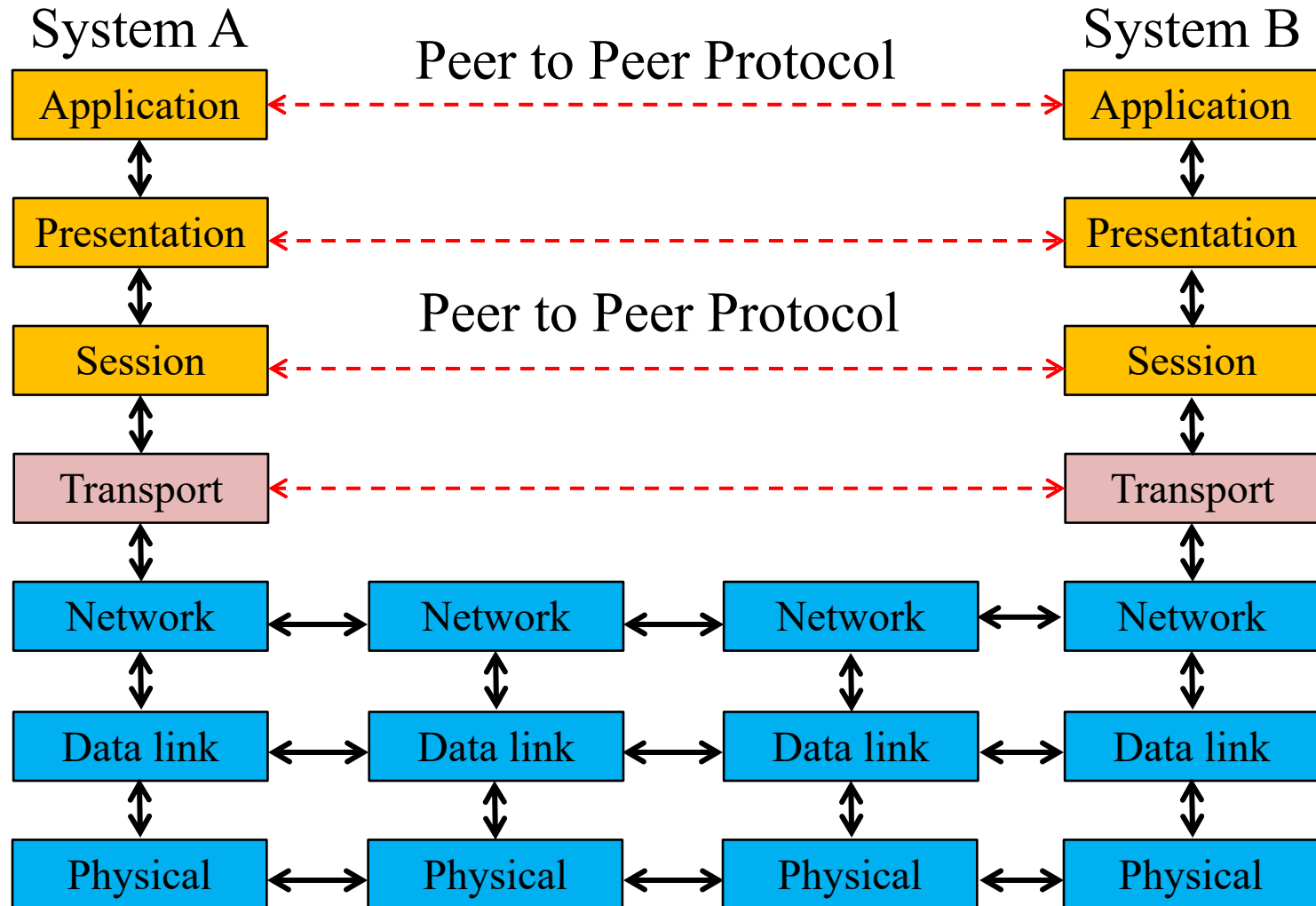
- **Network layer process**

- 1. Application layer (email)

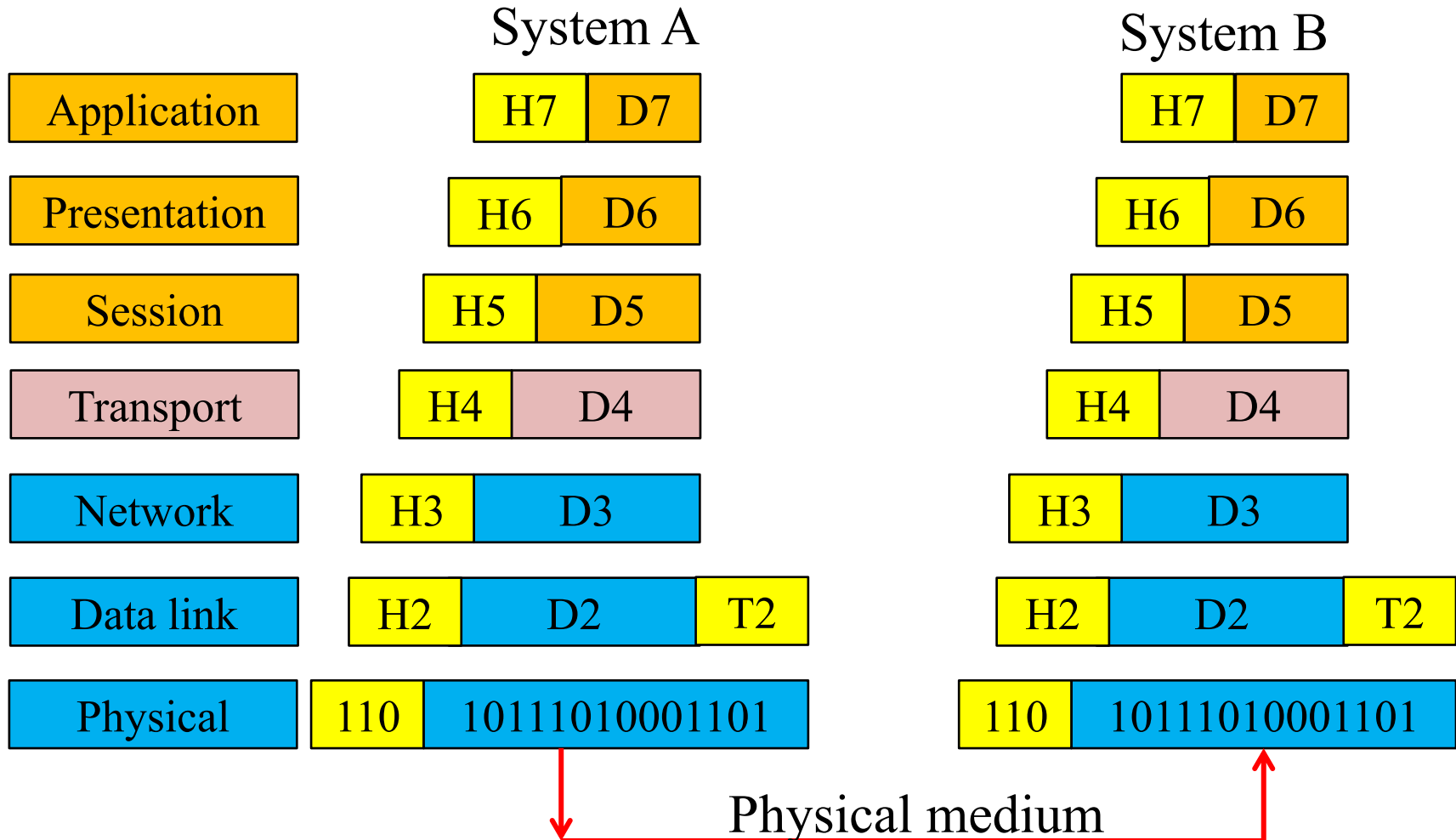
To address (ex: YYYY@gmail.com)

