The OSI Model and the TCP/IP Protocol Suite

OSI Reference Model

- OSI : Open System Interconnection by ISO
- Basic Reference Model : ISO-7498
- Purpose of OSI Model

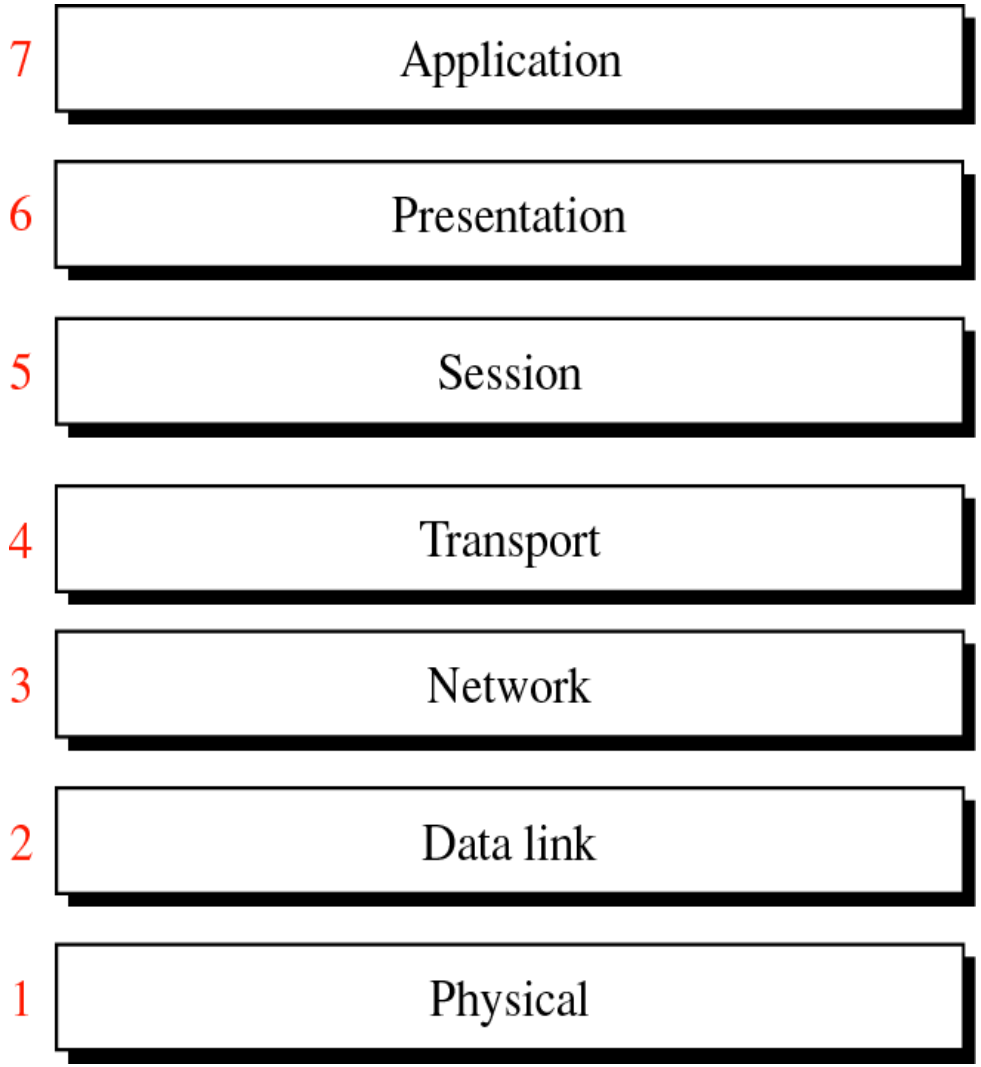
  ~ is to open communication between different systems without requiring changes to the logic of the underlying hardware and software.

The OSI Model

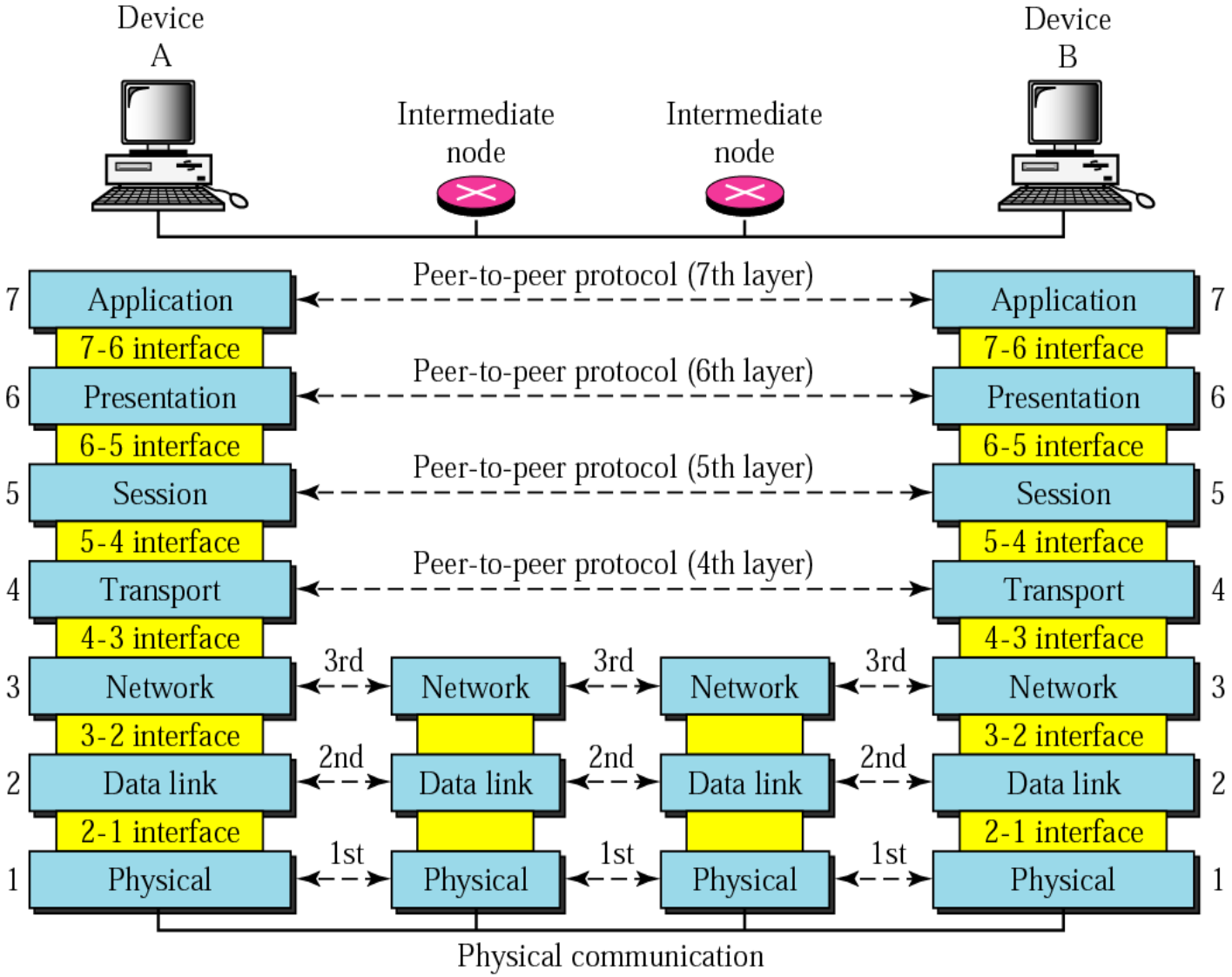
- OSI Model
  ~ is layered framework for the design of network systems that allows for communication across all types of computer systems
- Layered Architecture
  ~ shows the layers involved when a message is sent from device A to device B

OSI Model (cont'd)

- The OSI Model



OSI Layers


Device A
Device B
Intermediate node
Intermediate node
Peer-to-peer protocol (7th layer)
Peer-to-peer protocol (6th layer)
Peer-to-peer protocol (5th layer)
Peer-to-peer protocol (4th layer)
7 Application
7-6 interface
6 Presentation
6-5 interface
5 Session
5-4 interface
4 Transport
4-3 interface
3 Network
3-2 interface
2 Data link
2-1 interface
1 Physical
3rd
2nd
1st
Physical communication

OSI Model (cont'd)

