ES623 Networked Embedded Systems

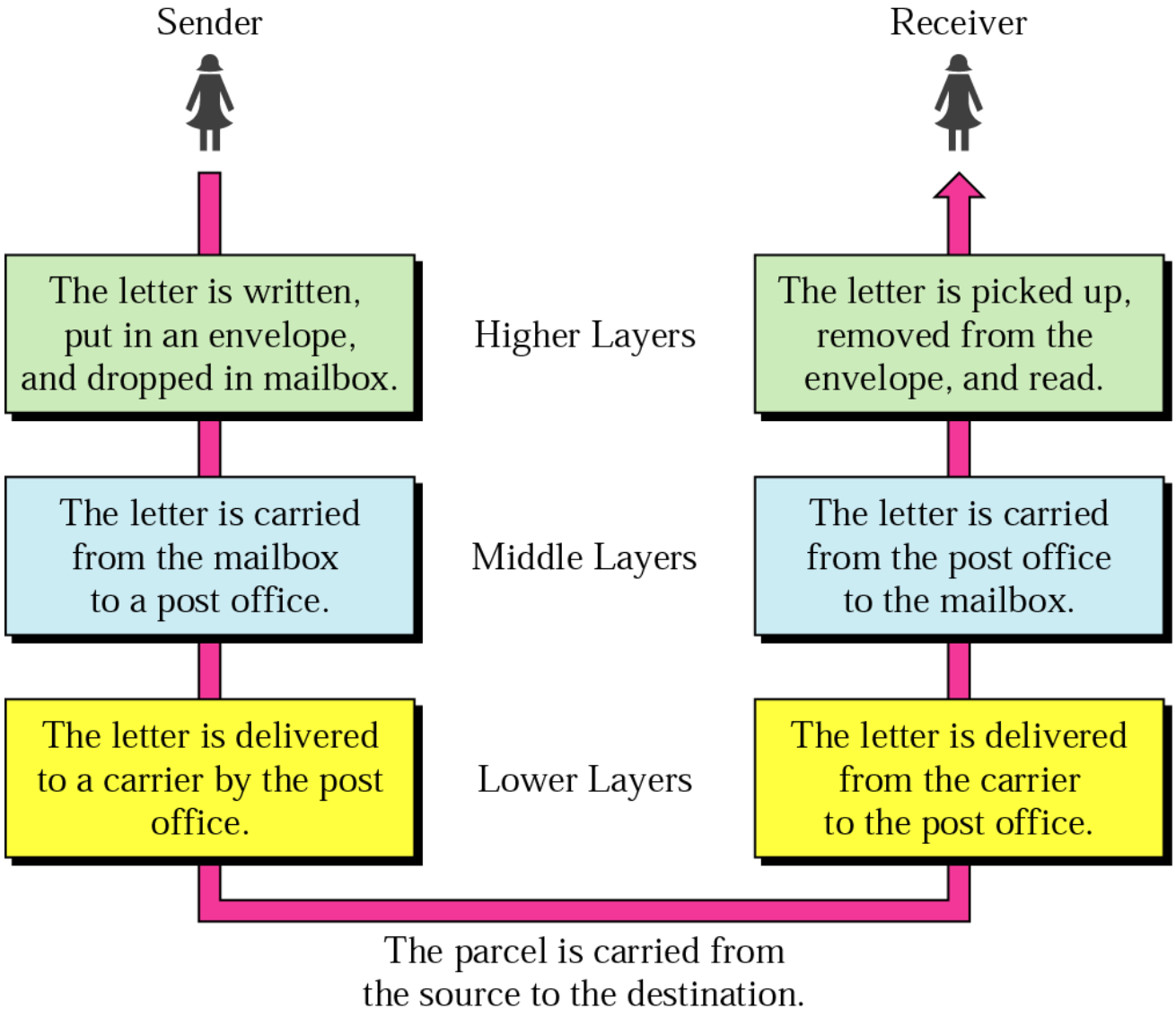
Introduction to Network models & Data Communication

16th April 2013

OSI Models

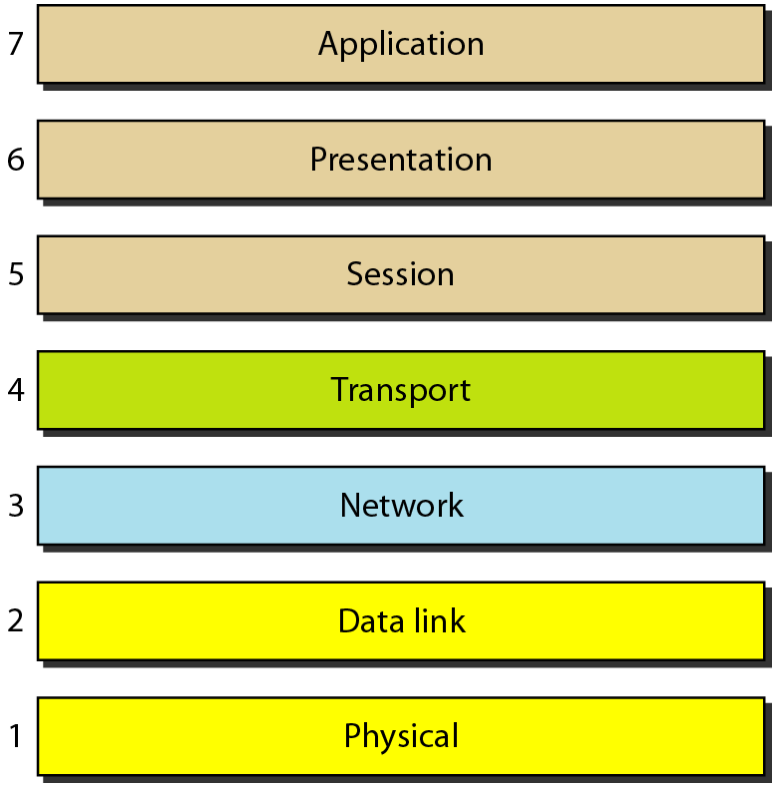
- An ISO standard that covers all aspects of network communication is the Open Systems Interconnection (OSI) model
- Layered framework model for the design of network systems and allows for communication across all types of systems
- Provides a standard conceptual reference architecture so that two computers that are located anywhere in the world can communicate with each other via diverse interconnected computer networks