- 2. Transport layer (End to end delivery)
- 3. Network layer (using the IP – logical addressing to reach the destination)
- 4. Data link layer (check the error, flow control of the packet)
- 5. Wired or wireless medium

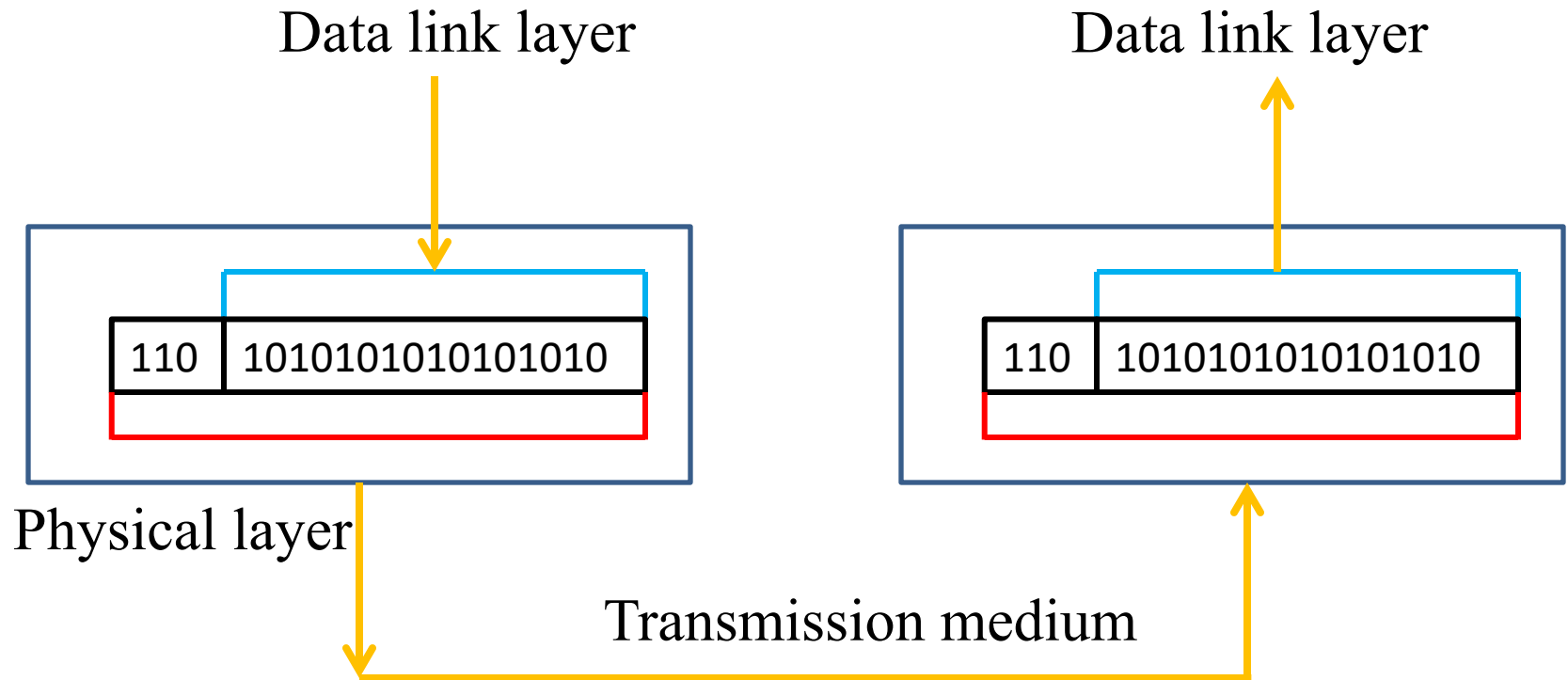
Inter connection between the layers



Data exchange using OSI model



Physical layer



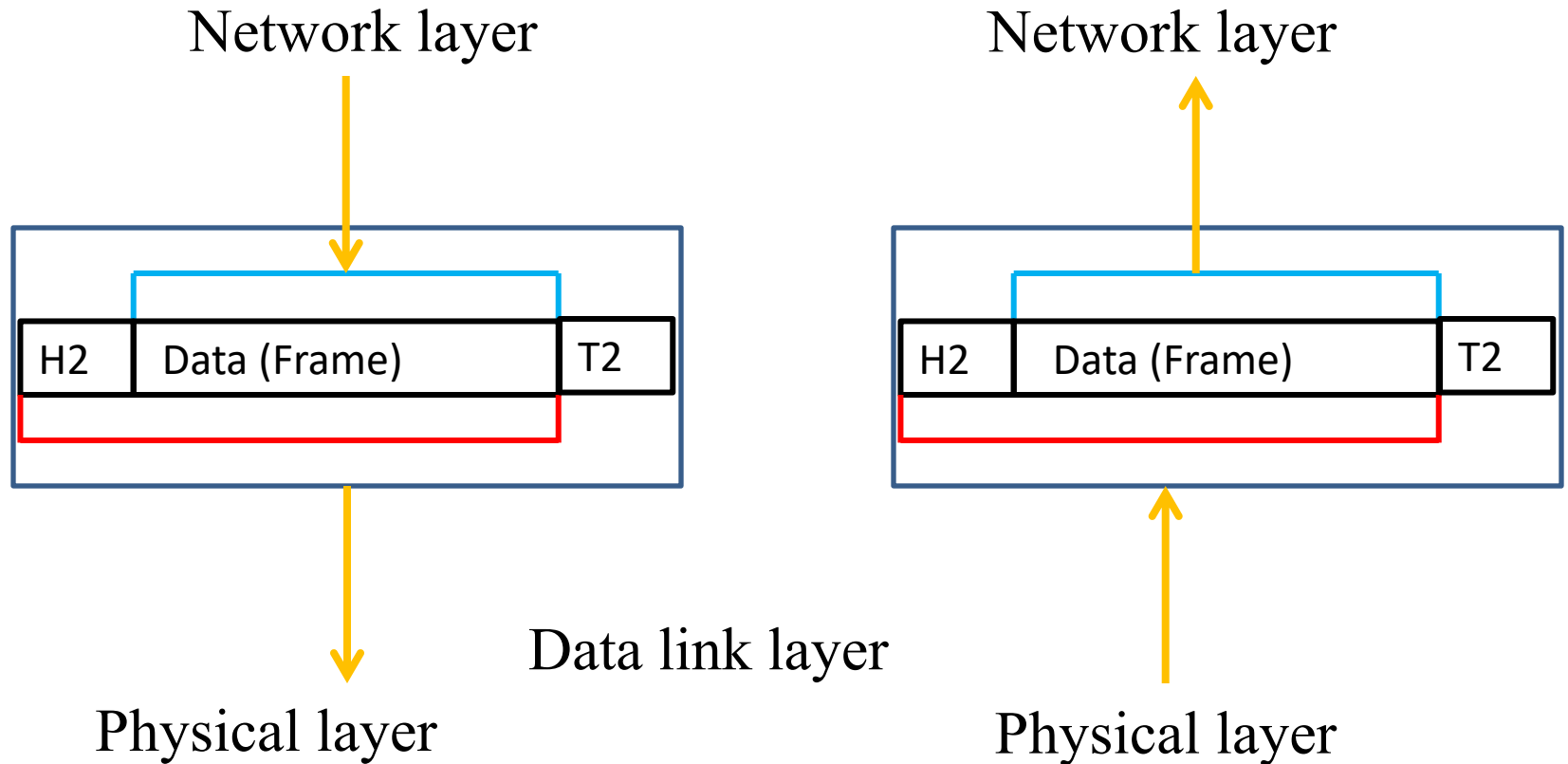
The physical layer is responsible for movements of individual bits from one hop (node) to the next.

- **Data Rate:** This layer defines the rate of transmission which is the number of bits per second.
- **Synchronization:** It deals with the synchronization of the transmitter and receiver.
- **Interface:** The physical layer defines the transmission interface between **devices** and **transmission medium**.

- **Line Configuration:** This layer connects devices with the medium:
 - **Point to Point** configuration
 - **Multipoint** configuration.
- **Topology:**
 - How network devices are arranged.
- **Signals:**
 - It defines the types of the signal used for transmitting the information.

- **Transmission Modes:** Physical Layer defines the direction of transmission between two devices:
 - **Simplex,**
 - **Half Duplex,**
 - **Full Duplex.**

Data link layer



Framing: the streams of packets are received from the network layer and it is converted into manageable data units, called as frames.