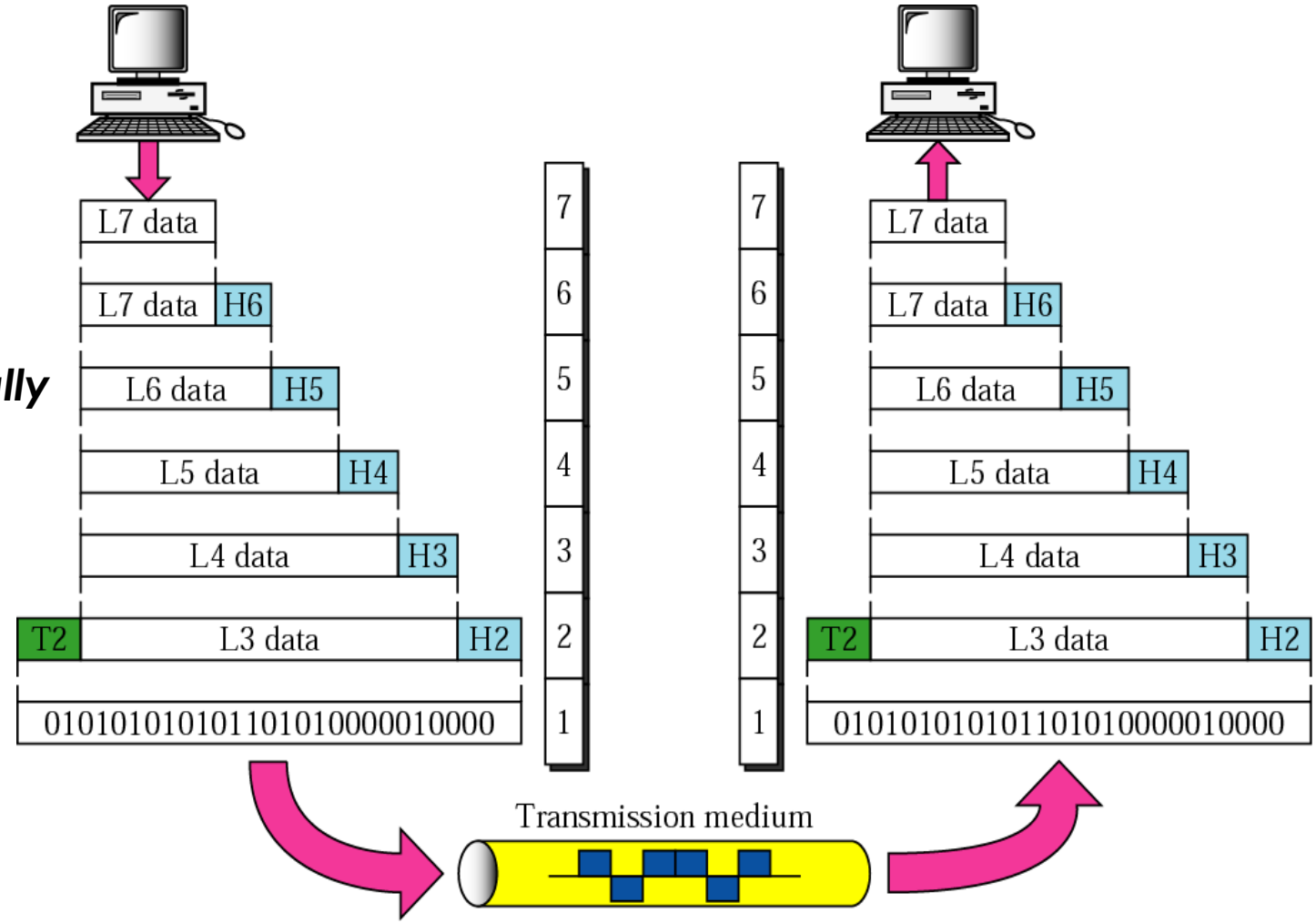
- Peer-to-peer process
  ~ process on each machine that communicates at a given layer
- Interfaces between Layers
  ~ defines what information and services a layer must provide for the layer above it

OSI Model (cont'd)

- Organization of the Layers
  - Layer 1, 2, 3(network support layers)
    ~ deal with the physical aspects of moving data from one device to another
  - Layer 5, 6, 7(user support layers)
    ~ allow interoperability among unrelated software systems
  - Layer 4(transport layer)
    ~ links the two subgroups and ensures that what the lower layers have transmitted is in a form that the upper layers can use

OSI Model (cont'd)

- ***Headers are added to the data at layers 6, 5, 4, 3, and 2. Trailers are usually added only at layer 2.***



Layers in the OSI Model

- Physical Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer

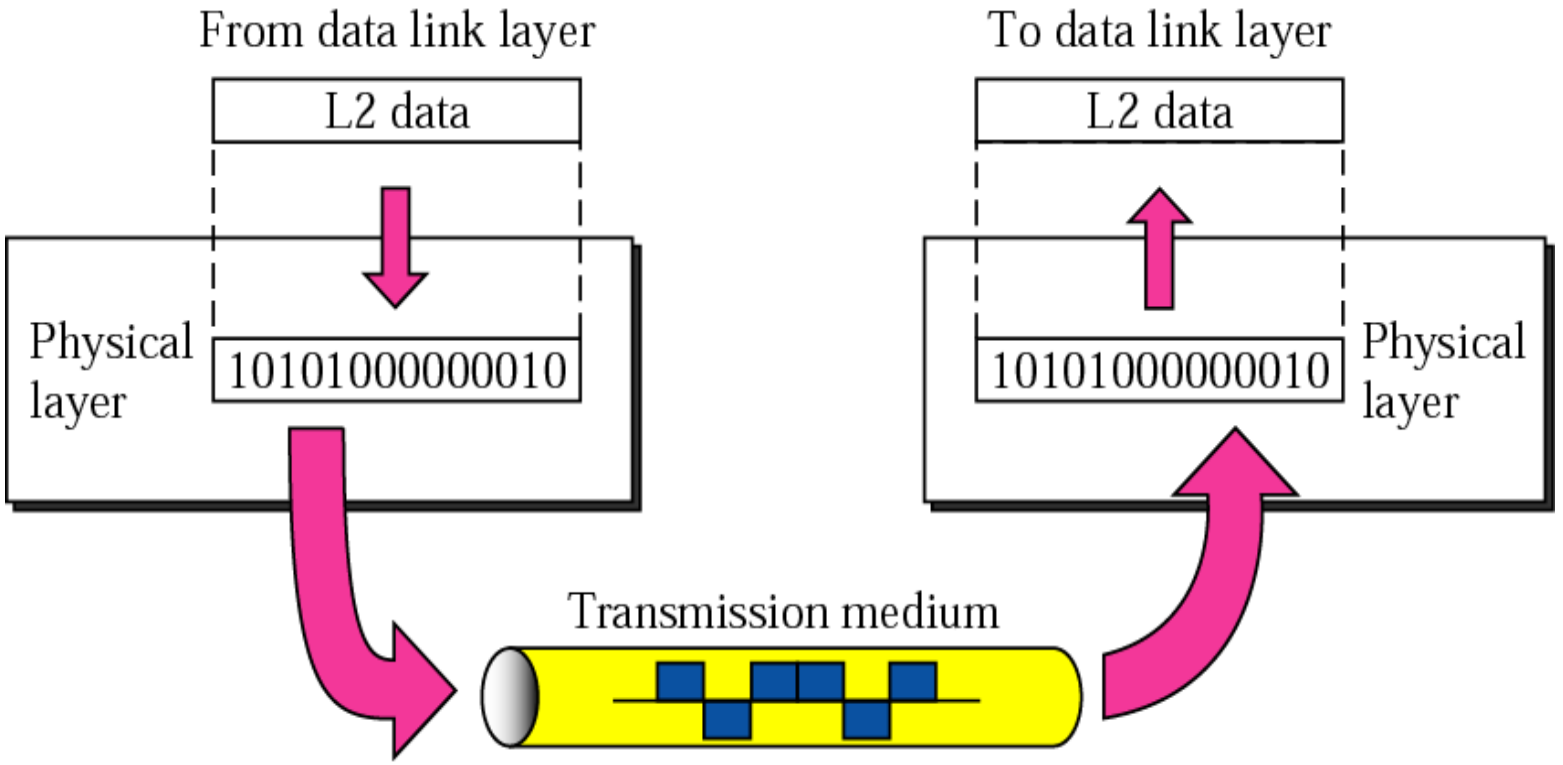
Physical Layer

- coordinates the functions required to transmit a bit stream over a physical medium.

(deal with the mechanical and electrical specification of the primary connections: cable, connector)

Physical Layer (cont'd)

- Physical Layer



Physical Layer (cont'd)

- Representation of bits : Encoding;
- Data rate : Synchronization of bits
- Line configuration : point-to-point, multipoint
- Topology : mesh, star, ring, bus
- Data transmission mode : simplex, half-duplex, full- duplex