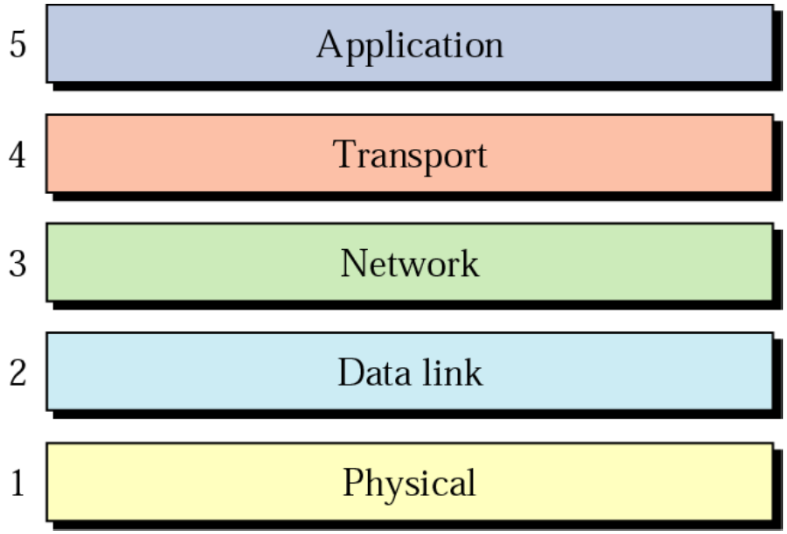
Layered structure



OSI Model

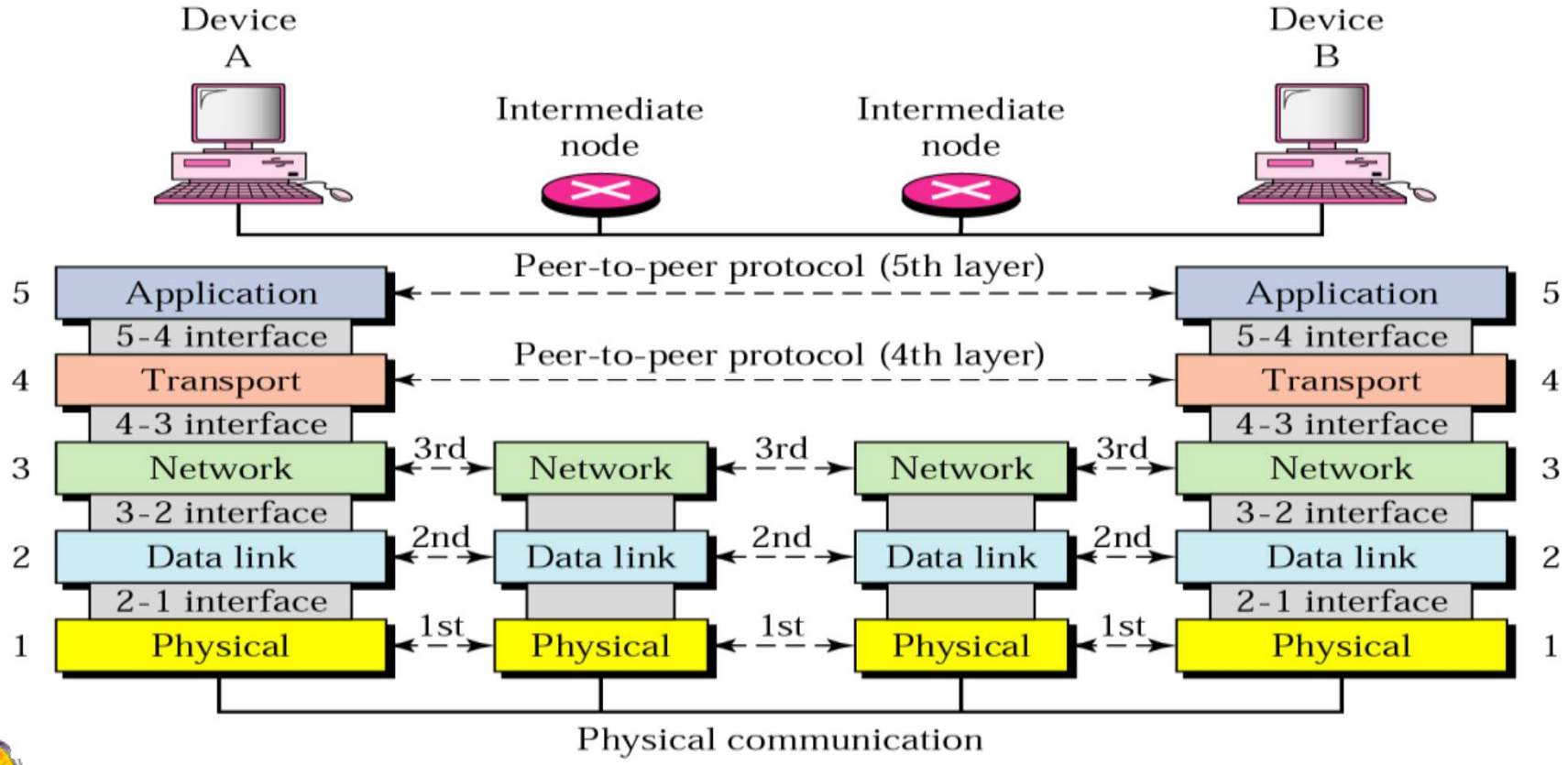
- OSI Model consists of seven layers





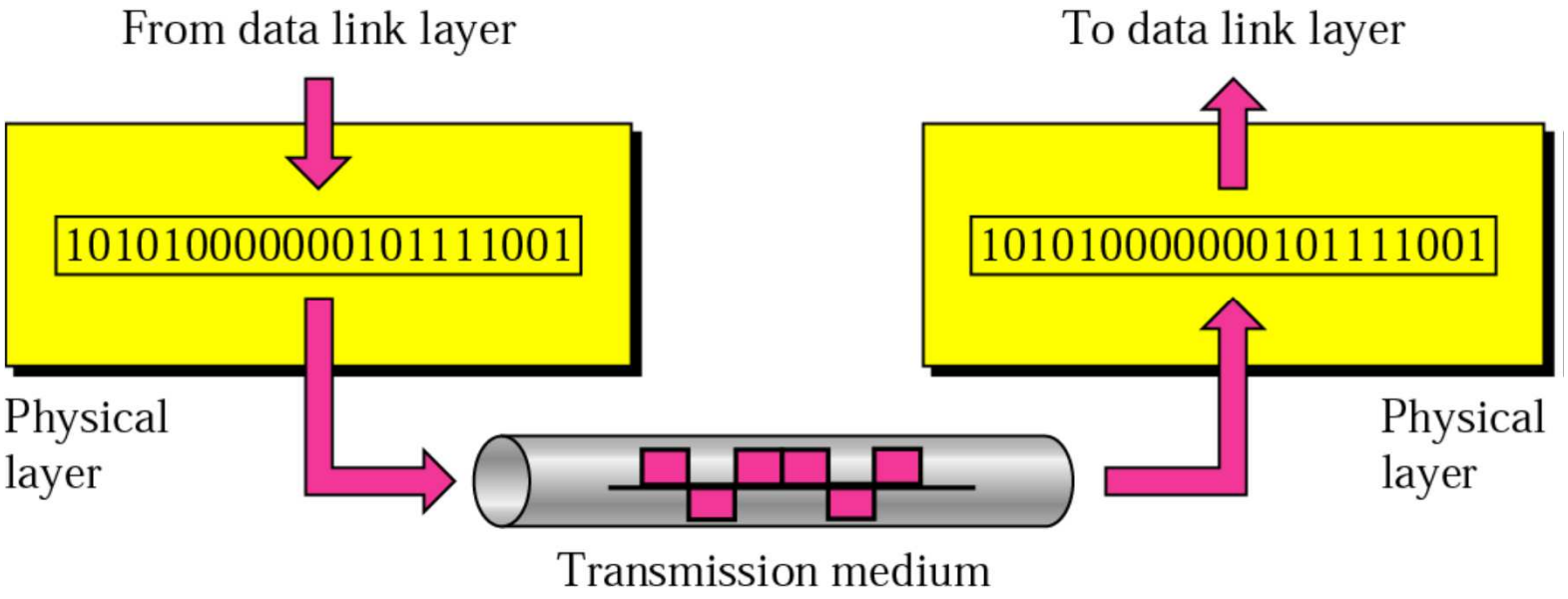
Peer-to-Peer Processes

- The processes on each machine that communicate at a given layer



Functions of the Layers

- **Physical layer**
  - Coordinates the functions required to transmit a bit stream over a physical medium
  - responsible for movements of individual bits from one hop (node) to the next.



Function of Physical Layer

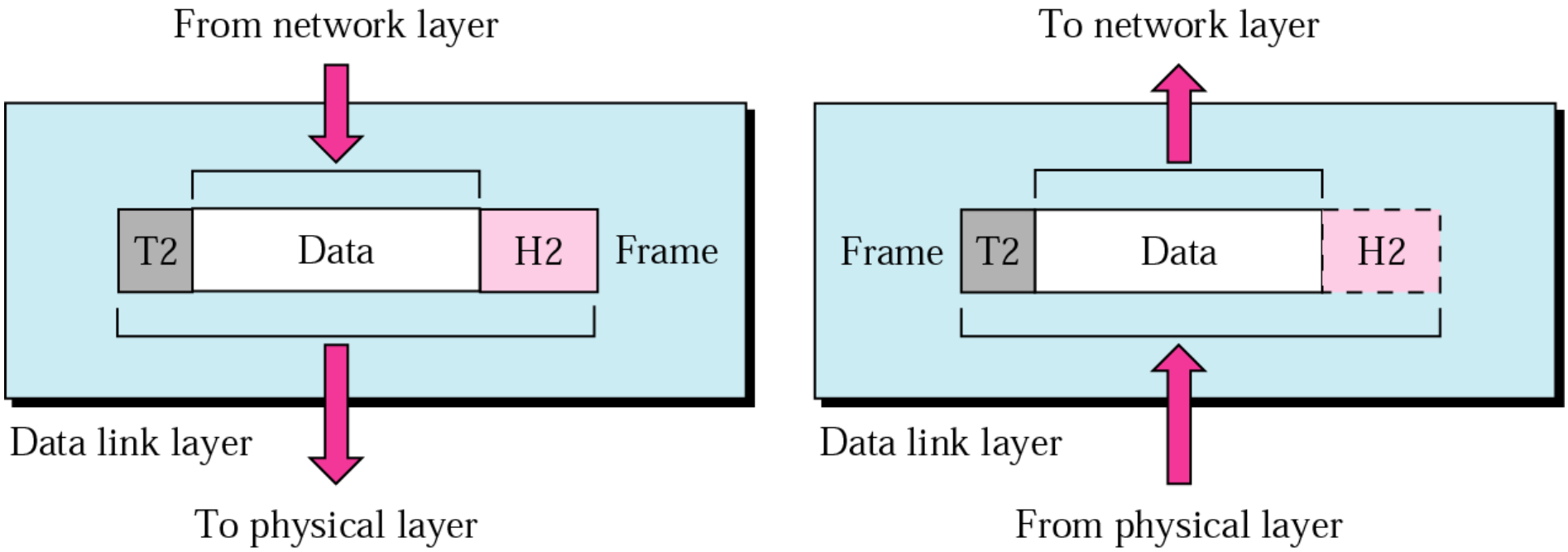
- Physical characteristic of interfaces and media:
  - Defines the characteristic of the interface between devices and media. It also define the type of transmission media.
- Representation of bits
  - The bit stream must be encoded into signals. It defines the type of representation
- Data rate
  - defines the number of bits sent per second and also the duration of bits.
- Synchronization of bits
  - The sender and receiver must be use the same bit rate also the receiver clock must be synchronized

Function of Physical Layer

- Line configuration
  - the connection of devices to the media (point-to point or multipoint)
- Physical topology
  - How devices connected to make a network
- Transmission mode
  - the direction of transmission between two devices

Data Link Layer

- Transforms the physical layer, to a reliable link and is responsible for node-to-node delivery.
  - responsible for moving frames from one hop (node) to the next.



