Network Models

REFERENCE MODELS

2 Types

1. OSI Reference Model
2. TCP/IP Reference Model

THE 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. It was first introduced in the late 1970s.

ISO is the organization.

OSI is the model

Layered Architecture

Peer-to-Peer Processes

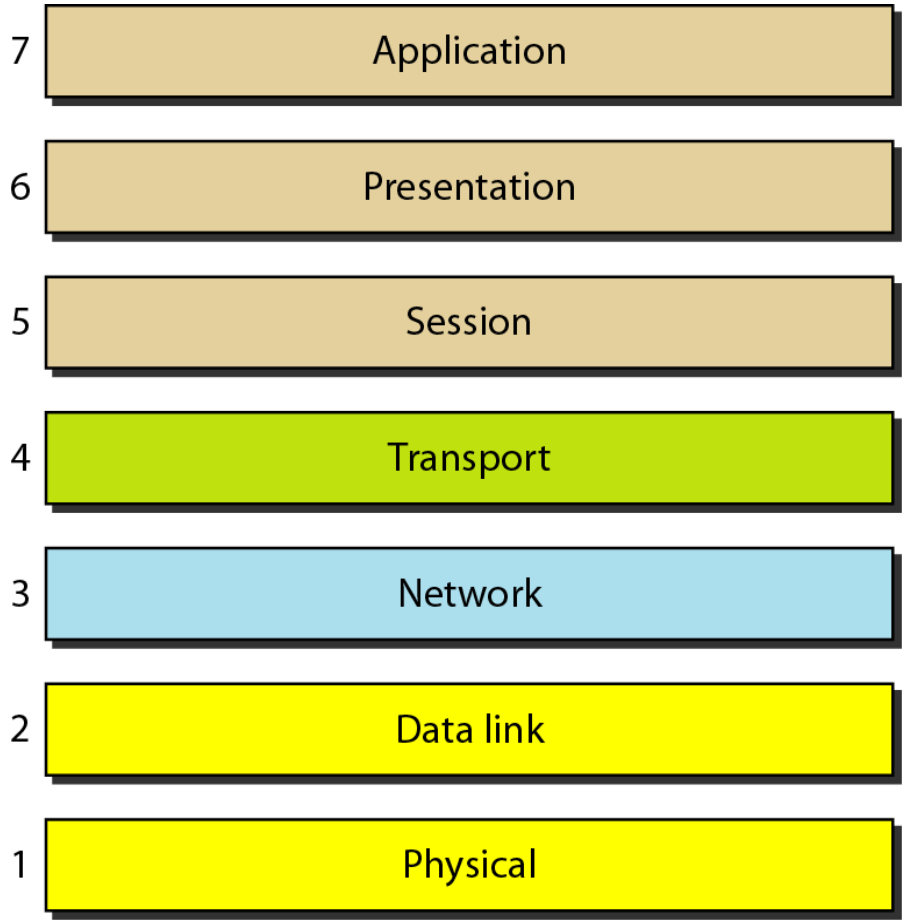
Why Layering

- **Large number of functions**
- **Manage Easily**

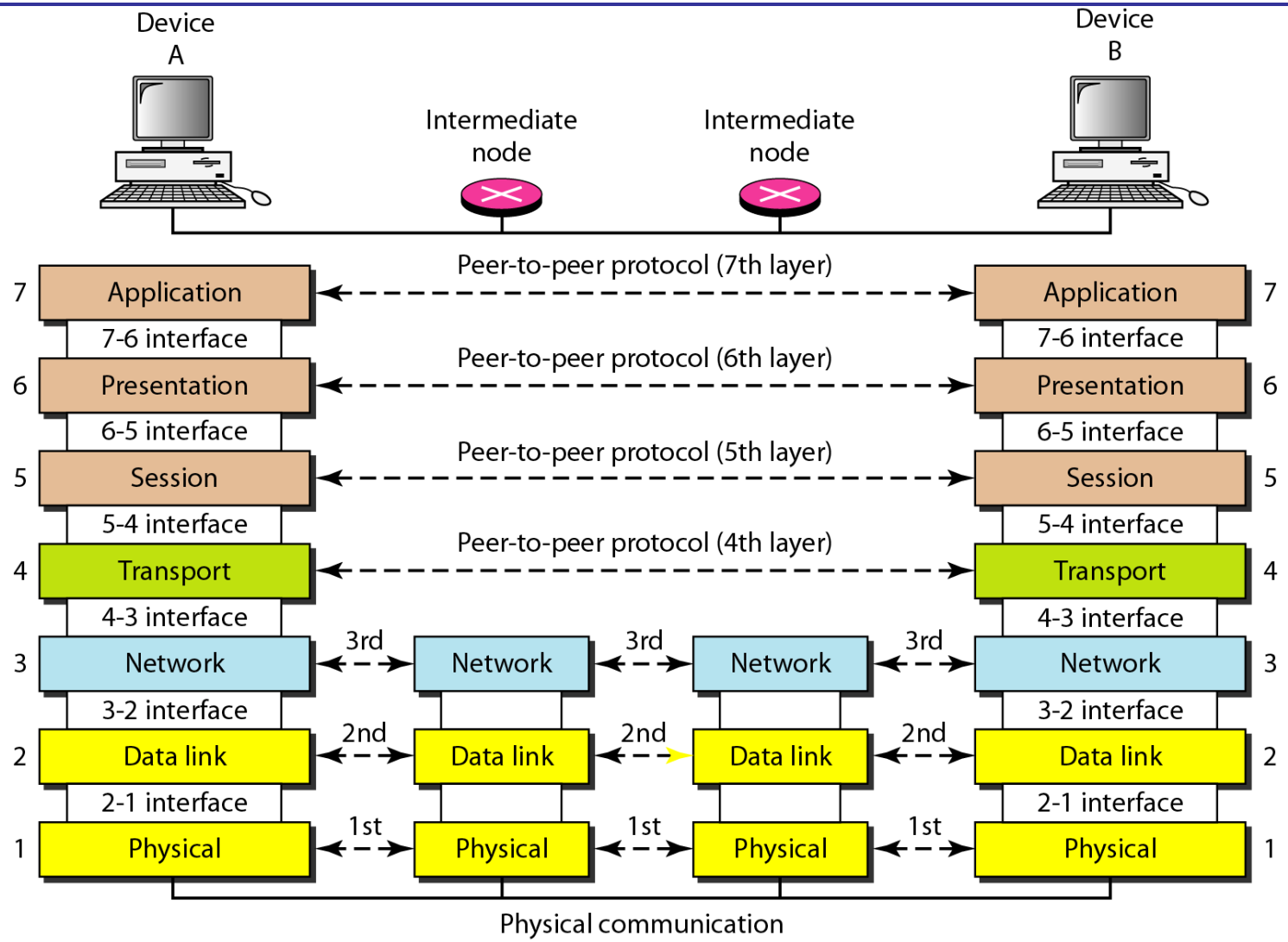
Peer to Peer Process

A layer appears to be communicating directly with the same layer at the other end of the link (i.e. its peer). What is actually happening is that the data is being passed down to lower layers for transmission and is passed up again at the other end.