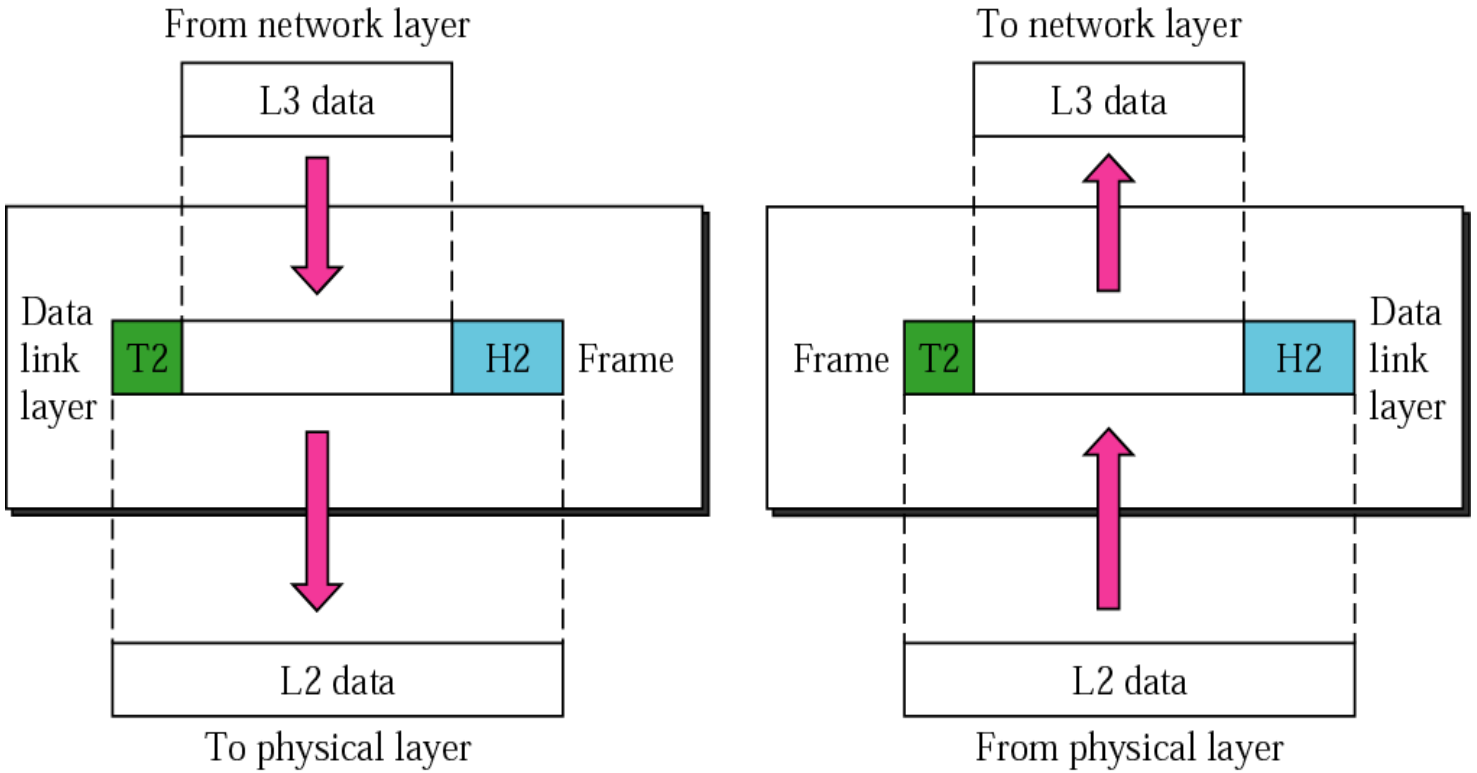
Data Link Layer

- is responsible for delivering data units(group of bits) from one station to the next without errors.

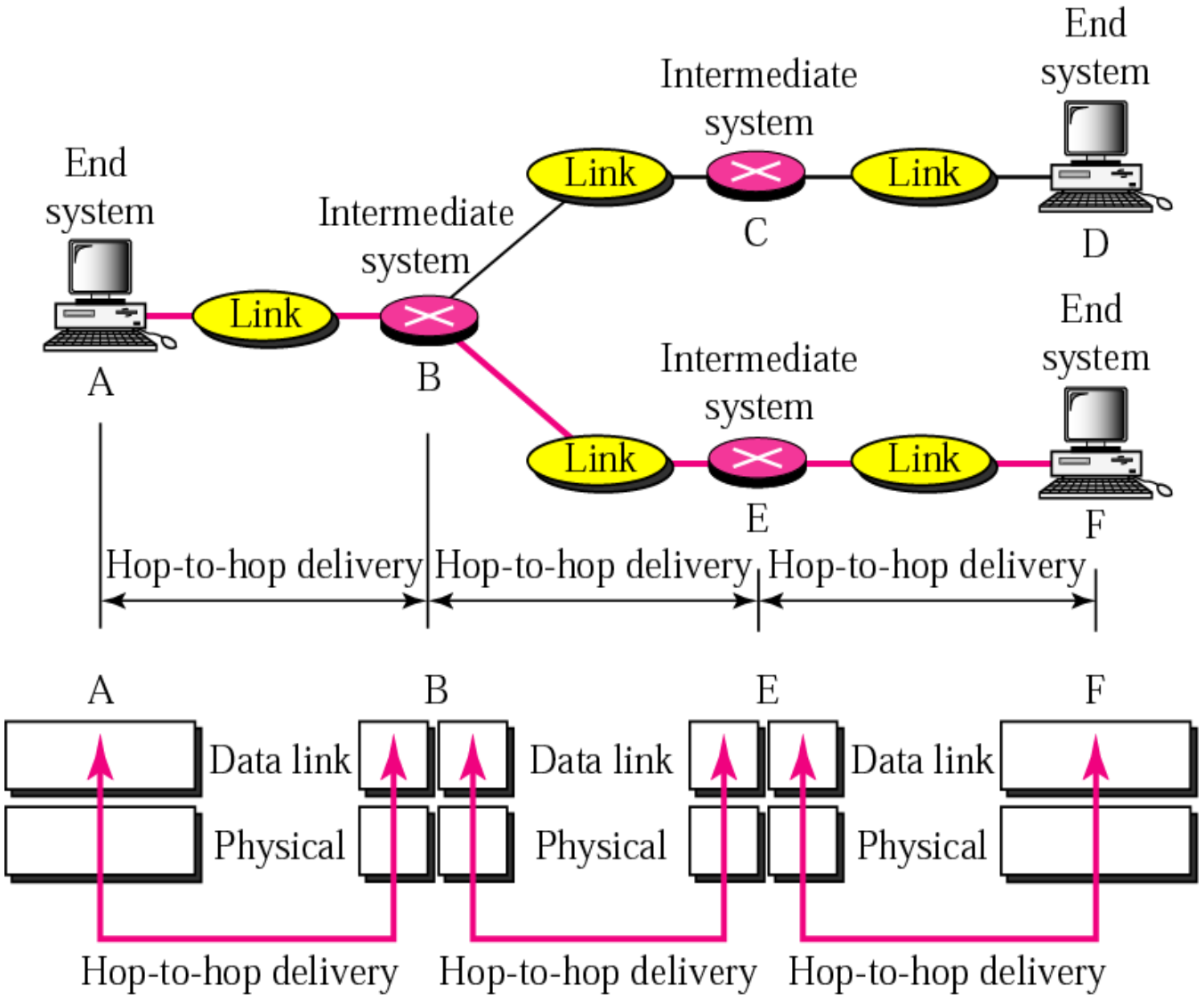
- It accepts a data unit from the third layer and adds meaningful bits to the beginning(header) and end(trailer) that contain addresses and other control information:

Data Link Layer

- Data Link Layer



Node-to-Node Delivery



Data Link Layer (cont'd)

- Specific responsibilities
  - Framing : dividing into Frames
  - Addressing
  - Flow control : for avoiding overwhelming the receiver
  - Error Control : retransmission
  - Access control : for avoiding collision

Network Layer

- is responsible for the source-to-destination delivery of a packet across multiple network links

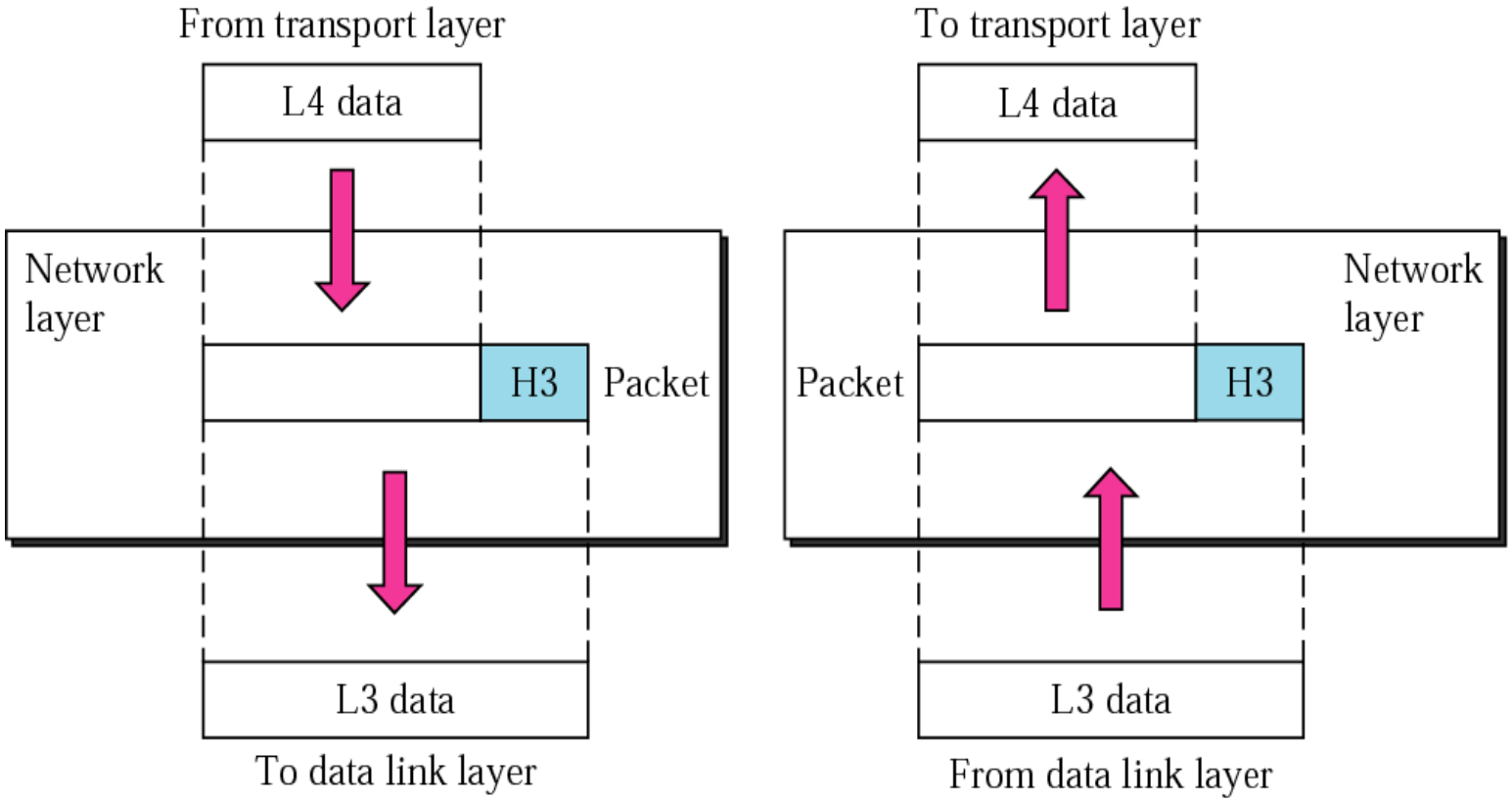
- provides two related services.
  - Switching
  - Routing