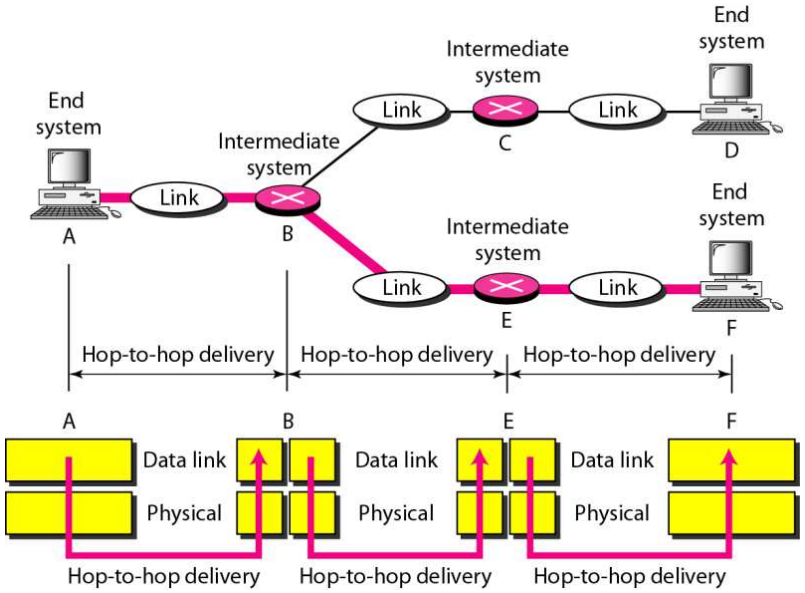
Function of Data link Layer

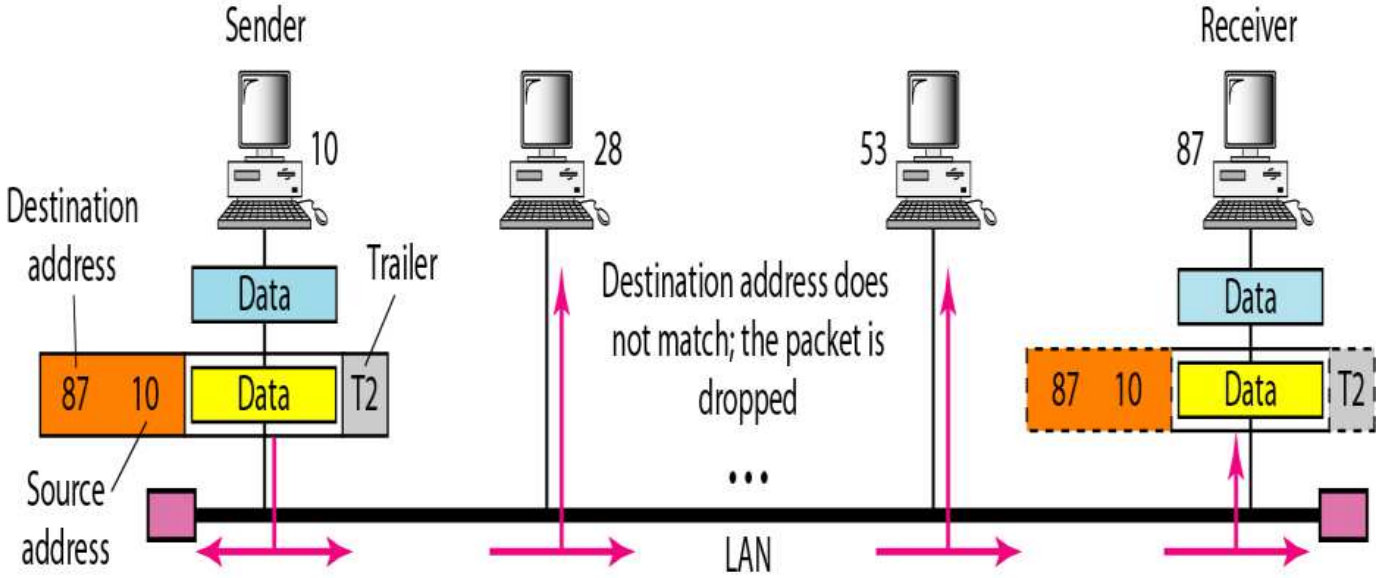
- Framing
  - Divide the stream of bits received from network layer into data units called frames
- Physical addressing
  - adds a header to the frame to define the sender and receiver of the frame.
  - if the frame for a system outside the sender's network the receiver address is the address of the connecting device that connects the network to next one (Router/switch).
- Flow control
  - imposes a flow control to avoid overwhelming the receiver

Function of Data link Layer

- Error control
  - Add mechanisms to detect and retransmit damaged or lost frames.
  - Prevent also duplication of frames.
  - Error control is normally achieved through a trailer added to the end of frame.
- Access Control
  - When two or more devices than one devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at given time.