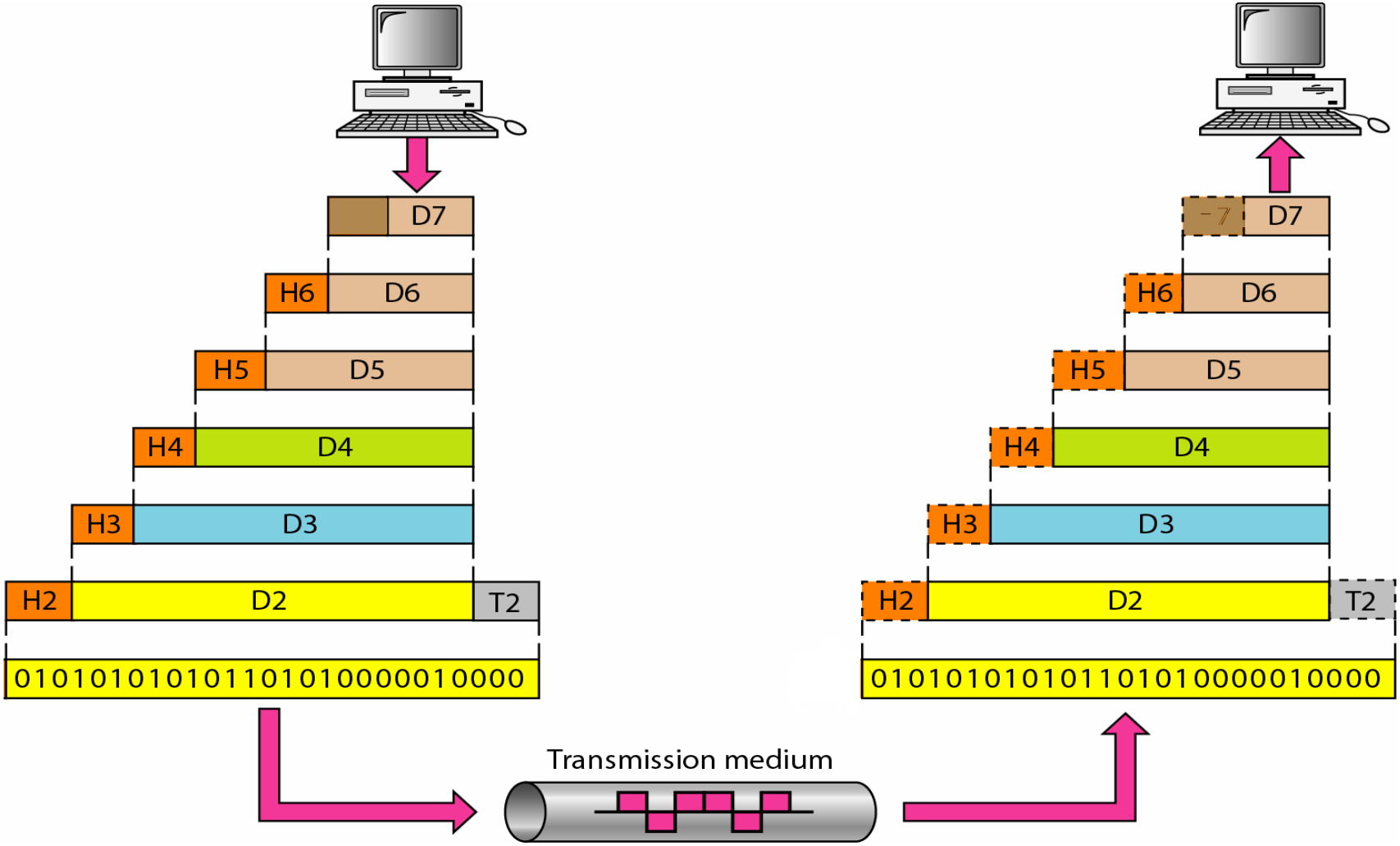
Seven layers of the OSI model



The interaction between layers in the OSI model



An exchange using the OSI model



LAYERS IN THE OSI MODEL

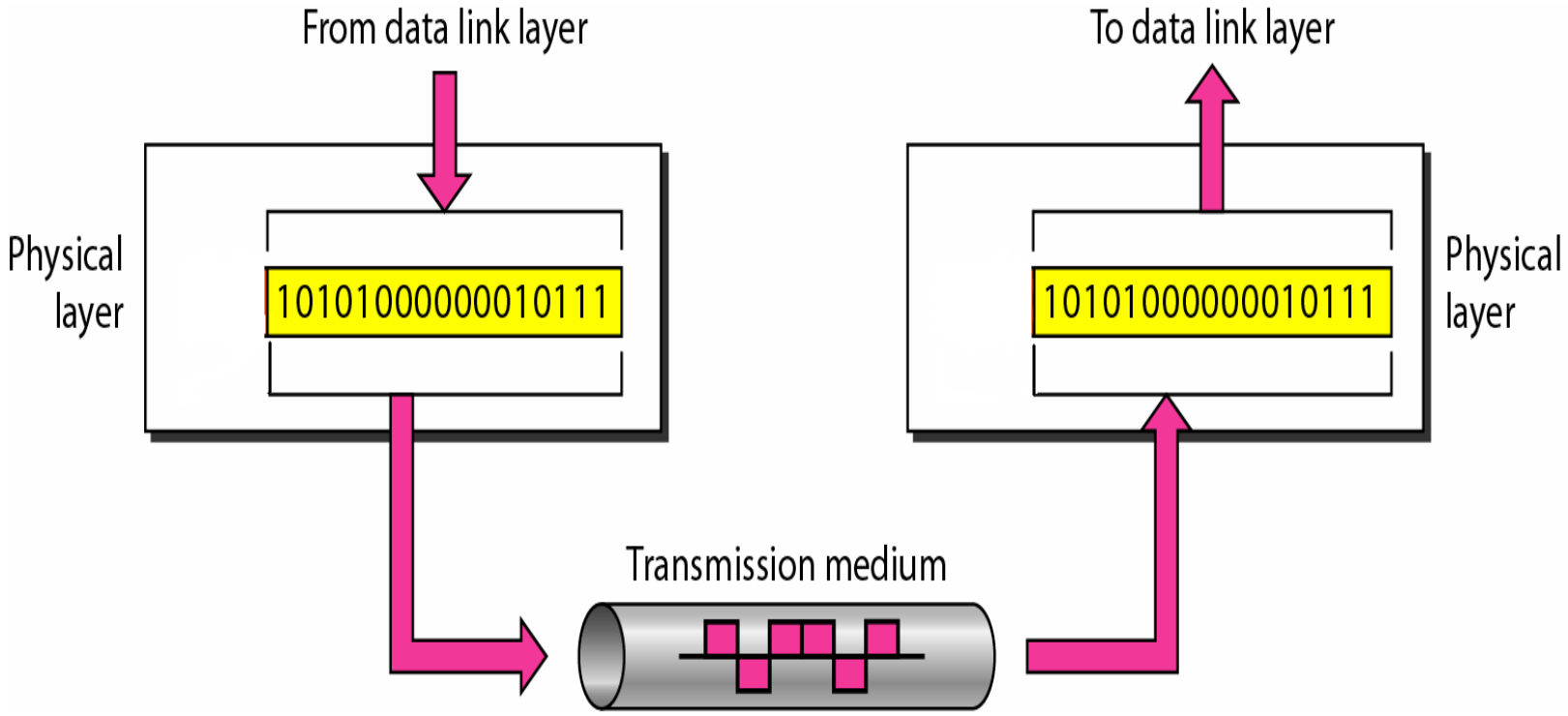
In this section we briefly describe the functions of each layer in the OSI model.

Topics discussed in this section:

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

Physical layer

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

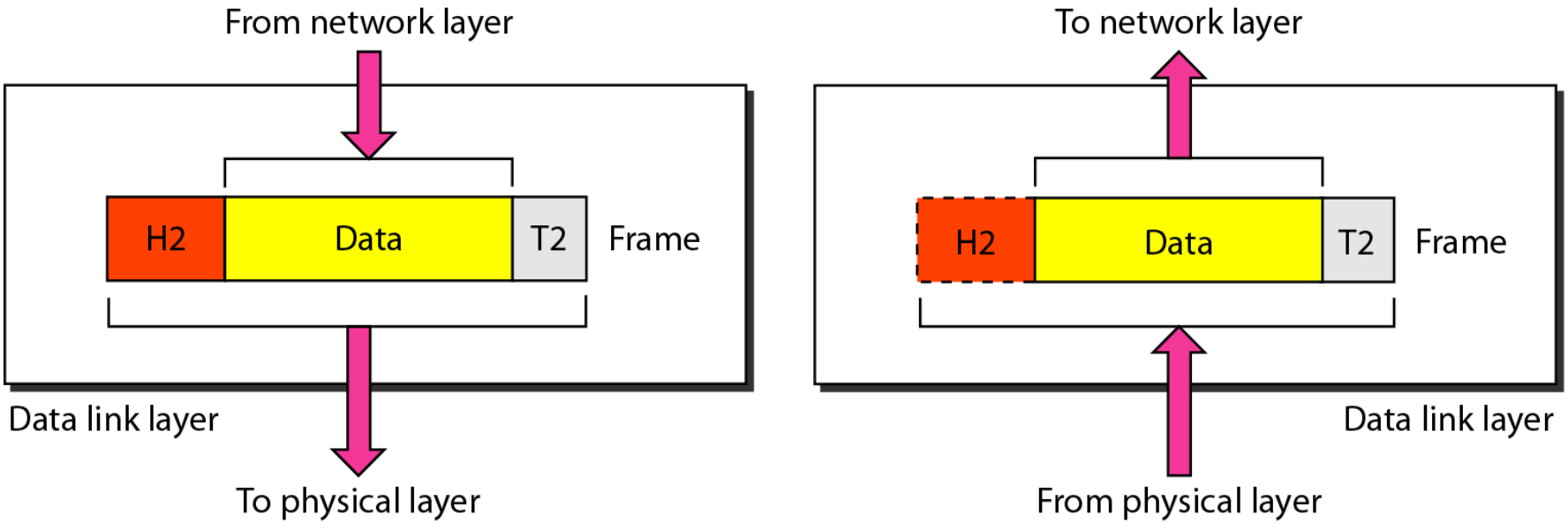


Physical layer Cont…

- Transmission medium is defined
- Representation of bits
  - Type of encoding to convert bits to signals
- Data rate
- Line Configuration
  - Point to Point
  - Multi point
- Physical Topology
  - Mesh, Star, Bus, Ring
- Transmission mode
  - Simplex, Half Duplex, Full Duplex

Data link layer

The data link layer is responsible for moving frames from one hop (node) to the next.