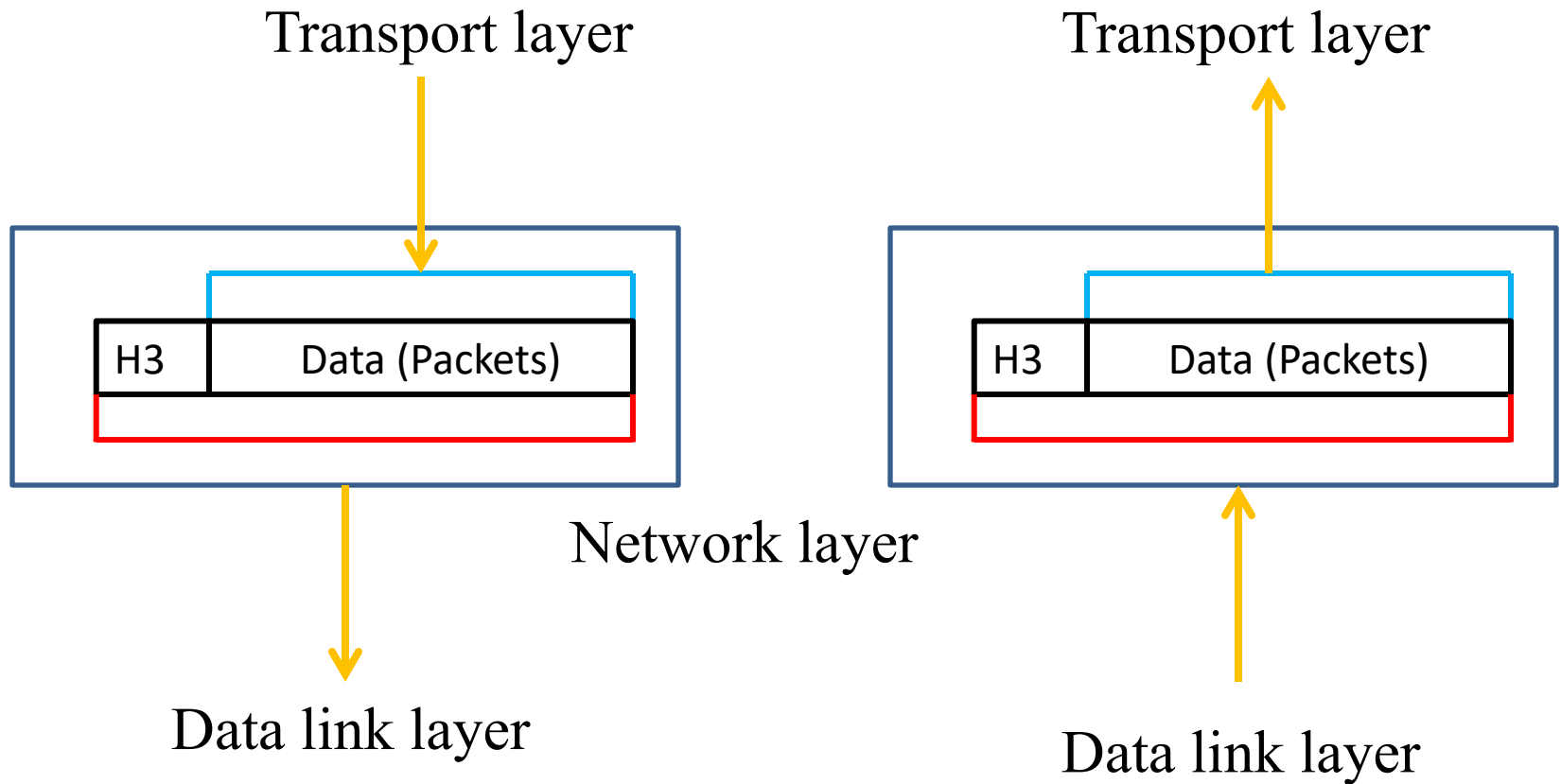
- Two Parts of Data Link Layer Data link layer is divided into two subparts
 - Logical Link Control Layer (LLC)
 - Media Access Control Layer (MAC)

Functions of Data link layer

- **Flow Control:** A flow control mechanism to avoid a fast transmitter from running a slow receiver by buffering the extra bit is provided by flow control. This prevents traffic jam at the receiver side.

- ☐ **Error Control:** Error control is achieved by adding a trailer at the end of the frame. Duplication of frames are also prevented by using this mechanism
- **Access Control:** Protocols of this layer determine which of the devices has control over the link at any given time.

Network layer



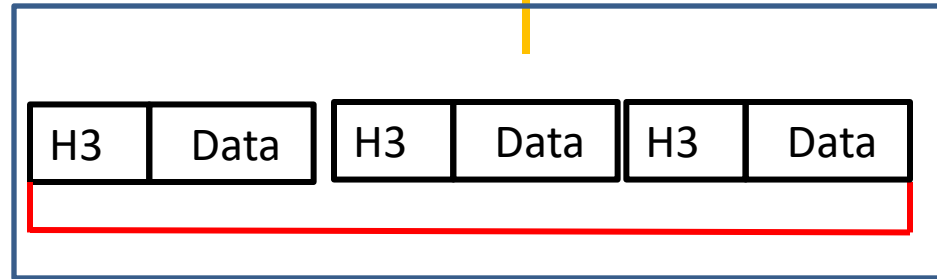
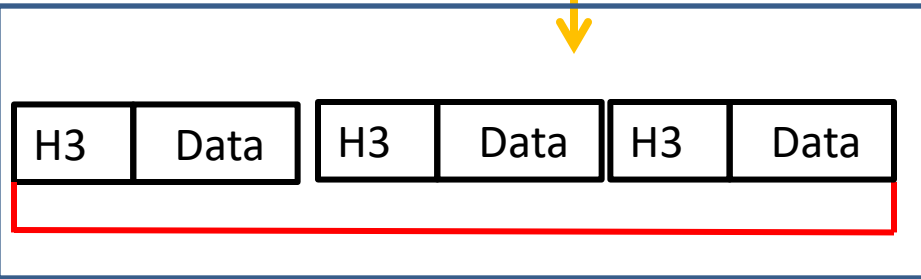
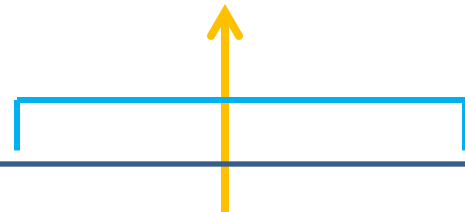
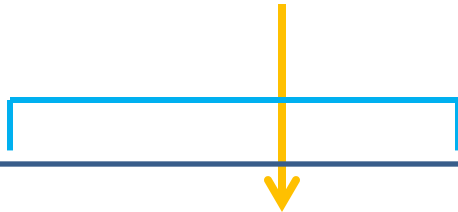
Functions of Network layer

- Addressing:
 - It translates logical network address into physical address.
- Internetworking:
 - Logical connection between the devices.
- Routing:
 - Select the optimal path from the multiple path between the source and destination.