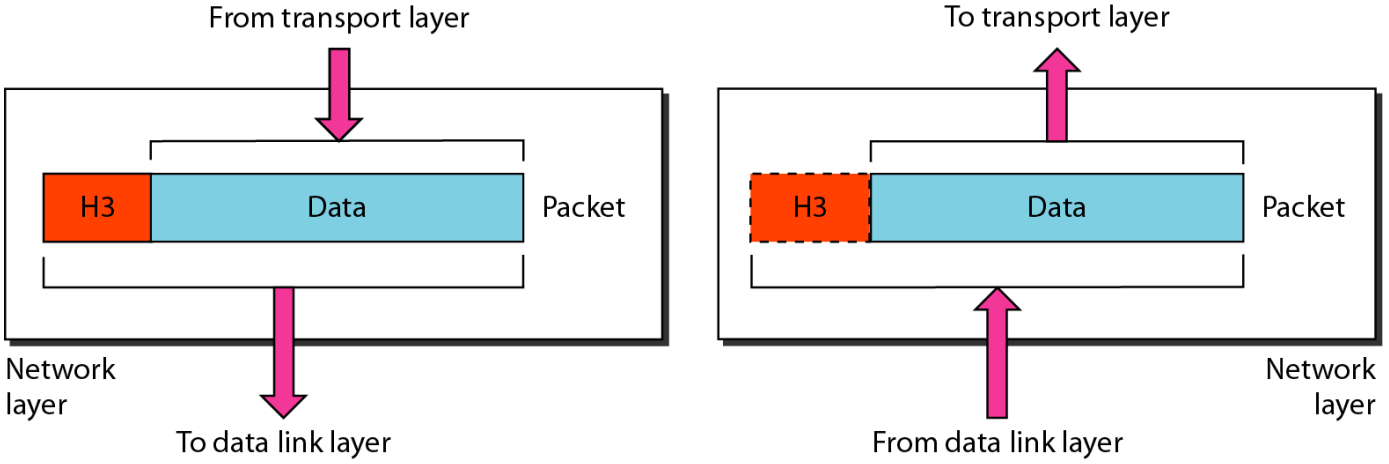
Function of Data link Layer





Network Layer

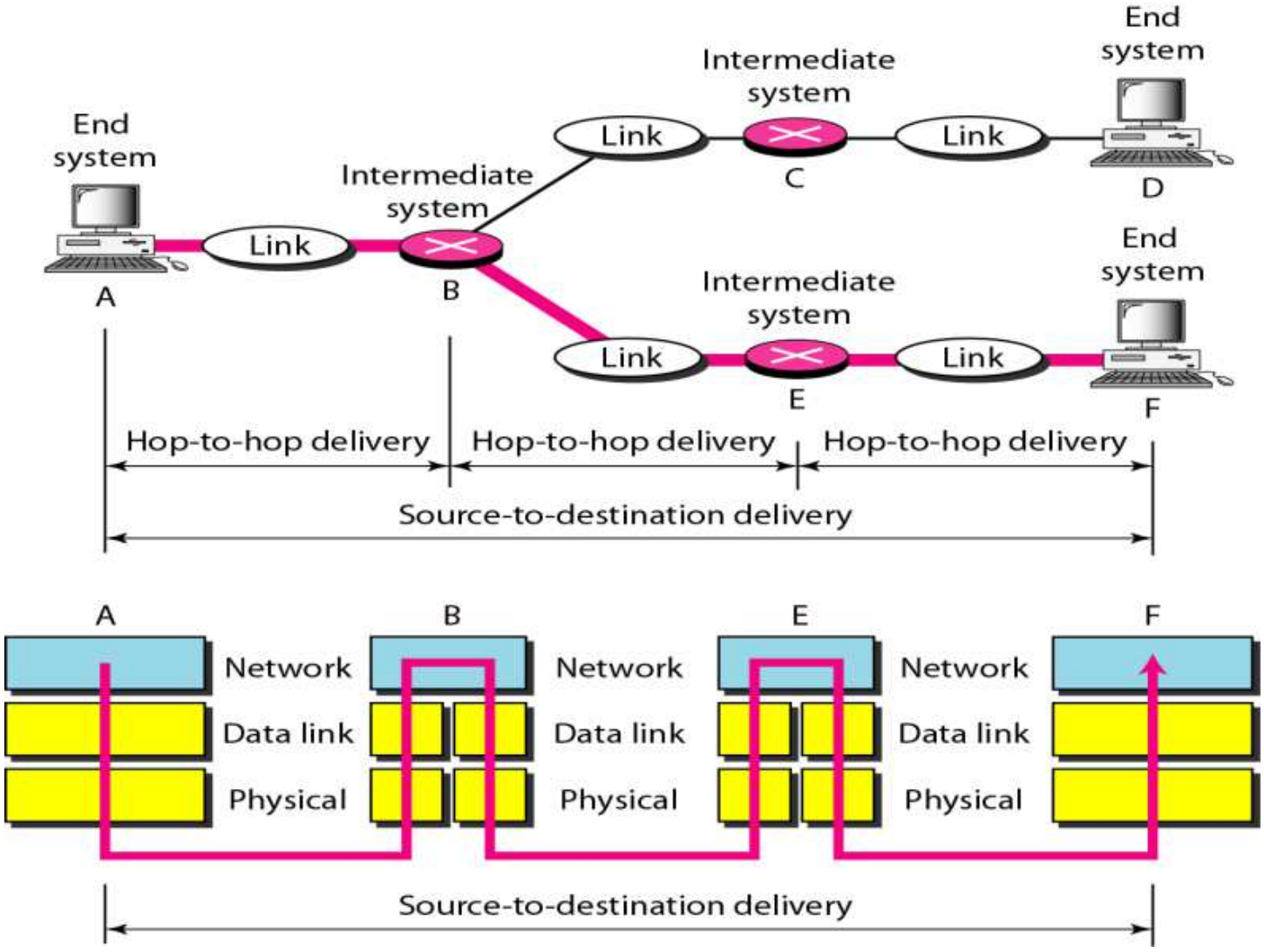
- Responsible for the delivery of individual packets from the source host to the destination host across multiple network
- If two system are connected to the same link (network), this layer is not required.