Network Layer (cont'd)

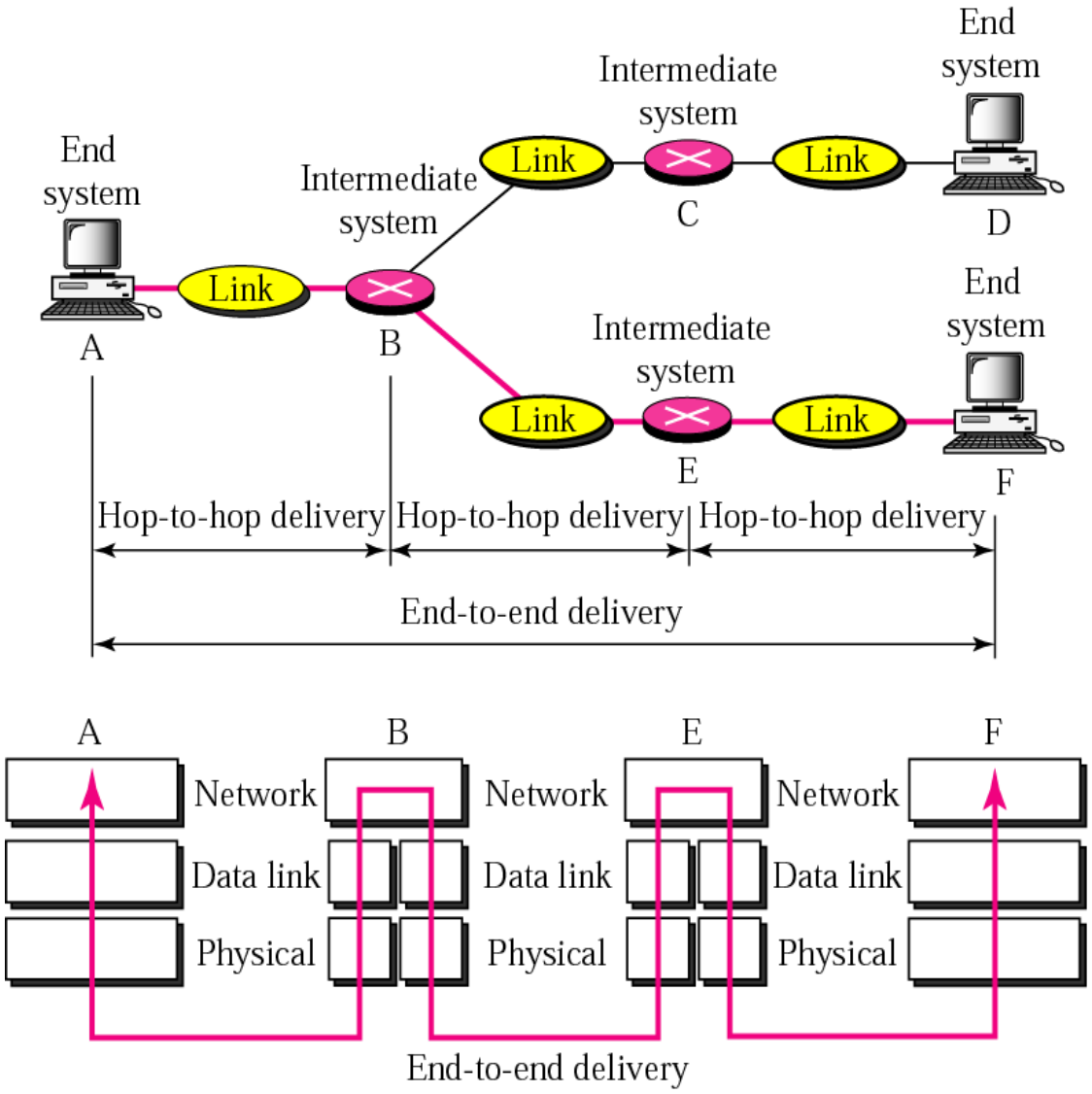
- Switching
  ~ refers to temporary connections between physical links, resulting in longer links for network transmission.(ex: telephone conversation)

- routing
  ~ means selecting the best path for sending a packet from one point to another when more than one path is available

Network Layer (cont'd)



Network Layer (cont'd)



Network Layer (cont'd)

- Specific responsibilities
  - Source-to-destination delivery(packet)
  - Logical addressing
  - Routing

Transport Layer

- is responsible for source-to-destination (end-to-end) delivery of the entire message.

cf: the network layer oversees end-to-end delivery of individual packet.

Transport Layer (cont'd)

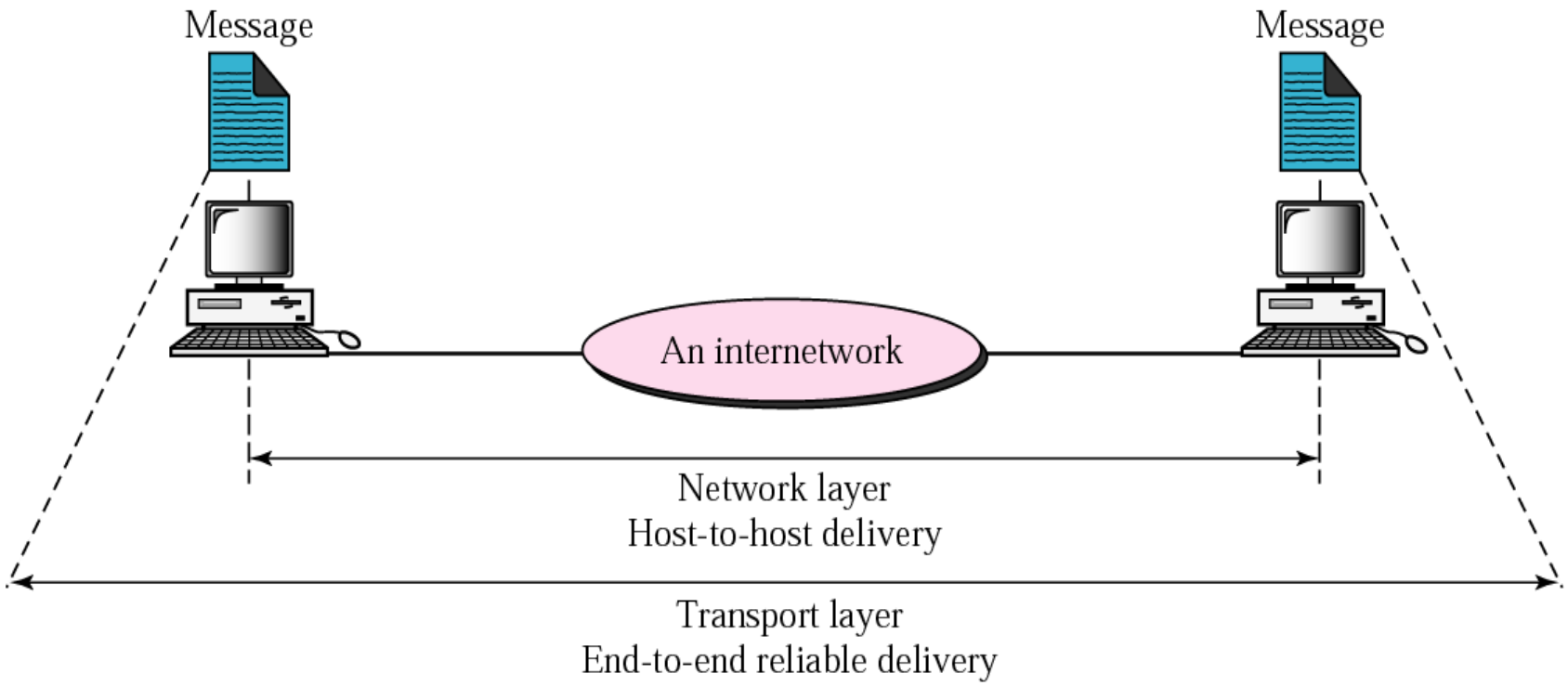
- Specific responsibility
  - Reliable End-to-end message delivery
  - Service-point(port) addressing
    - delivery of a message to the appropriate application on a computer running multiple applications
  - Segmentation and reassembly
  - Connection control
  - Flow Control
  - Error Control

Flow Control

- Flow control is a technique for assuring that a transmitting entity does not overwhelm the receiving entity with data. The receiving entity typically allocates a data buffer of some maximum length for a transfer. Because the receiver may do some processing on the data before passing it on to the application (if itself is not the last receiver), it may be over run by data if flow control is not employed.