Transport Layer

Session layer

Session layer



Transport layer

Network layer

Network layer

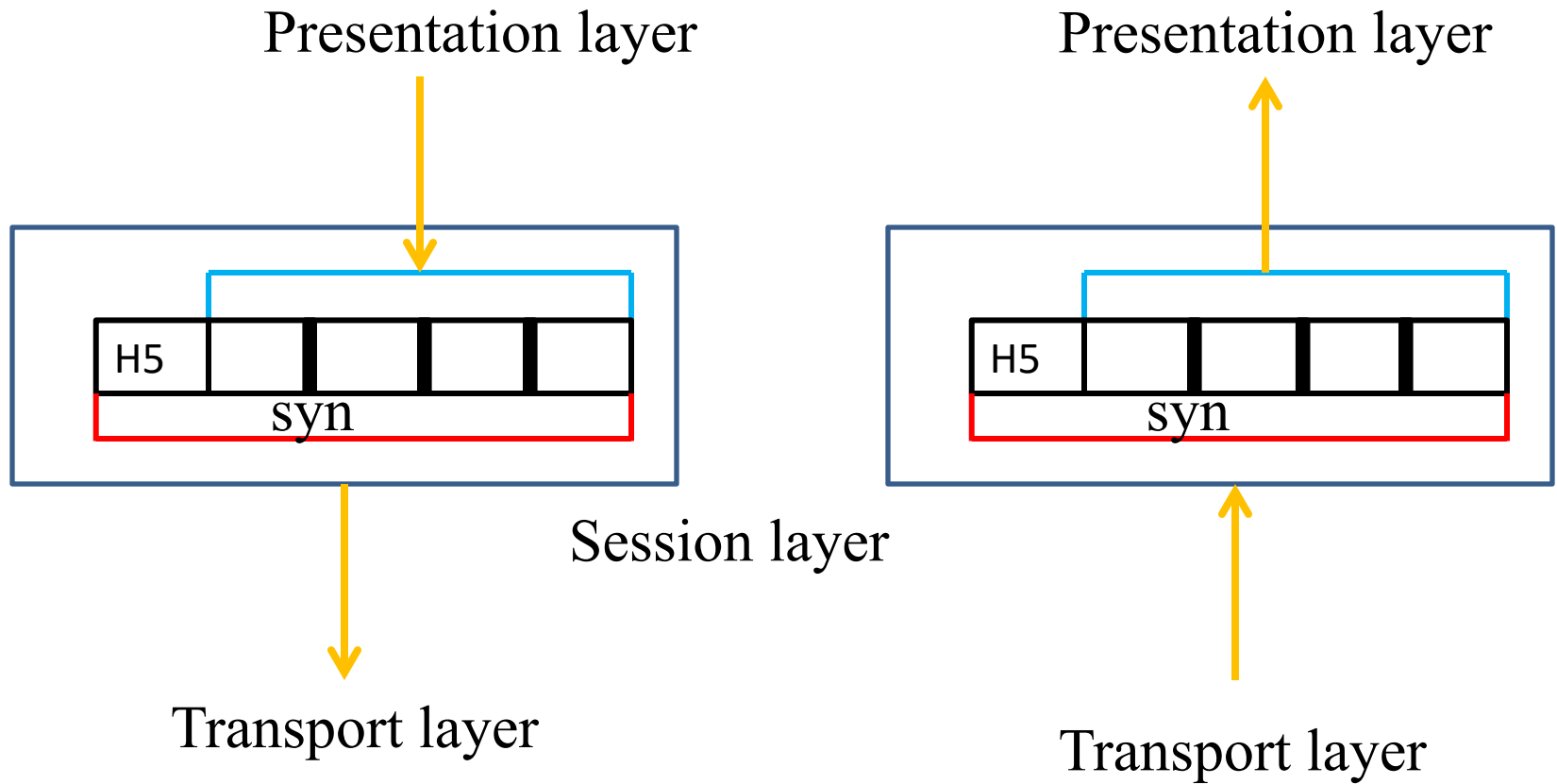


- The transport layer is responsible for the delivery of a message from one process to another.
- ☐ It receives messages from the session layer above it, convert the message into smaller units called as segments and passes it on to the network layer.

Functions of Transport layer

- **Service Point Addressing** : Transport Layer header includes service point address which is port address.
- **Segmentation and Reassembling** : A message is divided into segments; each segment contains sequence number, which enables this layer in reassembling the message.
- **Flow Control** : In this layer, flow control is performed end to end.
- ☐ **Error Control** : Error Control is performed end to end in this layer to ensure that the complete message arrives at the receiving transport layer without any error. Error Correction is done through retransmission.
- **Connection Control**
 - UDP, TCP