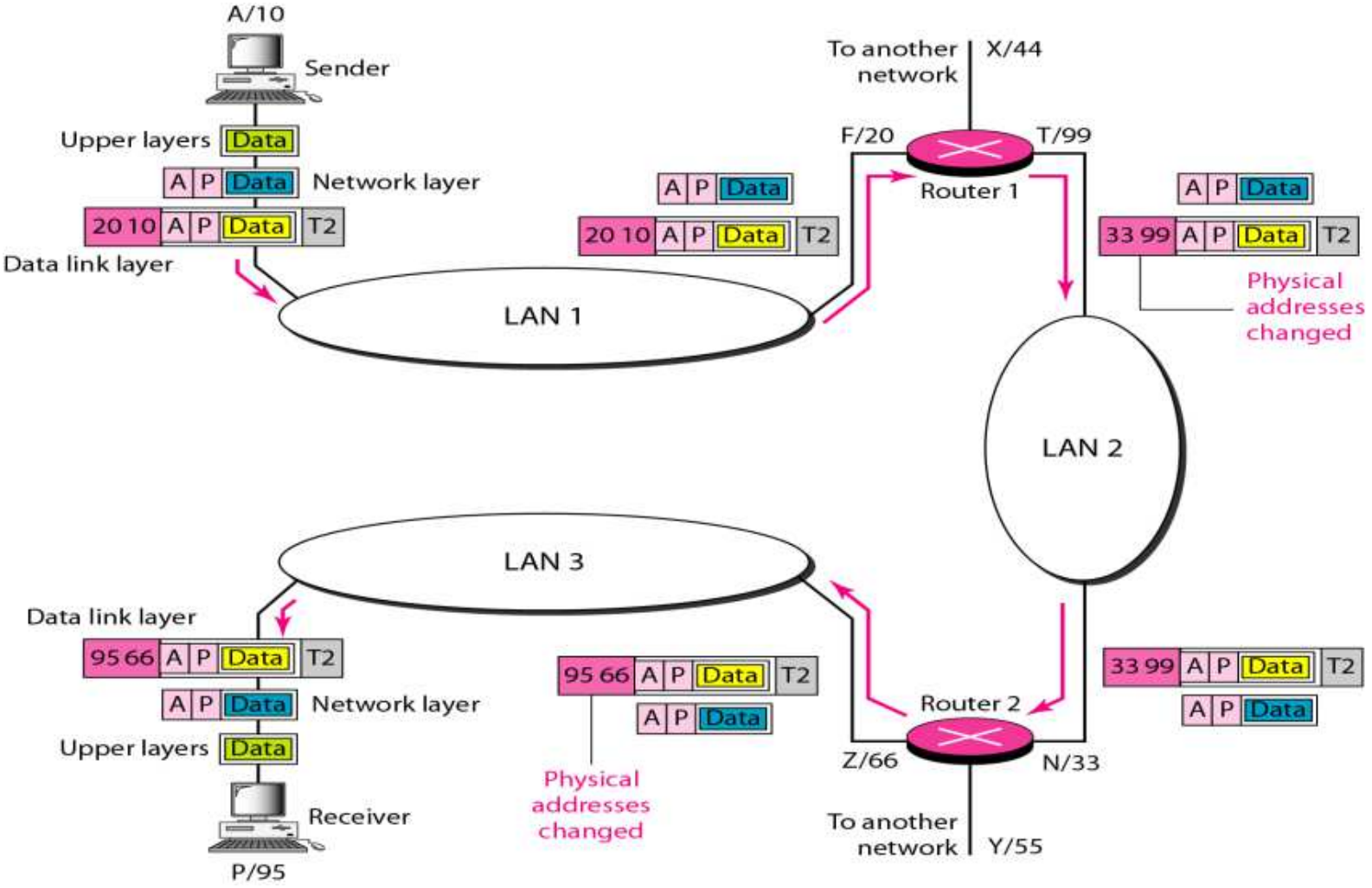
Network Layer

- Net work layer adds unique identifier (IP or logical address) to the packet.
- These unique identifier enable special devices called router to make sure the packet get to correct system.
- Routers : devices used when independent networks are connected to create an internetworking