Data link layer Cont…

Data framing

The stream of bits from network layer is divided into manageable data units called frames

Physical addressing

Media Access Control (MAC) addressing is used to uniquely identify hosts at the Data Link layer.

Flow control

refers to a set of procedures used to restrict the amount of data that the sender can send before waiting for acknowledgment.

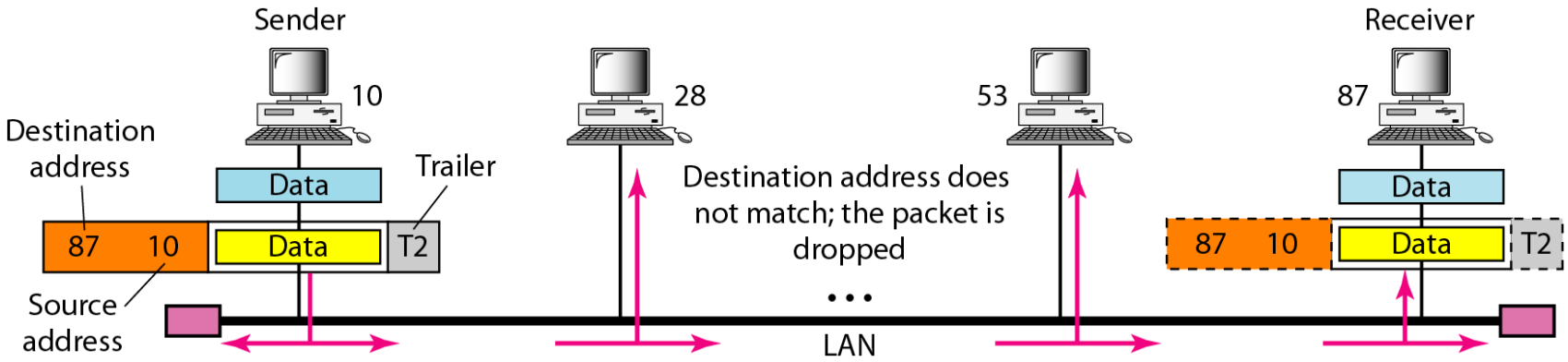
Error control

is based on automatic repeat request, which is the retransmission of data.

Access Control

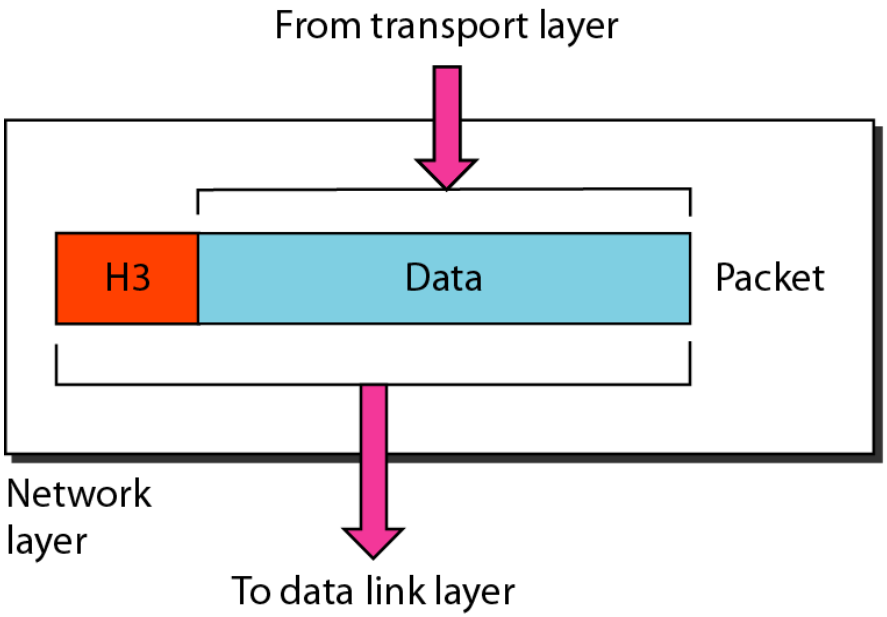
Which device has control over the line at any given time

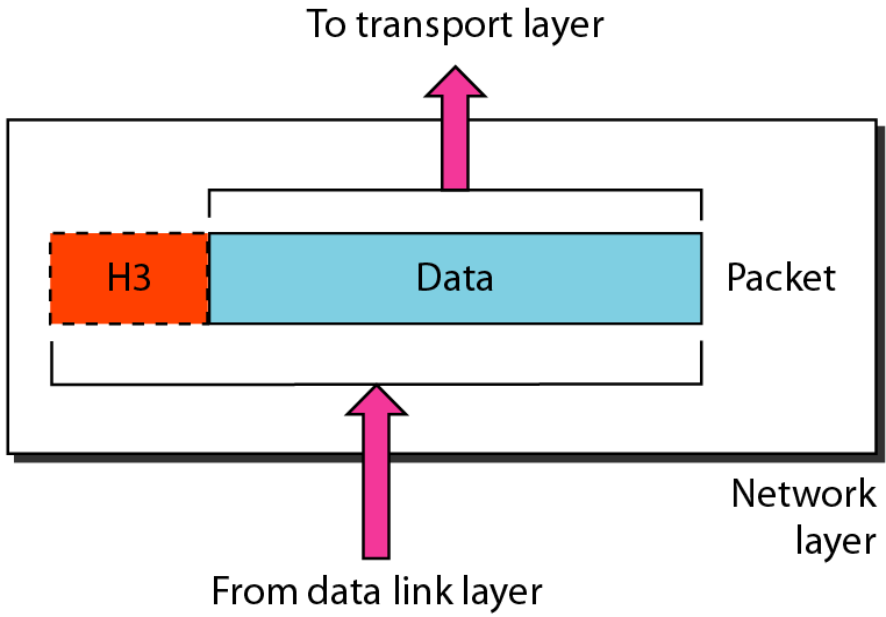
Data link layer Cont…



Network layer

The network layer is responsible for the delivery of individual packets from the source to the destination.





Network layer Cont…

Logical Addressing

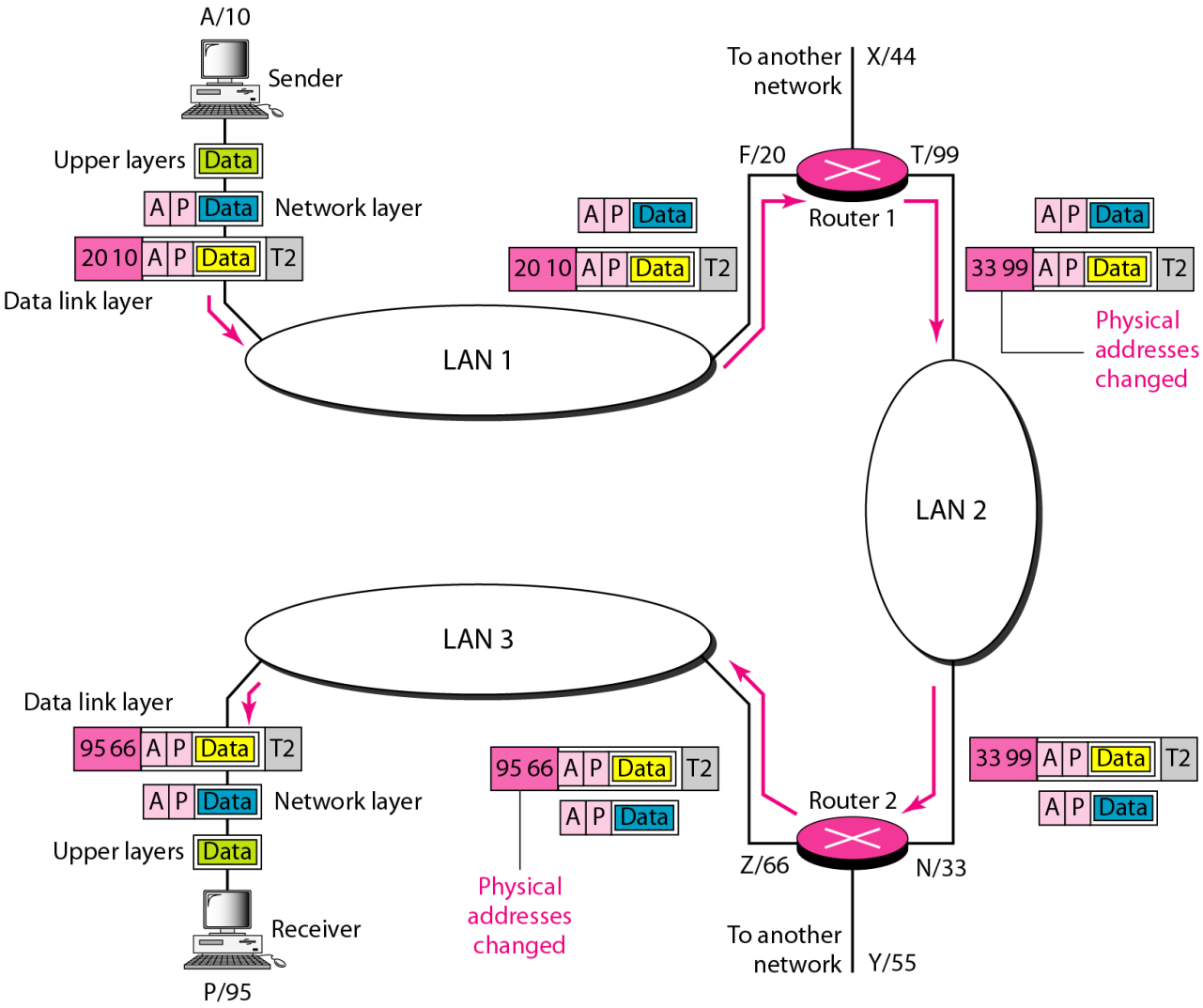
Packet passes the network boundary MAC alone cannot be used