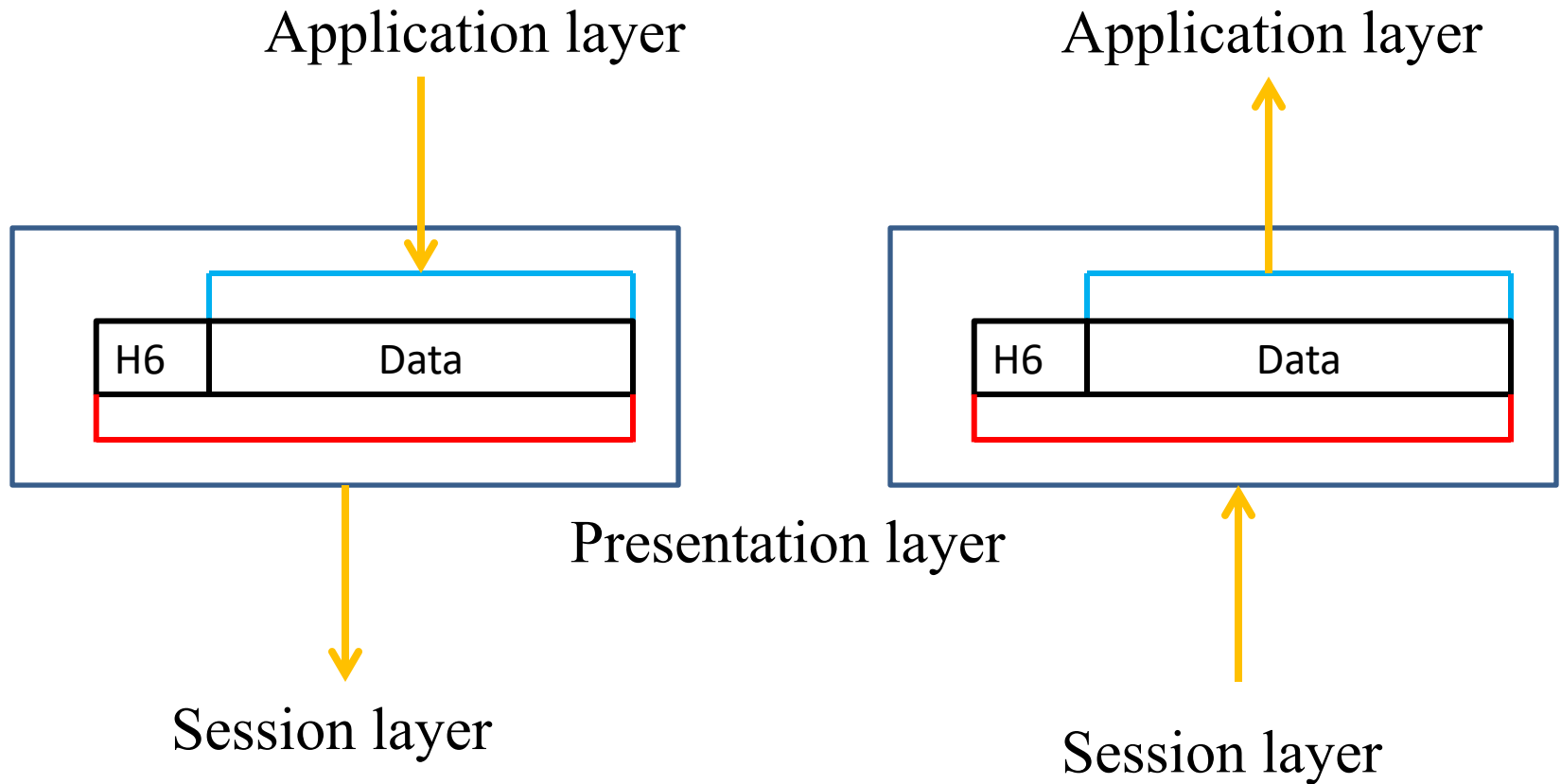
Session Layer



Functions of session layer

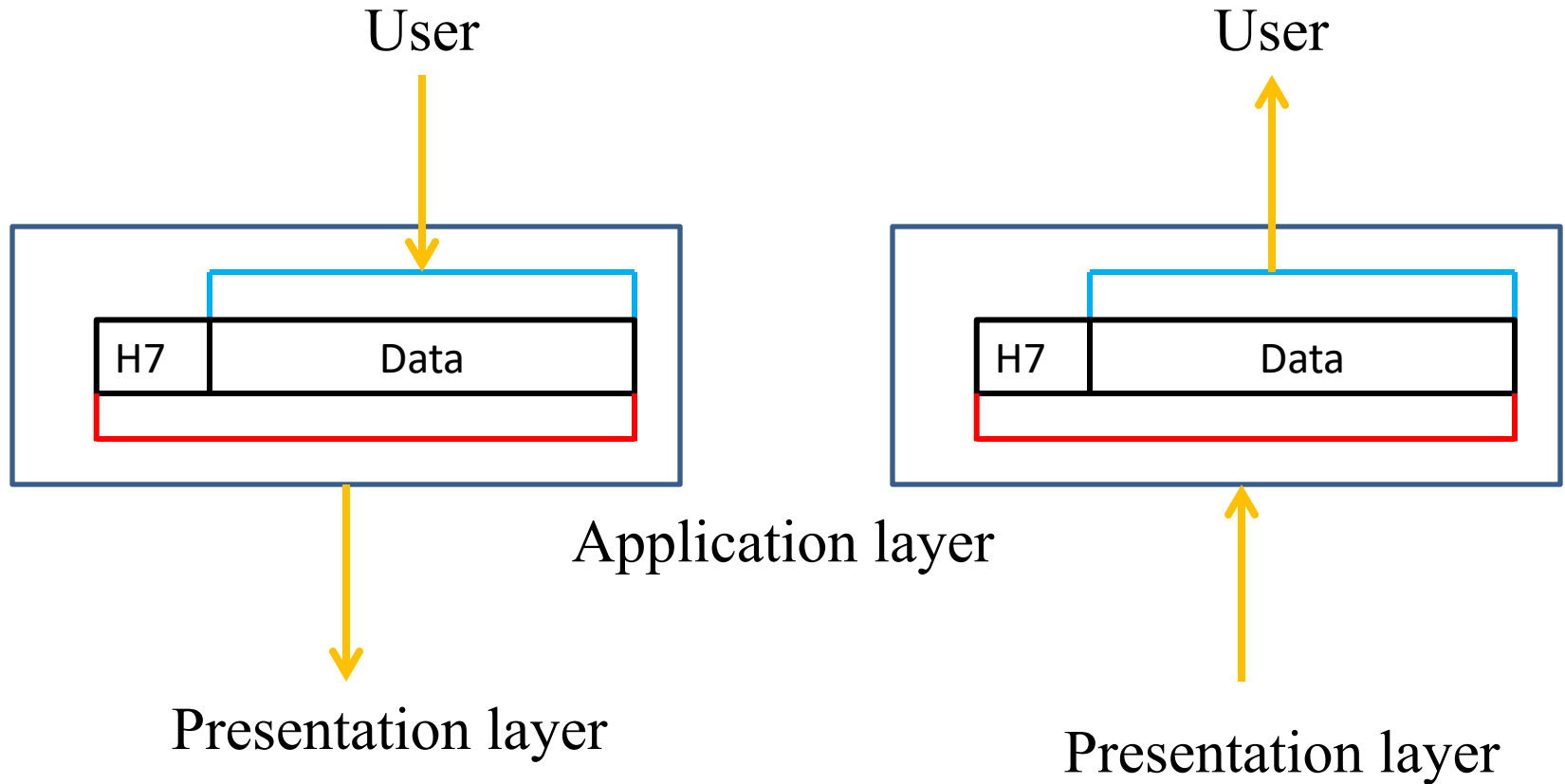
- The session layer is responsible for dialog control and synchronization
- **Dialog Control** : This layer allows two systems to start communication with each other in half-duplex or full-duplex.
- ☐ **Synchronization** : This layer allows a process to add checkpoints which are considered as synchronization points into stream of data.