Network Layer



Network Layer

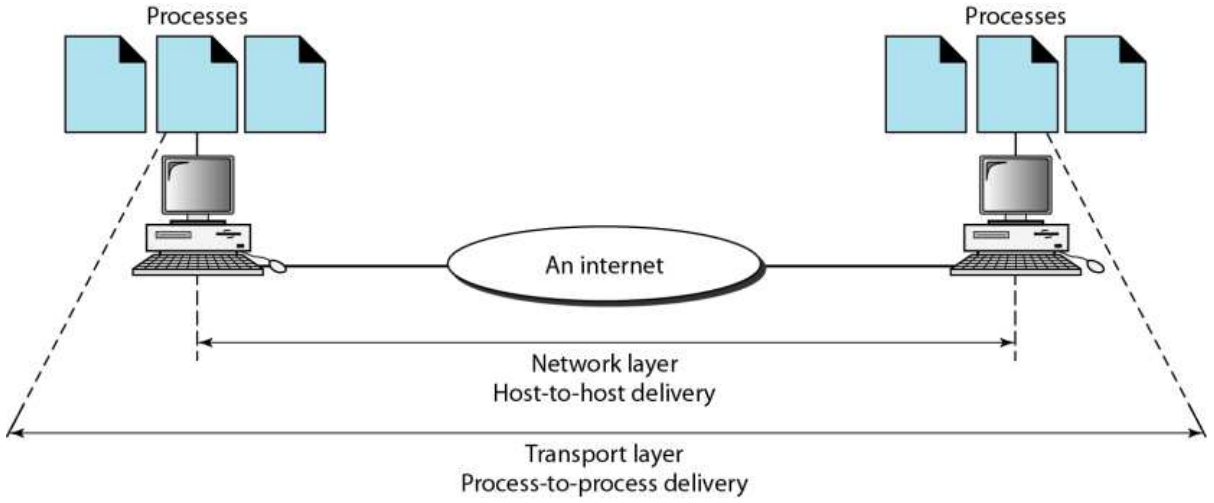


Transport Layer

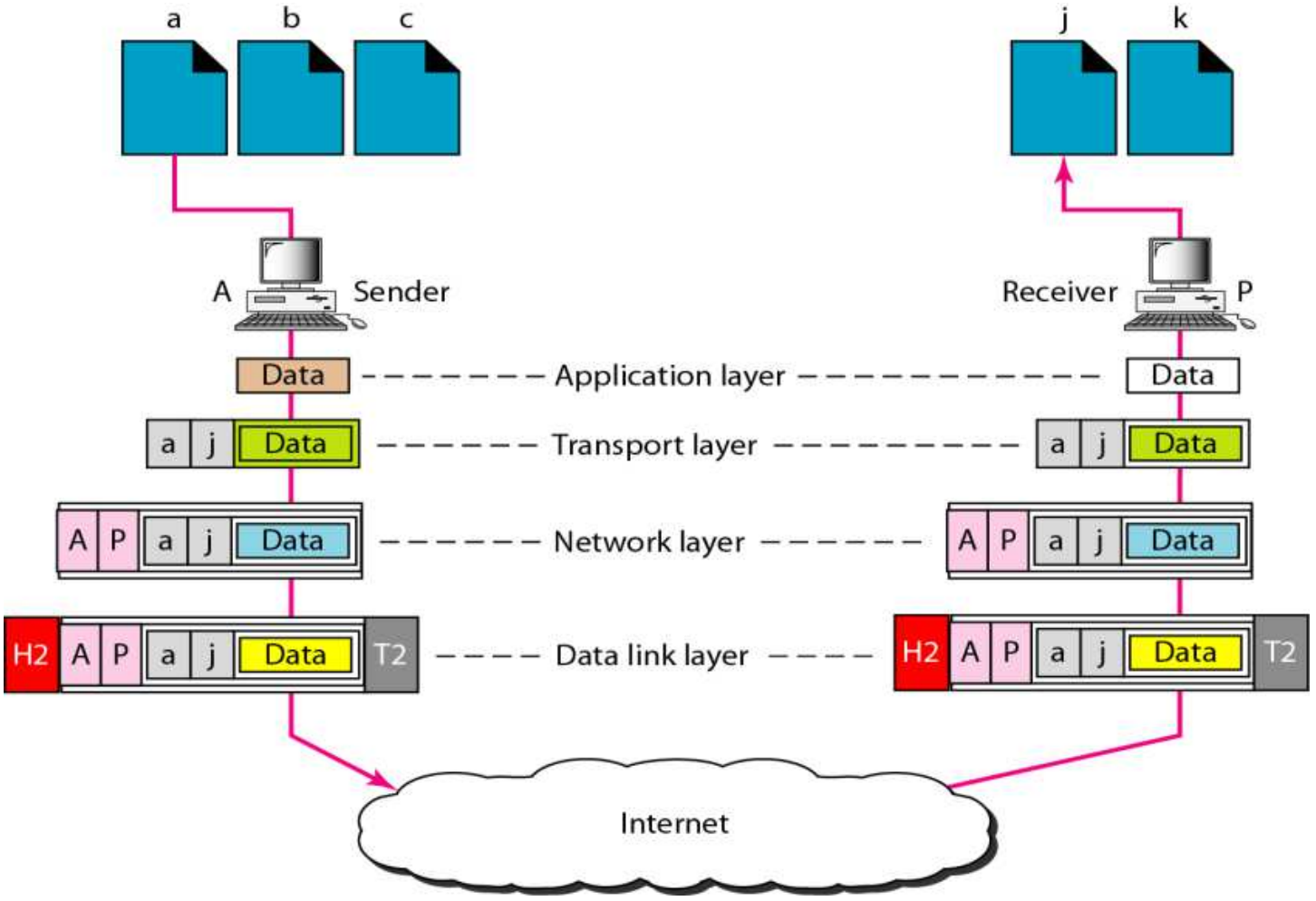
- Responsible for the delivery of a message from one process to another
- Port Addressing
  - Computer often run several process (running programs) at the same time, so the process to process delivery means delivery from a specific process on a computer to specific process to the other.
  - The transport layer header must include Port address
  - Port address: 16-bit addresses represented by decimal number range from 0-65535 to choose among multiple processes on the destination host

Transport Layer

- Error control
  - Error control at this layer is performed process-to-process rather than across a single link
  - The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss or duplicated).
  - Error correction is usually achieved through retransmission



Transport Layer



Session Layer

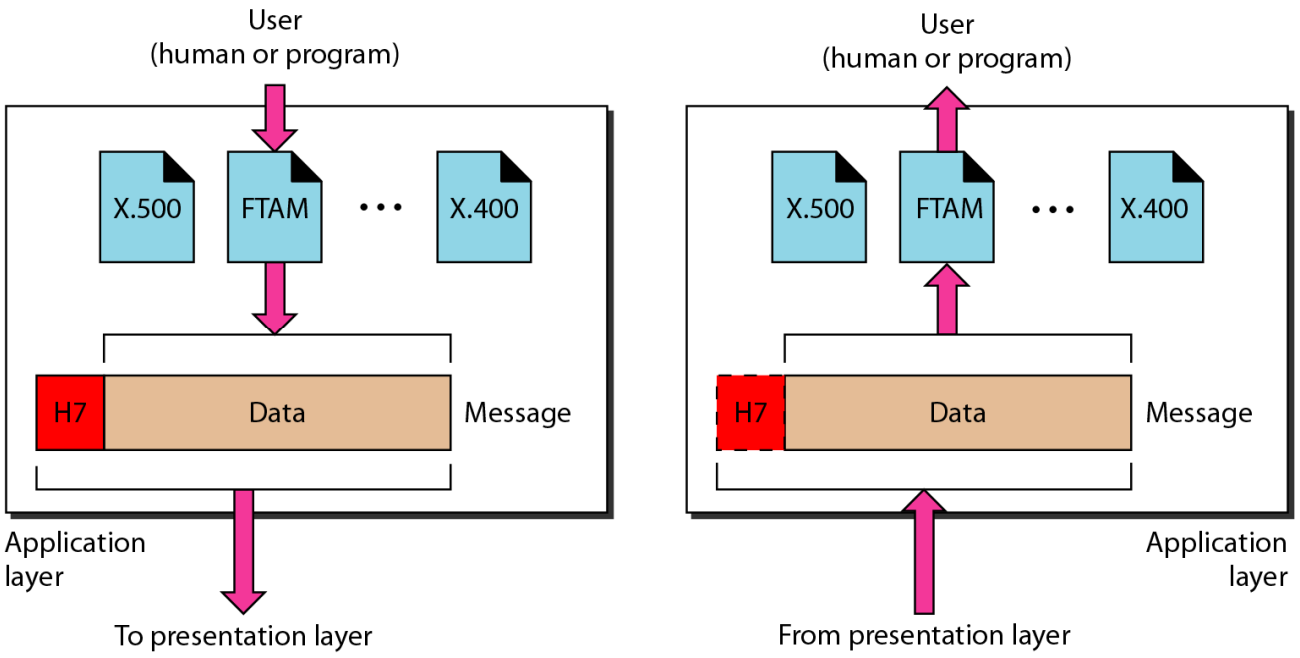
- Responsible for dialog control and synchronization
- Dialog control:
  - Allows two systems to enter into dialog. It allows communication between two processes in either half or full duplex.
- Synchronization (Recovery)
  - Allow a process to add check points (Synchronization point) into a stream of data . So that if a failure of some sort occurs between checkpoints, the layer can retransmit all data since the last checkpoint.