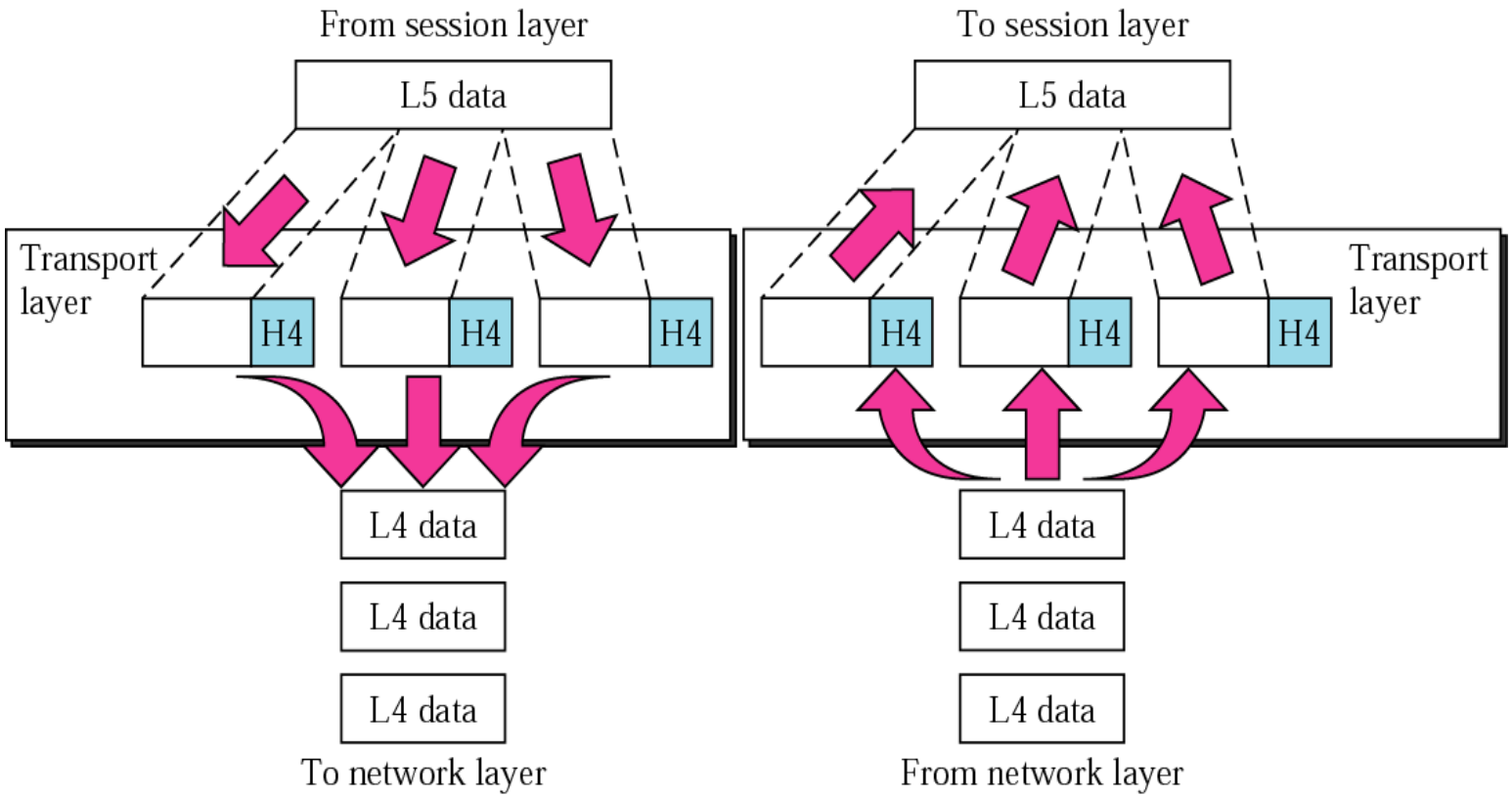
Transport Layer (cont'd)

- Reliable End-to-end delivery of a message



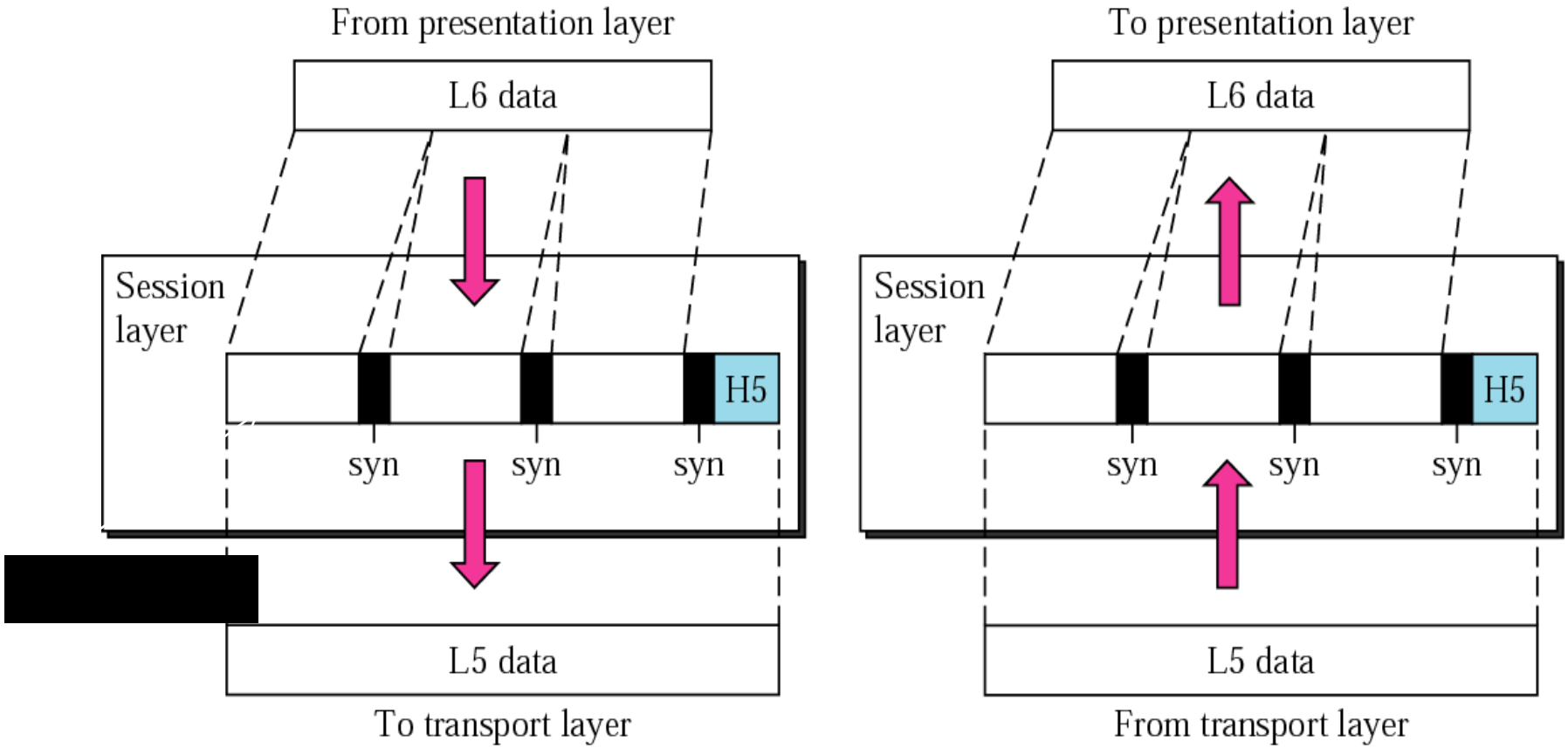
Transport Layer (cont'd)

- Transport Layer



Session Layer

- is the network dialog controller



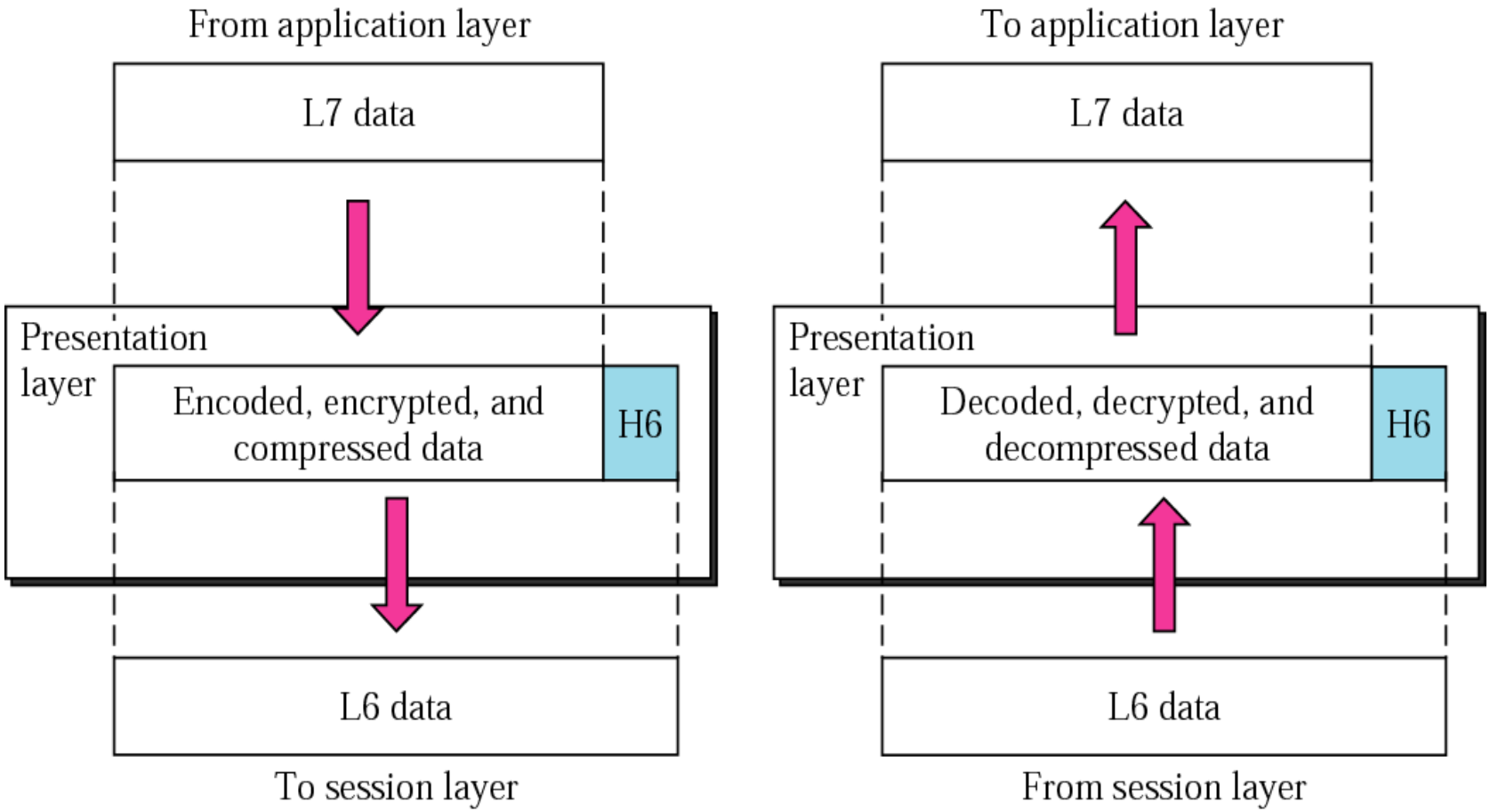
Session Layer (cont'd)