Presentation layer



- The presentation layer is responsible for translation, compression, and encryption.
- Translation:
 - It converts the data from sender-dependent format into a common format. And again convert common format into receiver dependent format.
- Encryption:
 - It adds the privacy in the transmitting data
- Compression:
 - It reduces the number of bits to be transmitted.
- The primary goal of this layer is to take care of the syntax and semantics of the information exchanged between two communicating systems.

Application layer

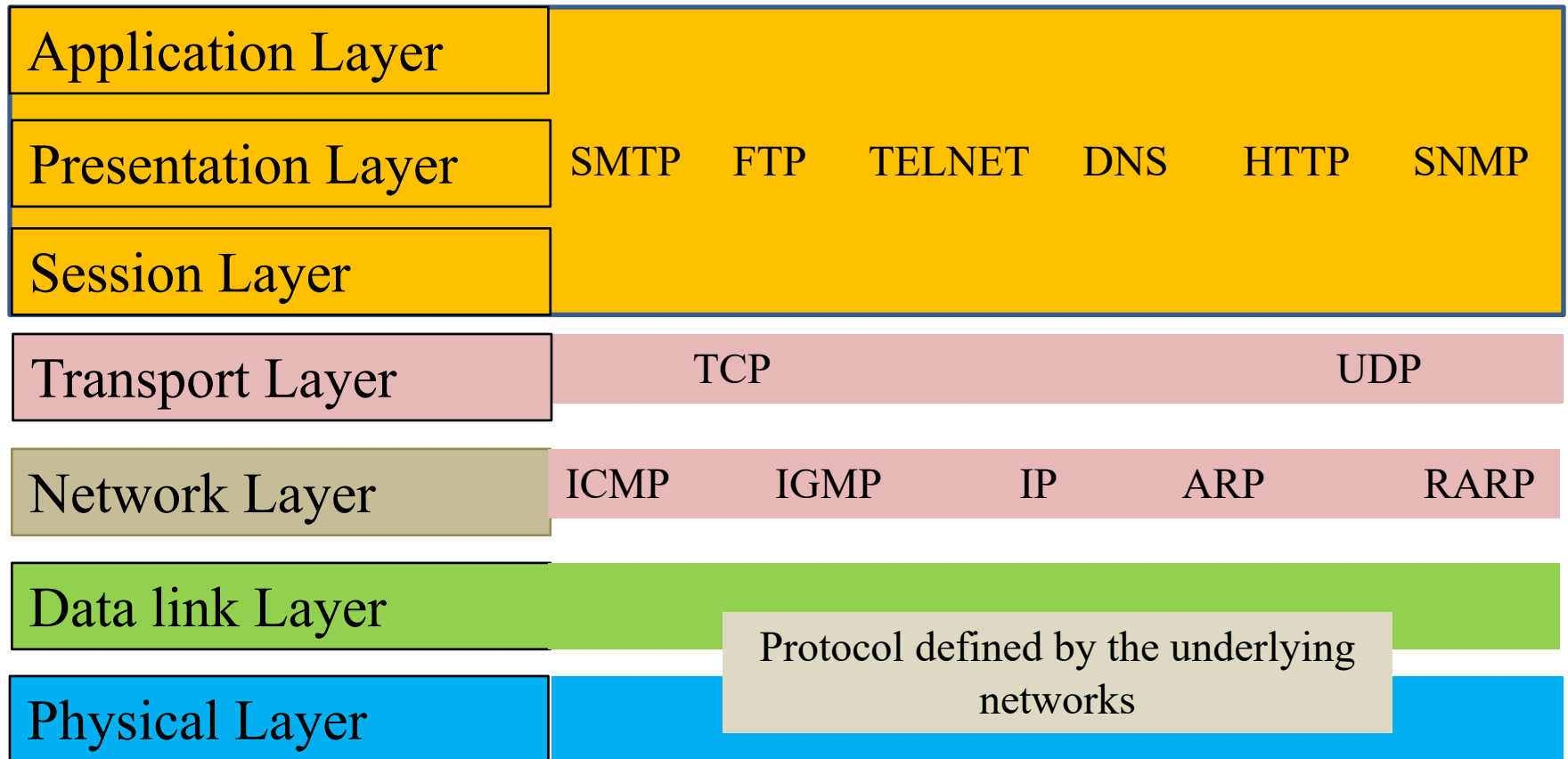


- The application layer is responsible for providing services to the user.
- It is the topmost layer.
- **Mail Services** : This layer provides the basis for E-mail forwarding and storage.
- **Directory Services** : This layer provides access for global information about various services.
- ☐ **File Transfer, Access and Management (FTAM)** : It is a standard mechanism to access files and manages it in a remote computer.

TCP/IP protocol suite

- The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application.