IP address is used to uniquely identify hosts at the Network Layer

Routing

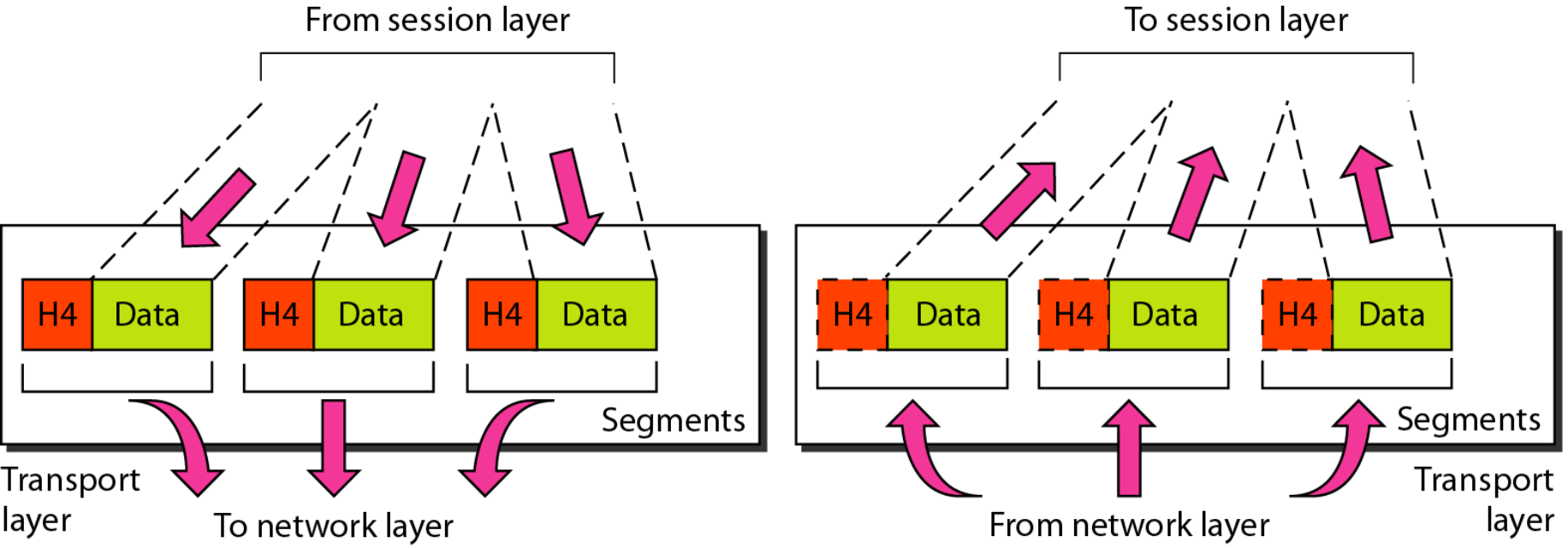
Routes the packet to the correct destination

Network layer Cont…



Transport layer

The transport layer is responsible for the delivery of a message from one process to another.