- Specific responsibility
  - Session management
  - Synchronization
  - Dialog control : Deciding who sends, and when

Presentation Layer

- ensures interoperability among communicating devices.
- The layer is concerned with transformation of transferred information. The controls include
- message compression and expansion, encryption and de-encryption of data when necessary for transmission efficiency.
- peripheral device coding and formatting.

Presentation Layer (cont'd)



Presentation Layer (cont'd)

- Specific responsibility
  - Translation
  - Encryption
  - Compression

Application Layer

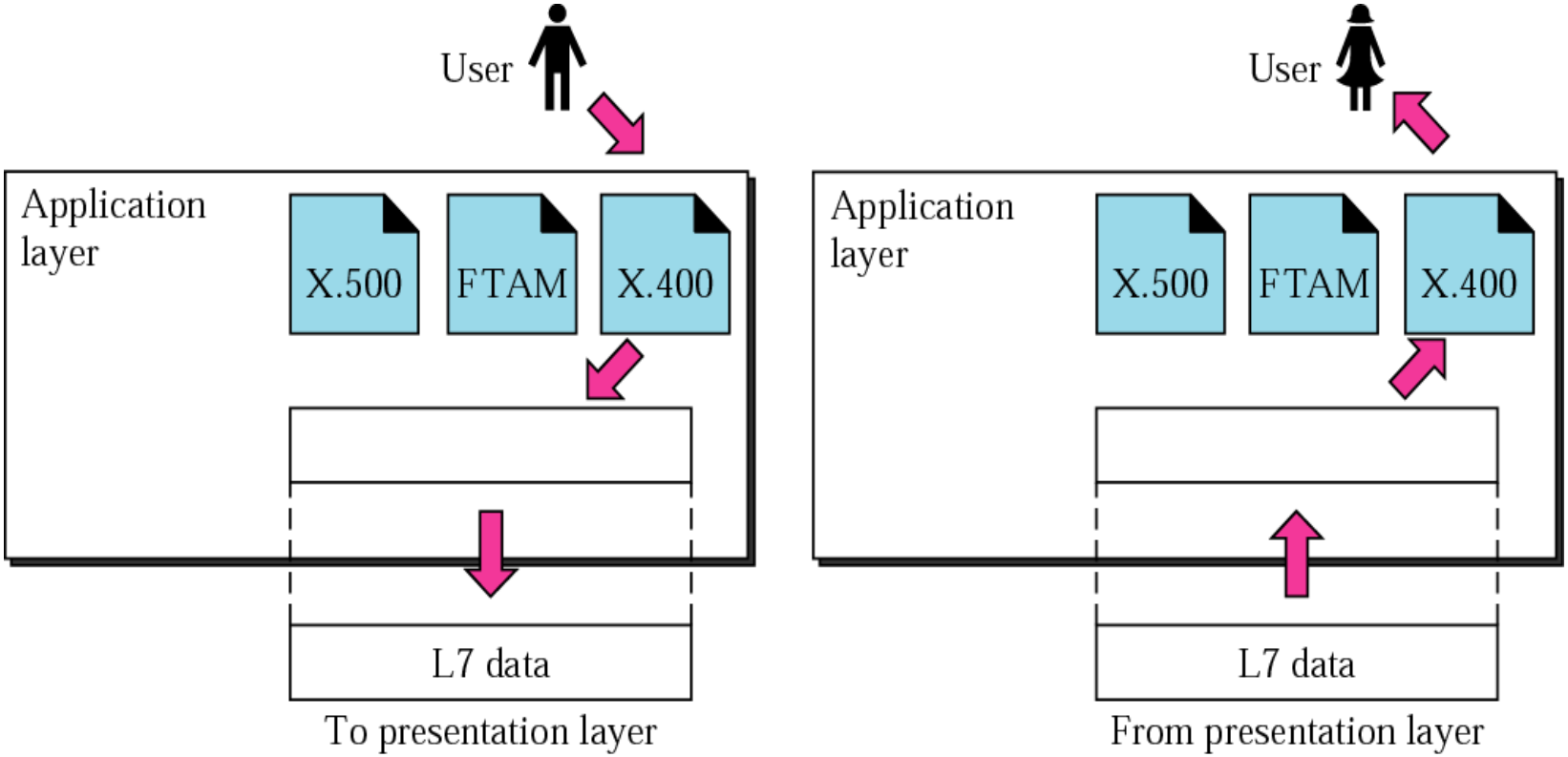
- enables the user, whether human or software, to access the network.

- provides user interfaces and support for services.
  - Email, remote file access and transfer, shared database management

- The layer is concerned with the application and system activity. The content of the application layer is up to the individual user.

Application Layer (cont'd)

- Application Layer

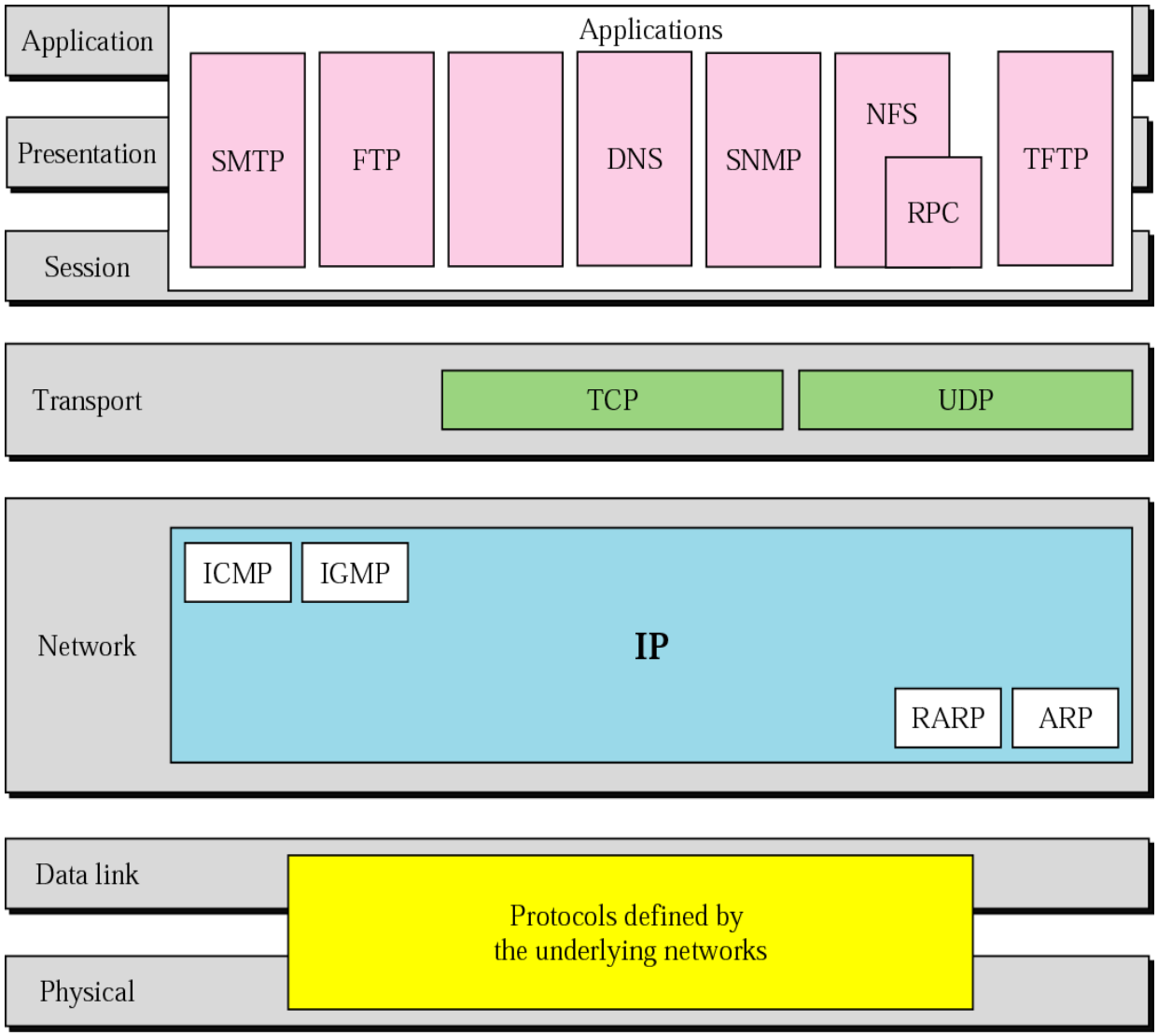


Application Layer (cont'd)