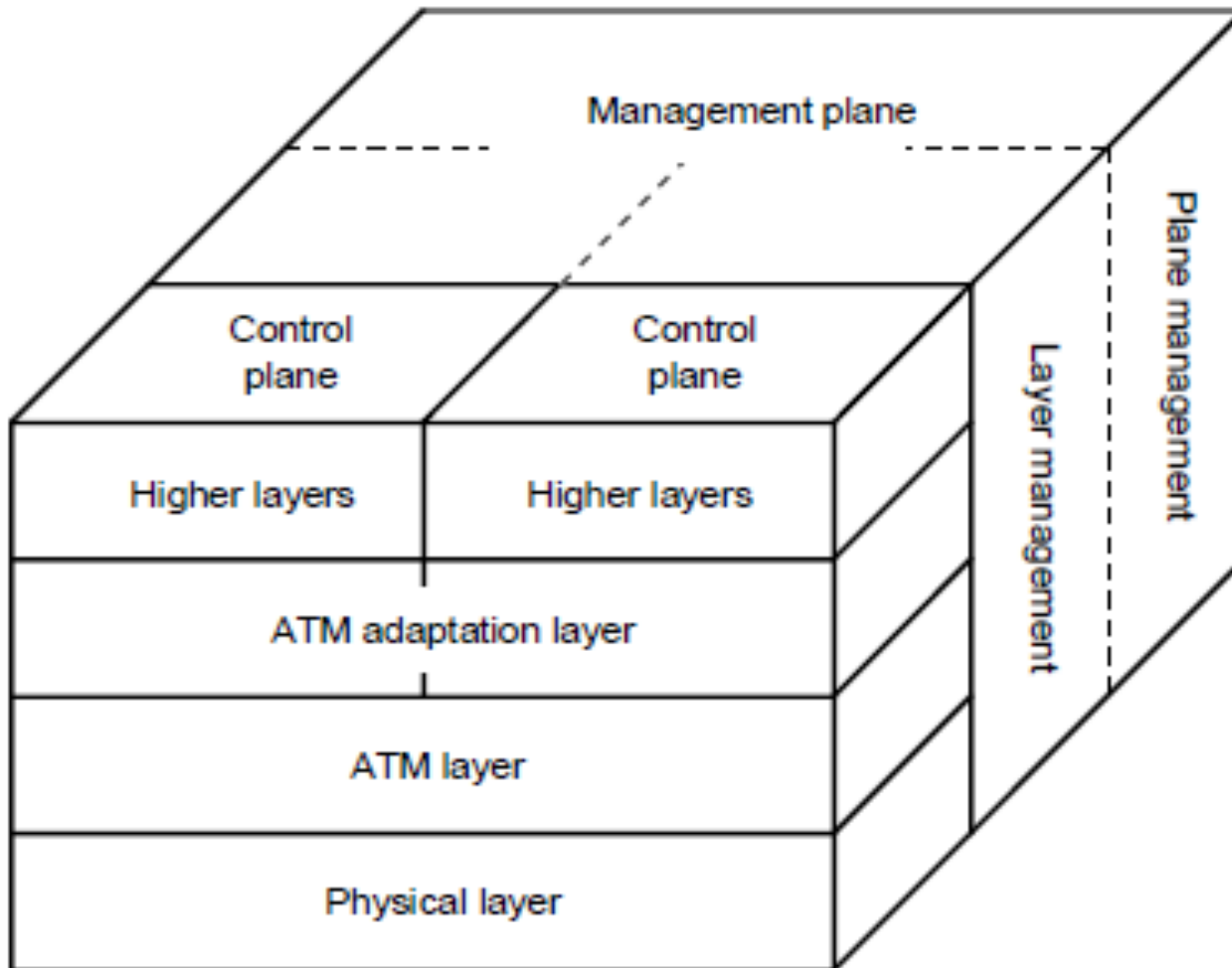
TCP/IP protocol suite



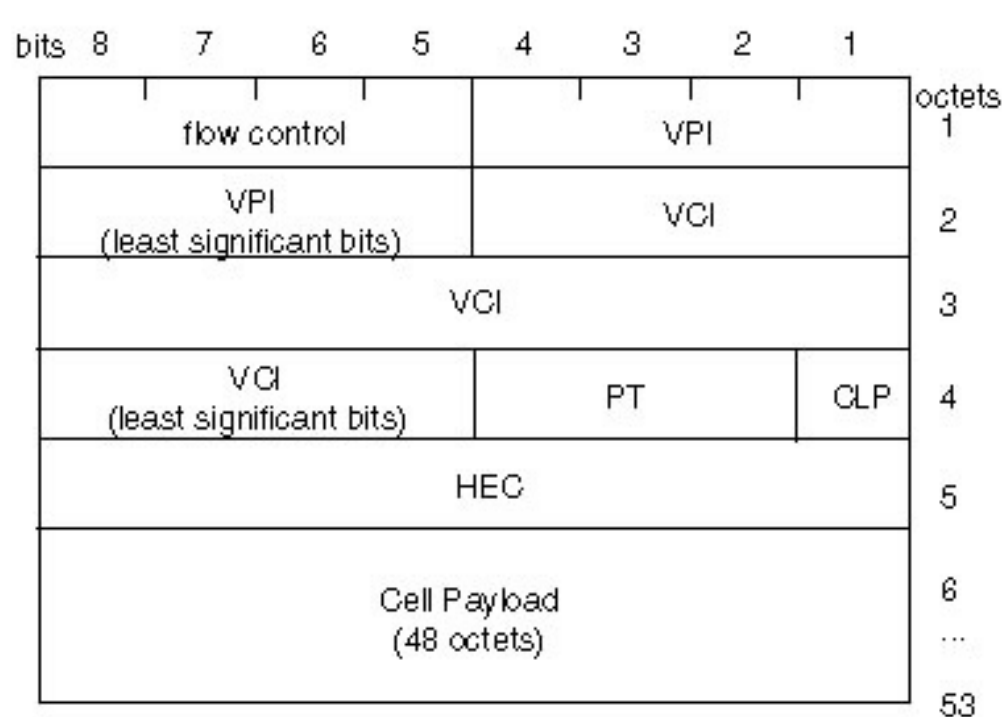
Performance metrics

- Bandwidth or throughput
 - The bandwidth of a network is given by the number of bits that can be transmitted over the network in a certain period of time.
- Latency
 - $\text{Latency} = \text{Propagation} + \text{Transmit} + \text{Queue}$
 - $\text{Propagation} = \text{Distance} / \text{Speed of Light}$
 - $\text{Transmit} = \text{Size} / \text{Bandwidth}$

B-ISDN protocol reference model



ATM Cell Format



VPI = virtual path identifier

VCI = virtual channel identifier

PT = payload type

CLP = cell loss priority (0 is high; 1 is low and subject to discard)

HEC = header error check

- User plane
 - It provides for user information flow transfer, along with associated controls (i.e., flow and error).
- Control plane
 - It performs the call control and connection control functions.
 - It deals with the signaling necessary to set up, supervise and release calls and connections.

Management plane

- The management plane provides two types of functions,
 - Layer Management
 - Plane management
- Plane management functions
 - It performs management functions related to a system as a whole and provides coordination between all the planes. Plane management has no layered structure.
- Layer Management functions
 - It performs management functions (e.g. meta-signaling) relating to resources and parameters residing in its protocol entities.