Transport layer Cont…

Service Point Addressing

Port address is necessary for delivering the packet to the correct destination

Segmentation and Reassembly

A message is divided into transmittable segments

The receiver reassemble the segments in order to get the entire message

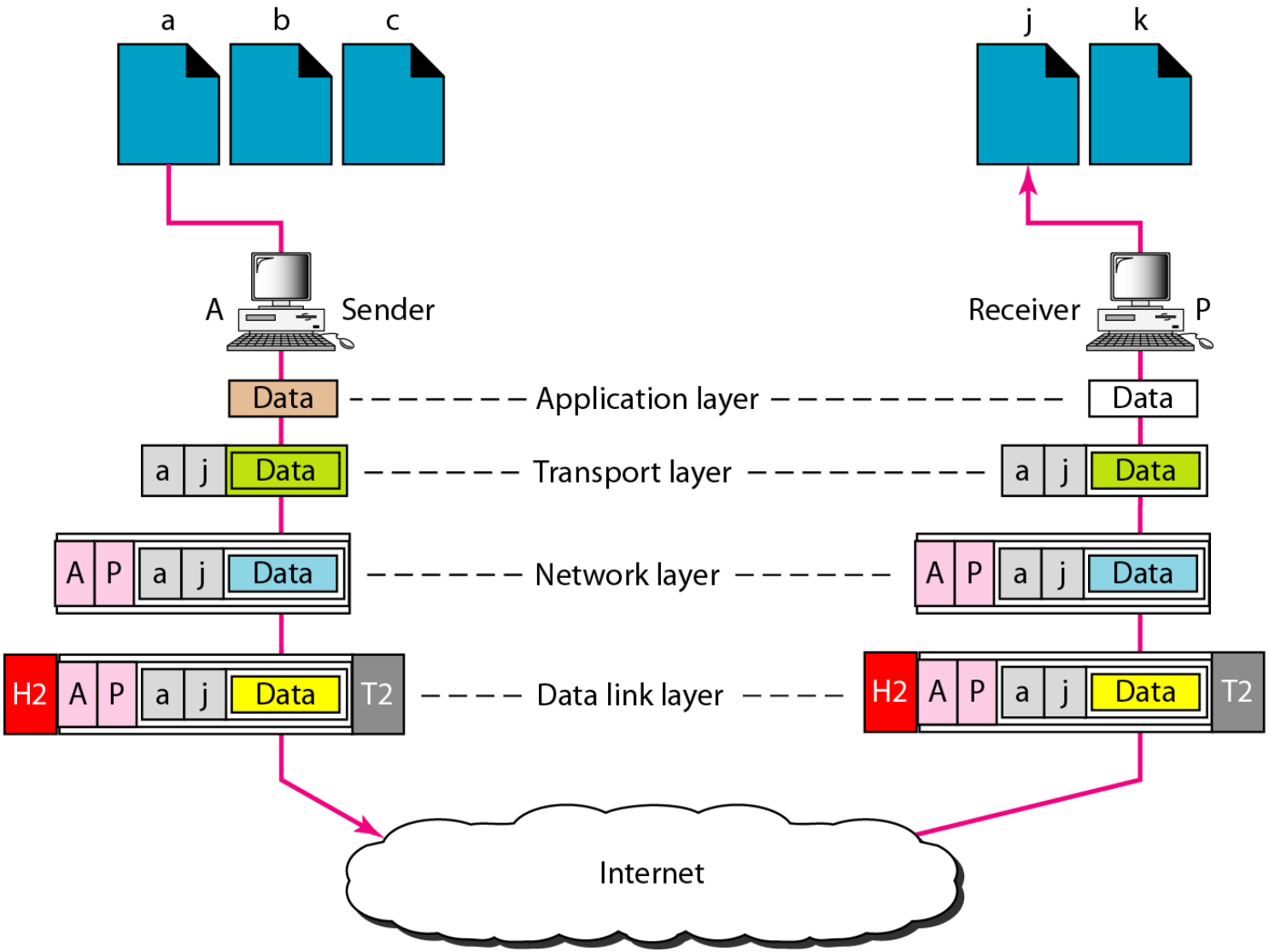
Connection Control

Connection oriented and Connection less service

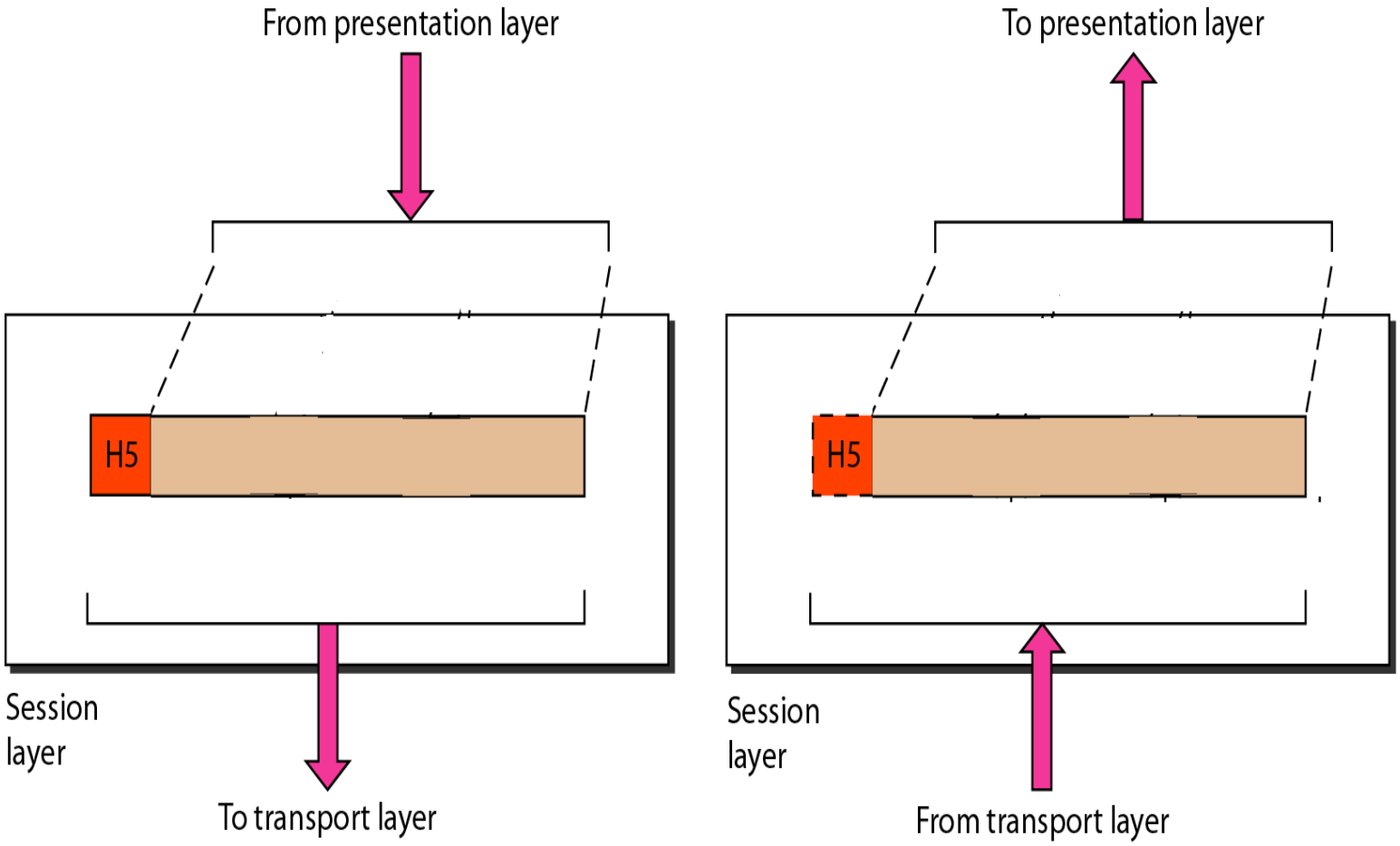
Flow control and Error Control

Similar to data link layer but at end to end

Transport layer Cont…



Session layer



Session layer Cont…

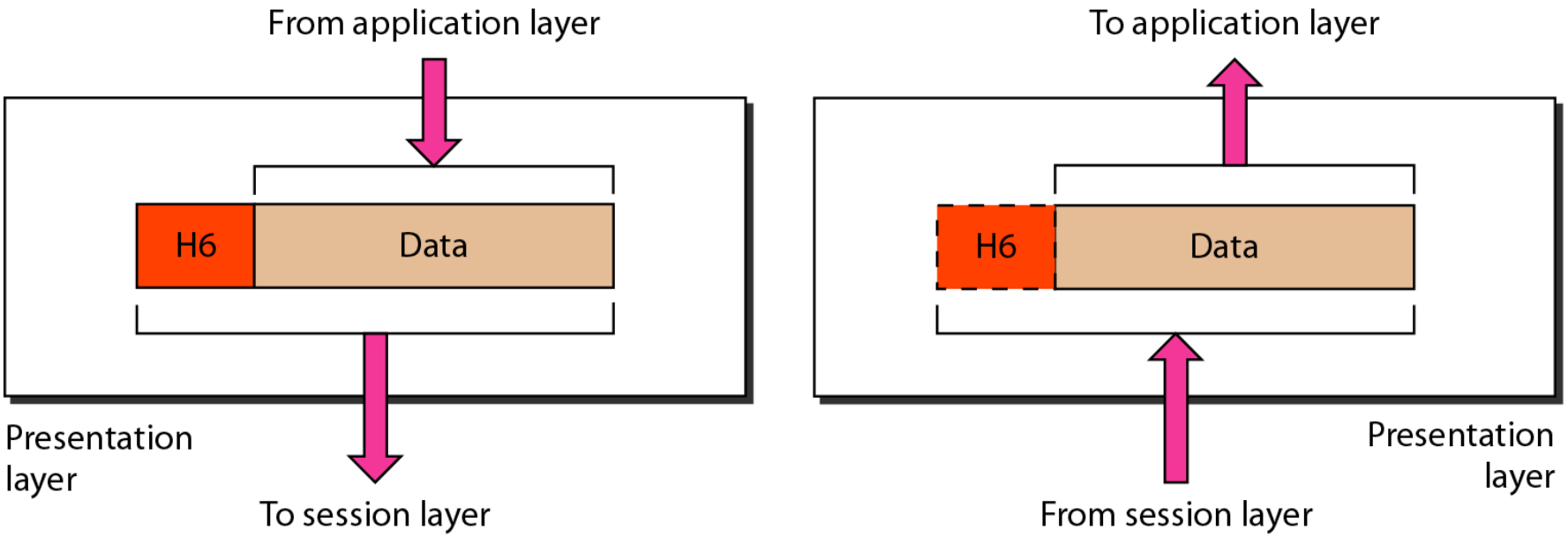
Dialog control

Simplex, Half Duplex, Full Duplex

Synchronization

Presentation layer

The presentation layer is responsible for translation, compression, and encryption



Presentation layer Cont…

Translation

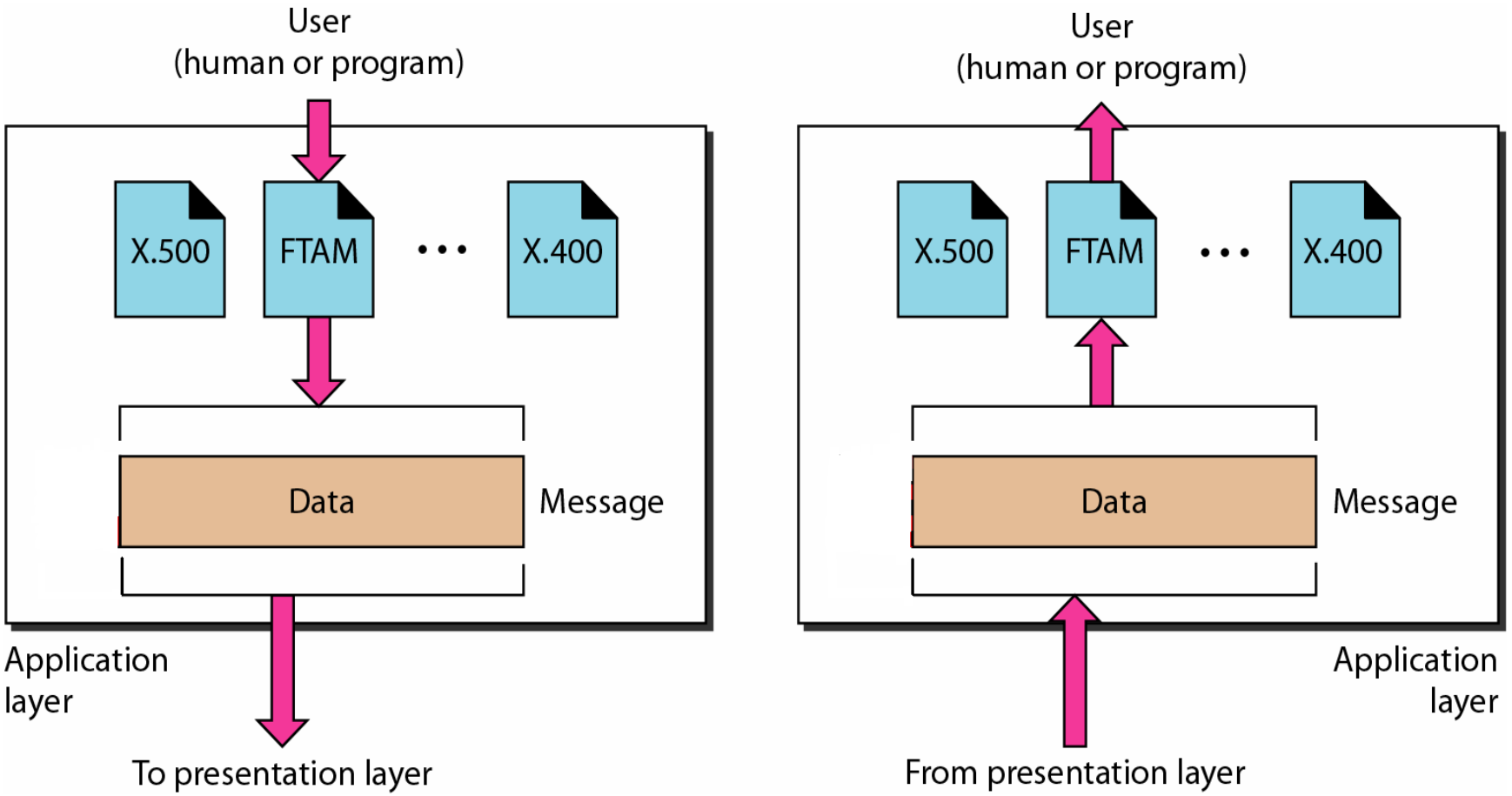
Encoding Decoding (Bit streams for transmission)