Presentation Layer

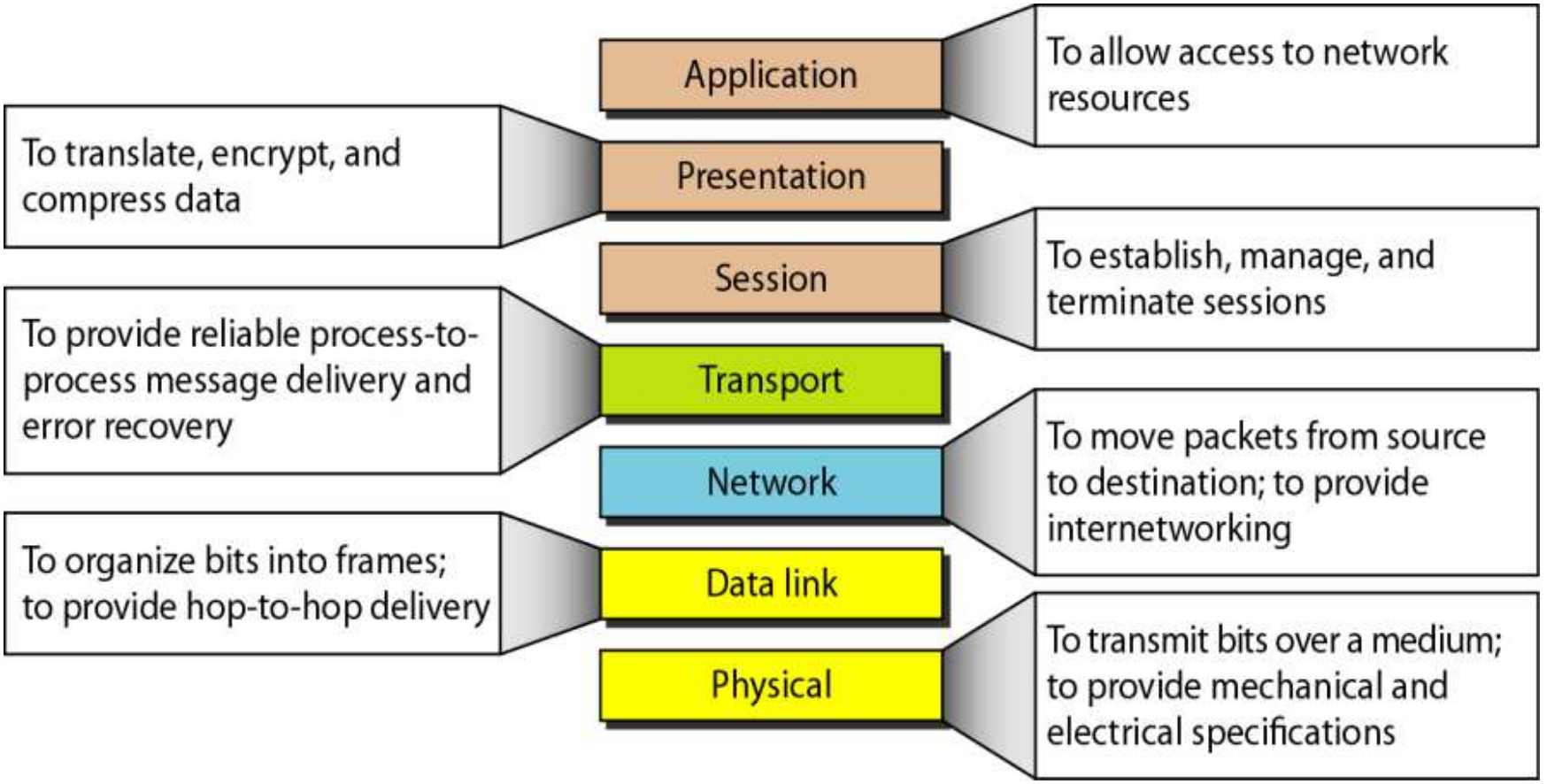
- concerned with the syntax and semantics of the information exchanged between two systems
- responsible for translation, compression, and encryption
- Translation
  - At the sender it changes the information from its sender – dependent format into common format. At receiving, changes the common format into its receiver-dependent format
- Encryption-Decryption
  - To ensure privacy and security
- Compression
  - reduces the number of bits contained in the information, important in the transmission of multimedia such as audio or video

Application Layer

- responsible for providing service to the user



Summary of Layers



TCP/IP

- Transmission Control Protocol/Internetworking Protocol
- Used in Internet
- Made of five layers