- Specific services
  - Network virtual terminal
  - File access, transfer, and management
  - Mail services
  - Directory services

TCP/IP Protocol Suite

This protocol
Is made up of
Five layers :
physical,
data link,
network,
transport, and
application



Internetworking Protocol (IP)

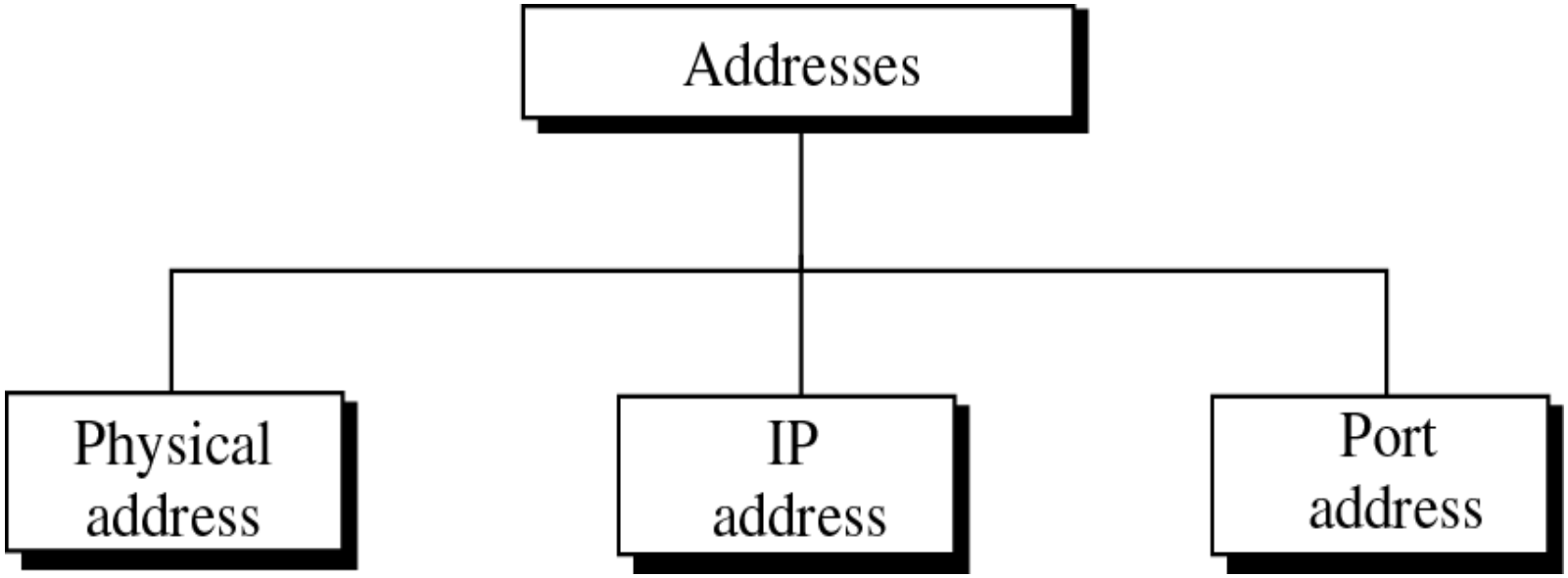
- Transmission mechanism by the TCP/IP
- An unreliable and connectionless datagram protocol – best-effort delivery service; IP provides no error checking or tracking

UDP and TCP

- User Datagram Protocol (UDP)
  - A process-to-process protocol that add only port addresses, checksum error control, length information
- Transmission Control Protocol (TCP)
  - Reliable stream (connection-oriented) transport protocol
  - Dividing a stream of data into smaller units called segments

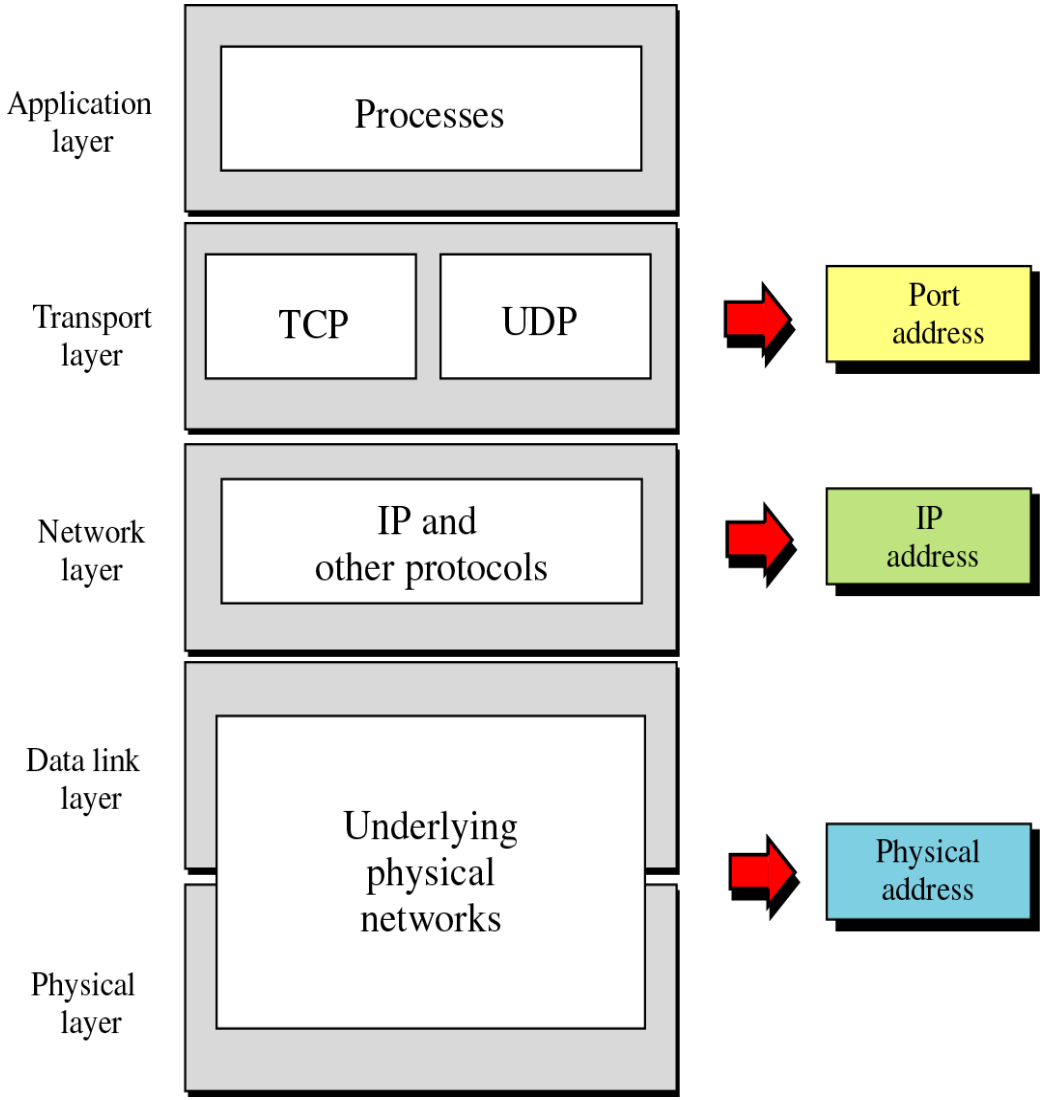
Addressing

- Addresses in TCP/IP

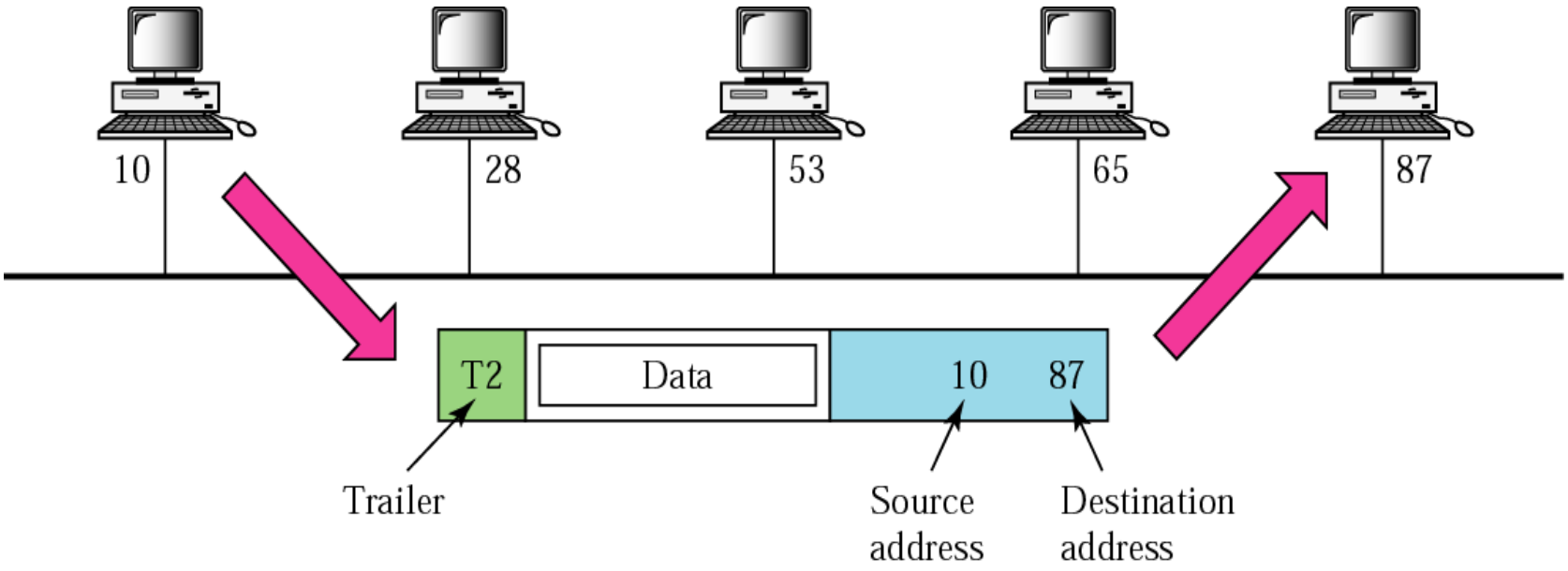


Addressing (cont'd)