Encryption Decryption

Compression

Application layer

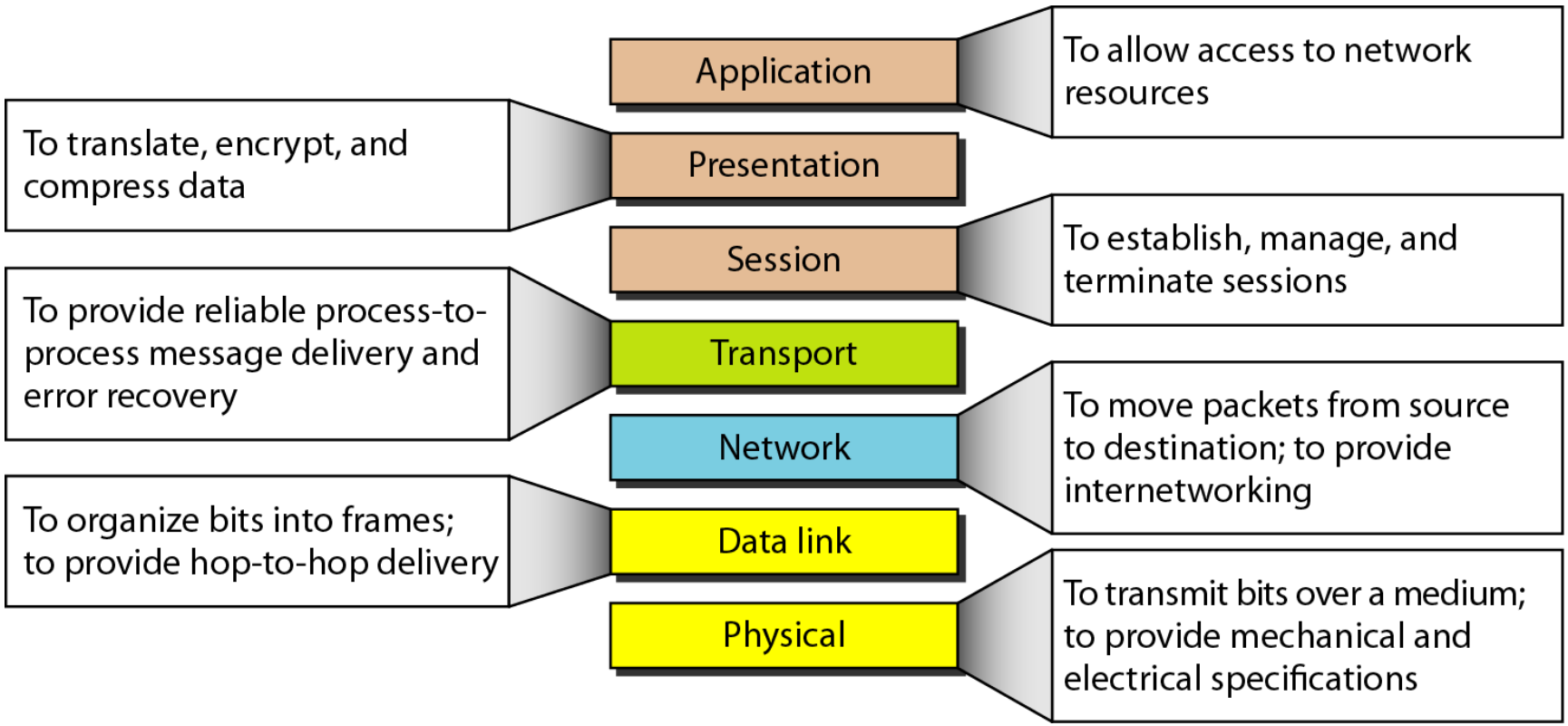
The application layer is responsible for providing services to the user



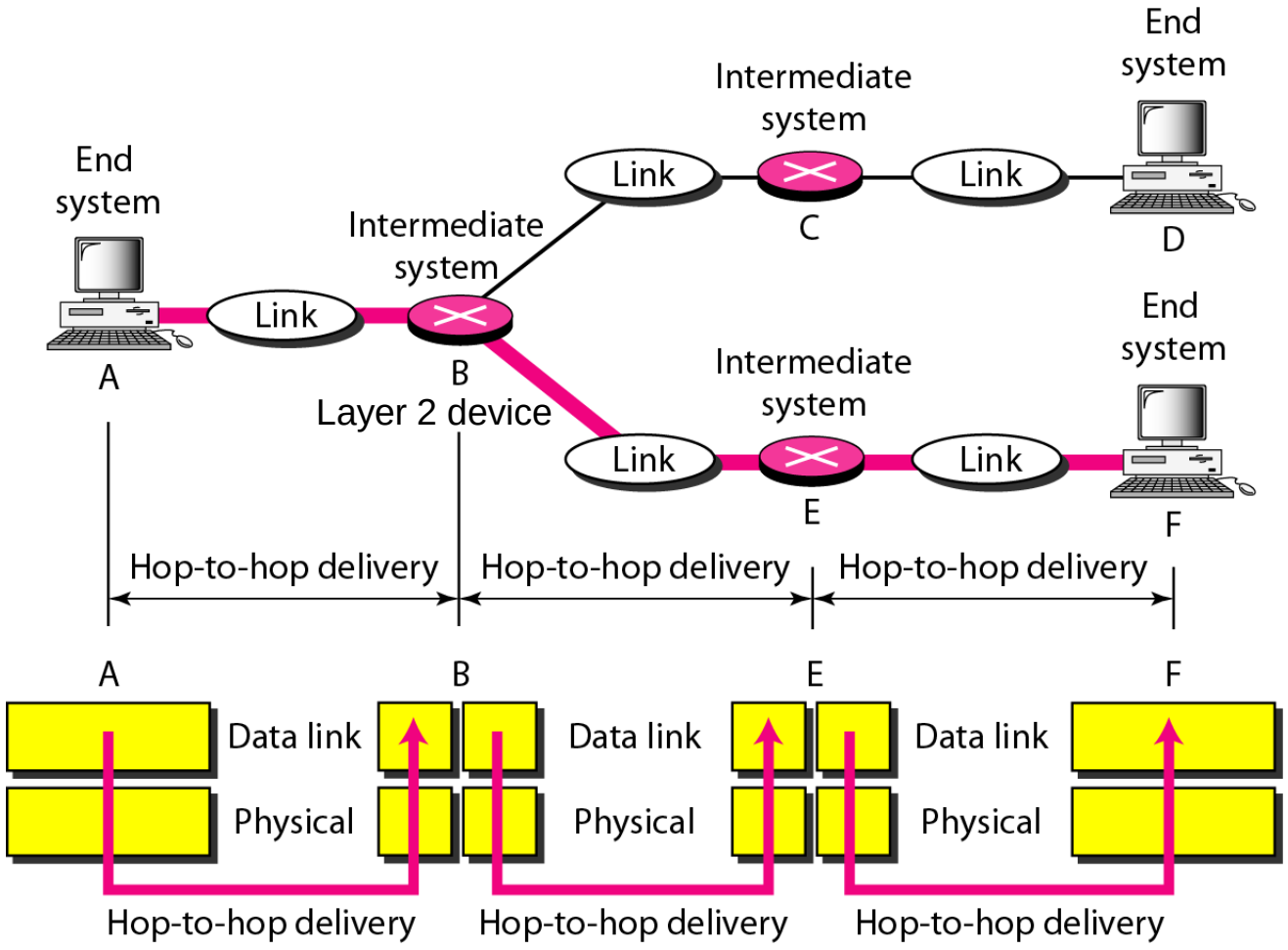
Application layer Cont…

X.400 – message handling service – e-mail
X.500 – directory services
FTAM –File Transfer, Access and Management

Summary of layers



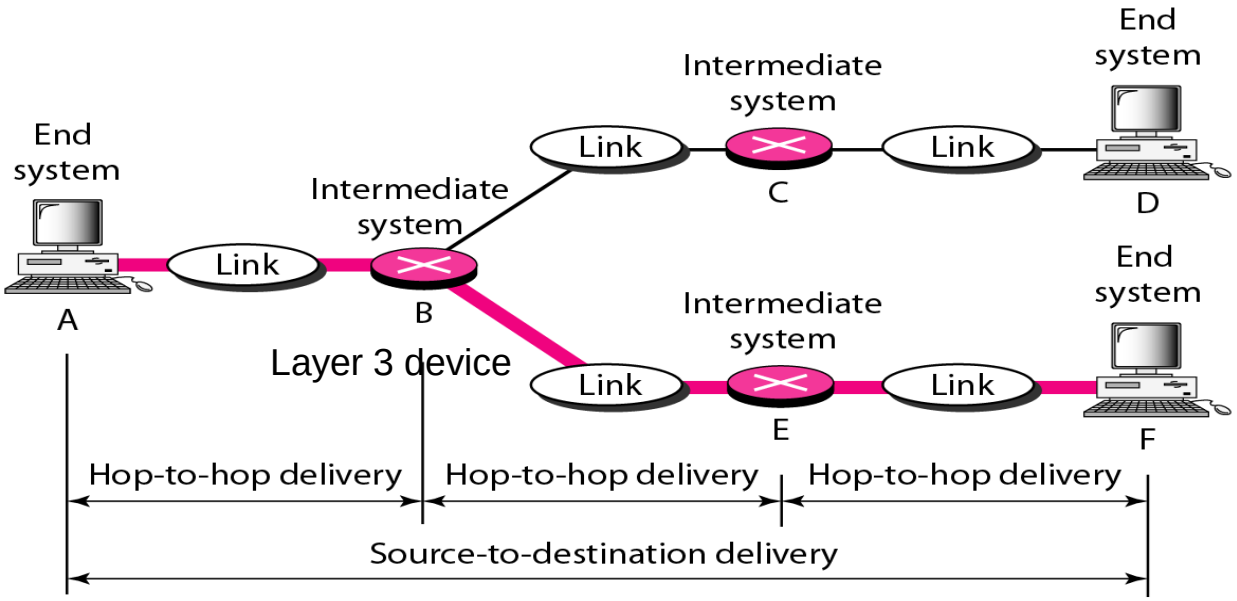
Hop-to-hop delivery

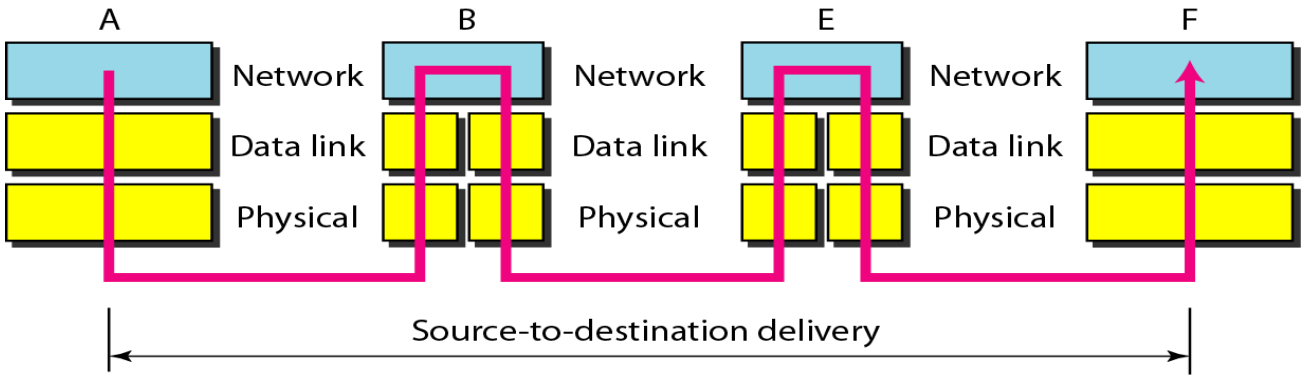


Header of data link layer of A will have source address as A and destination address as B