- Relationship of layers and addresses in TCP/IP



Physical address (example 1)



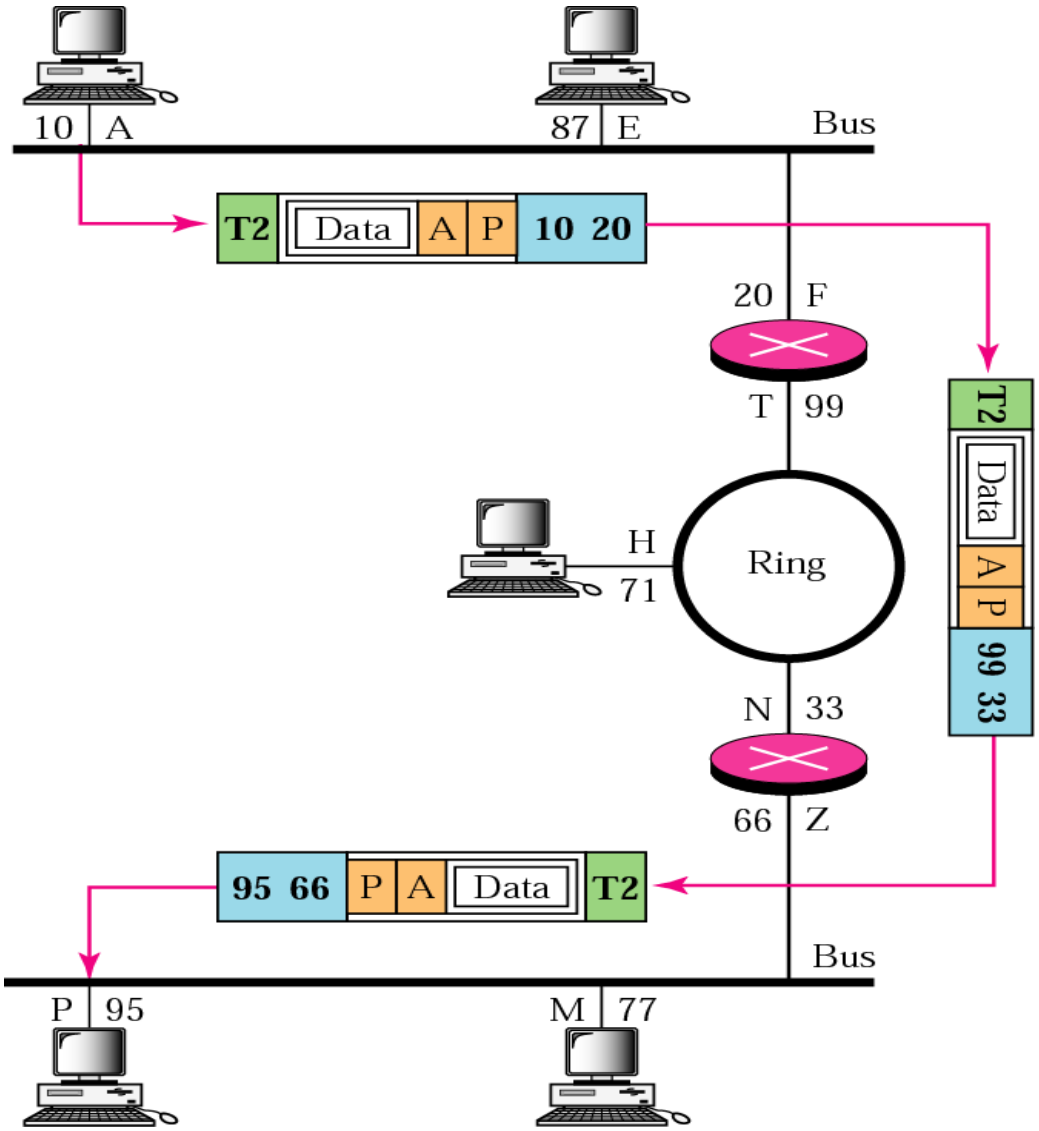
Physical address (example 2)

- Most local area networks use a 48-bit (6 bytes) physical address written as 12 hexadecimal digits, with every 2 bytes separated by a hyphen as shown below:

- 07-01-02-01-2C-4B

  A 6-byte (12 hexadecimal digits) physical address

IP Addresses (example 3)

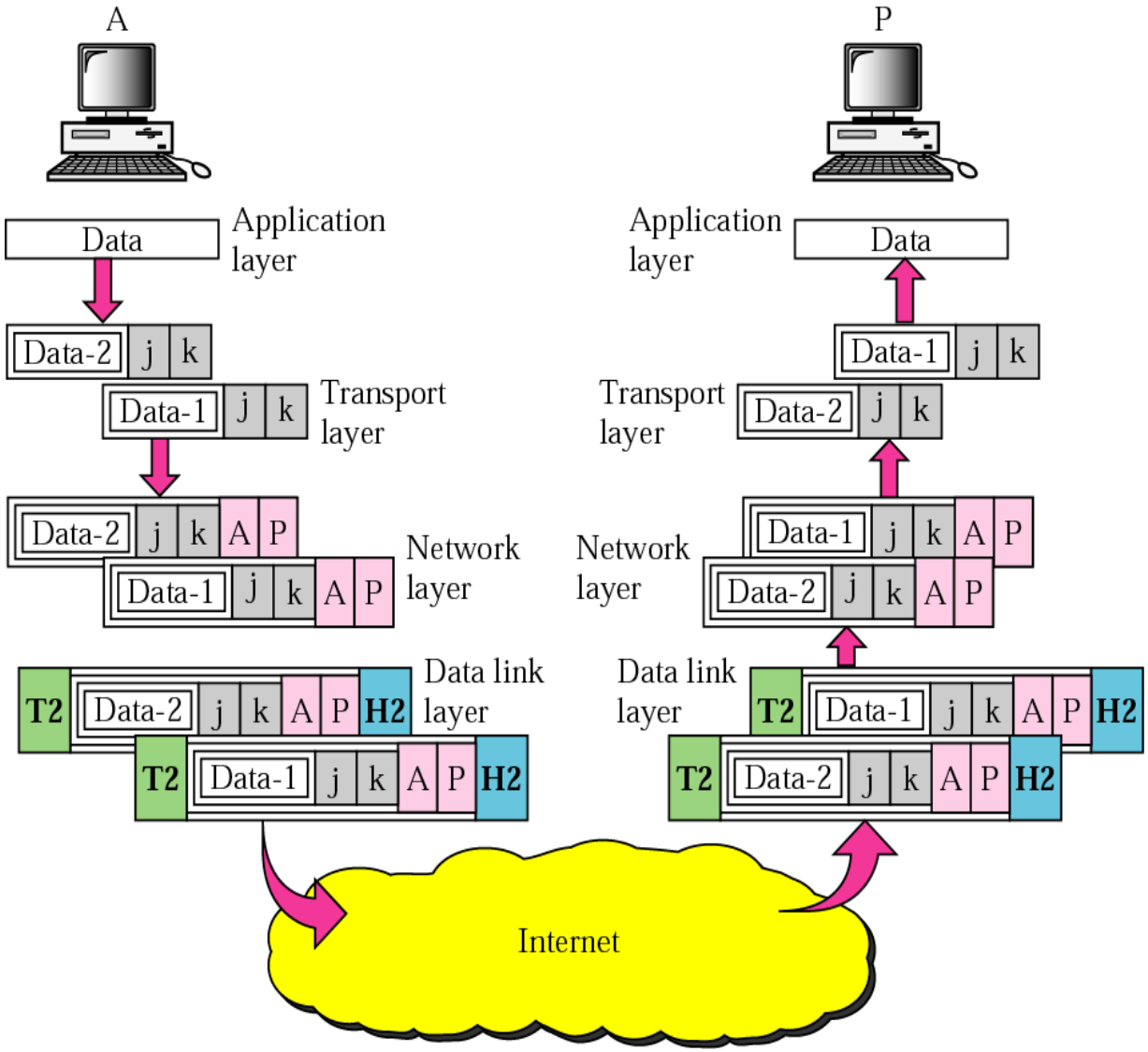


IP Addresses (example 4)

- As we will see later, an Internet address (in IPv4) is 32 bits in length, normally written as four decimal numbers, with each number representing 1 byte. The numbers are separated by a dot. Below is an example of such an address

- 132.24.75.9

Port Addresses (example 5)



Port Addresses (example 6)

- A port address is a 16-bit address represented by one decimal number as shown below.
- 753 : A 16-bit port address

2.5 TCP/IP Versions

- Version 4 (IPv4)
  - 32 bits address length
- Version 6 (IPv6 or IPng)
  - 128 bits address length