Header of B node DLL is B and E so on

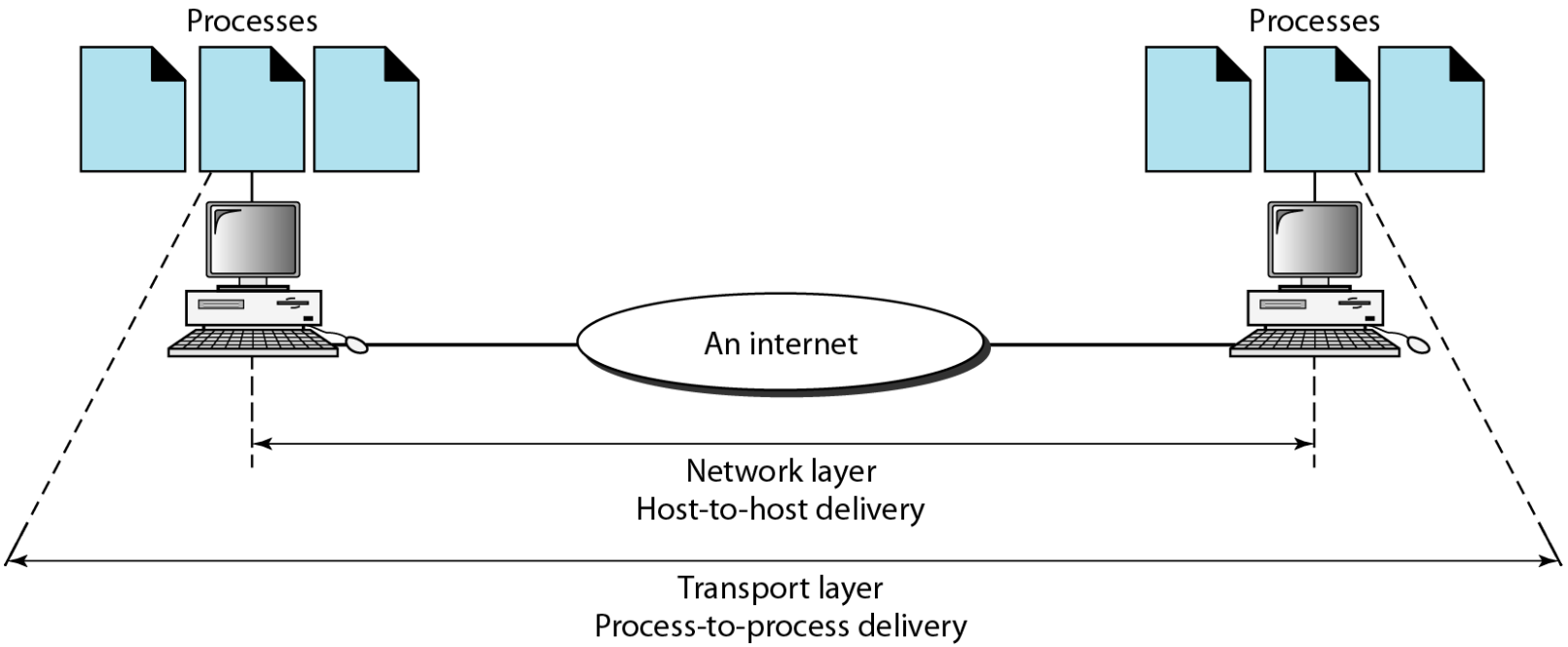
Source-to-destination delivery





Routing for next hop is done by checking the routing table of each node

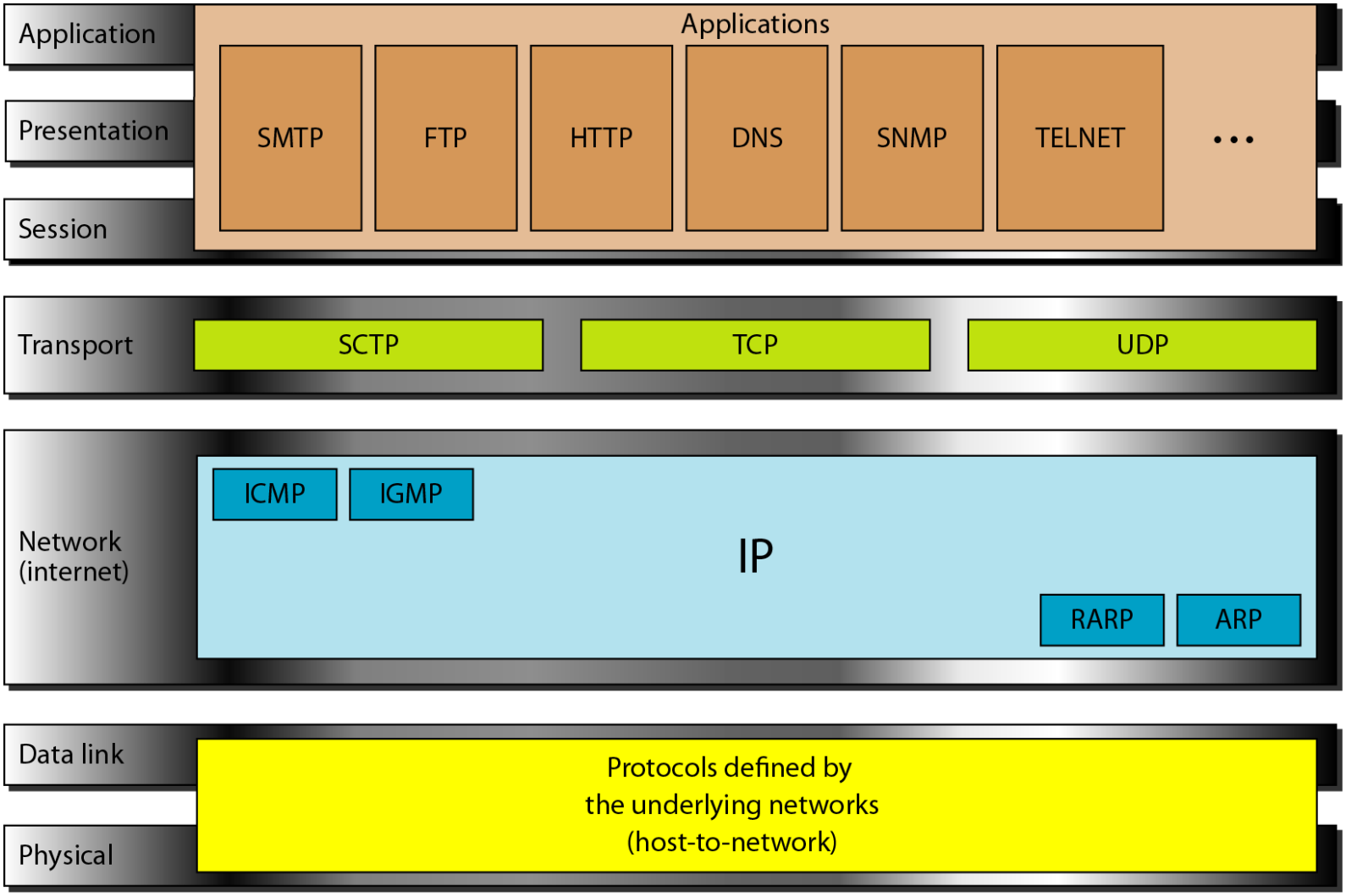
Reliable process-to-process delivery of a message



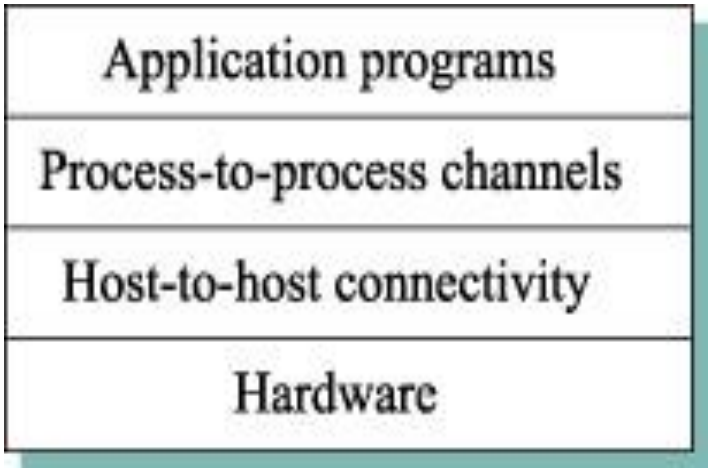
TCP/IP PROTOCOL SUITE

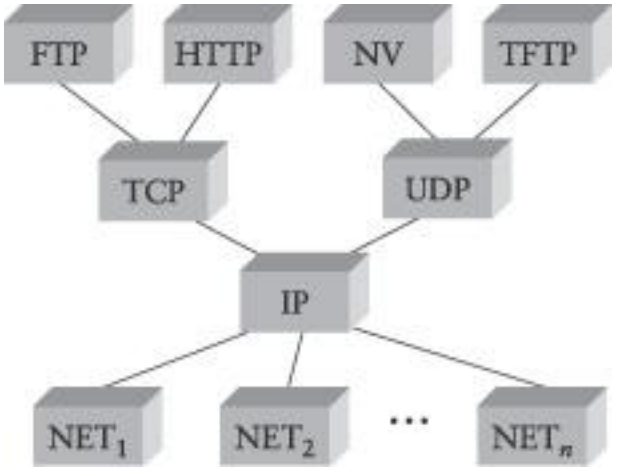
The layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application.

TCP/IP model


Application
Applications
SMTP
FTP
HTTP
DNS
SNMP
TELNET
• • •
Presentation
Session
Transport
SCTP
TCP
UDP
Network
(internet)
ICMP
IGMP
IP
RARP
ARP
Data link
Protocols defined by
the underlying networks
(host-to-network)
Physical

TCP/IP model

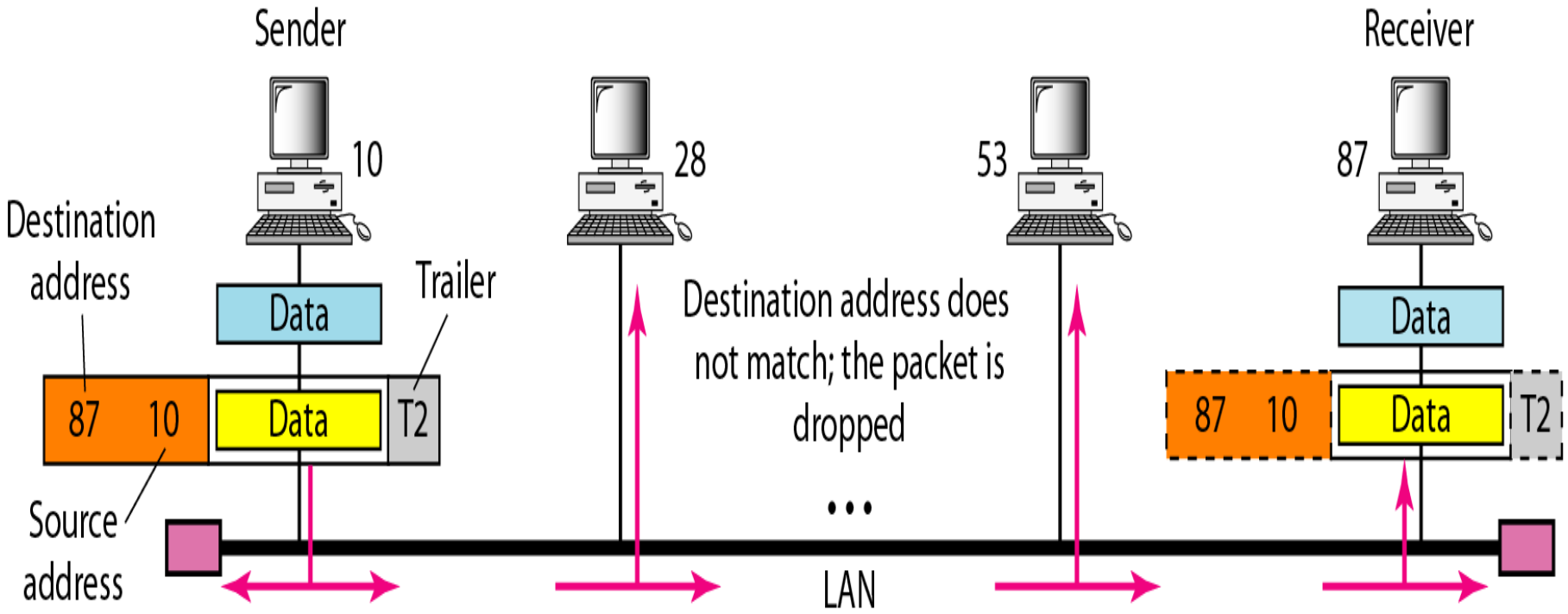

Application programs
Process-to-process channels
Host-to-host connectivity
Hardware


FTP
HTTP
NV
TFTP
TCP
UDP
IP
NET1
NET2
...
NETn

Example

In Figure a node with physical address 10 sends a frame to a node with physical address 87. The two nodes are connected by a link (bus topology LAN). As the figure shows, the computer with physical address 10 is the sender, and the computer with physical address 87 is the receiver.

Physical addresses



Example

Most local-area networks use a 48-bit (6-byte) physical address written as 12 hexadecimal digits; every byte (2 hexadecimal digits) is separated by a colon, as shown below:

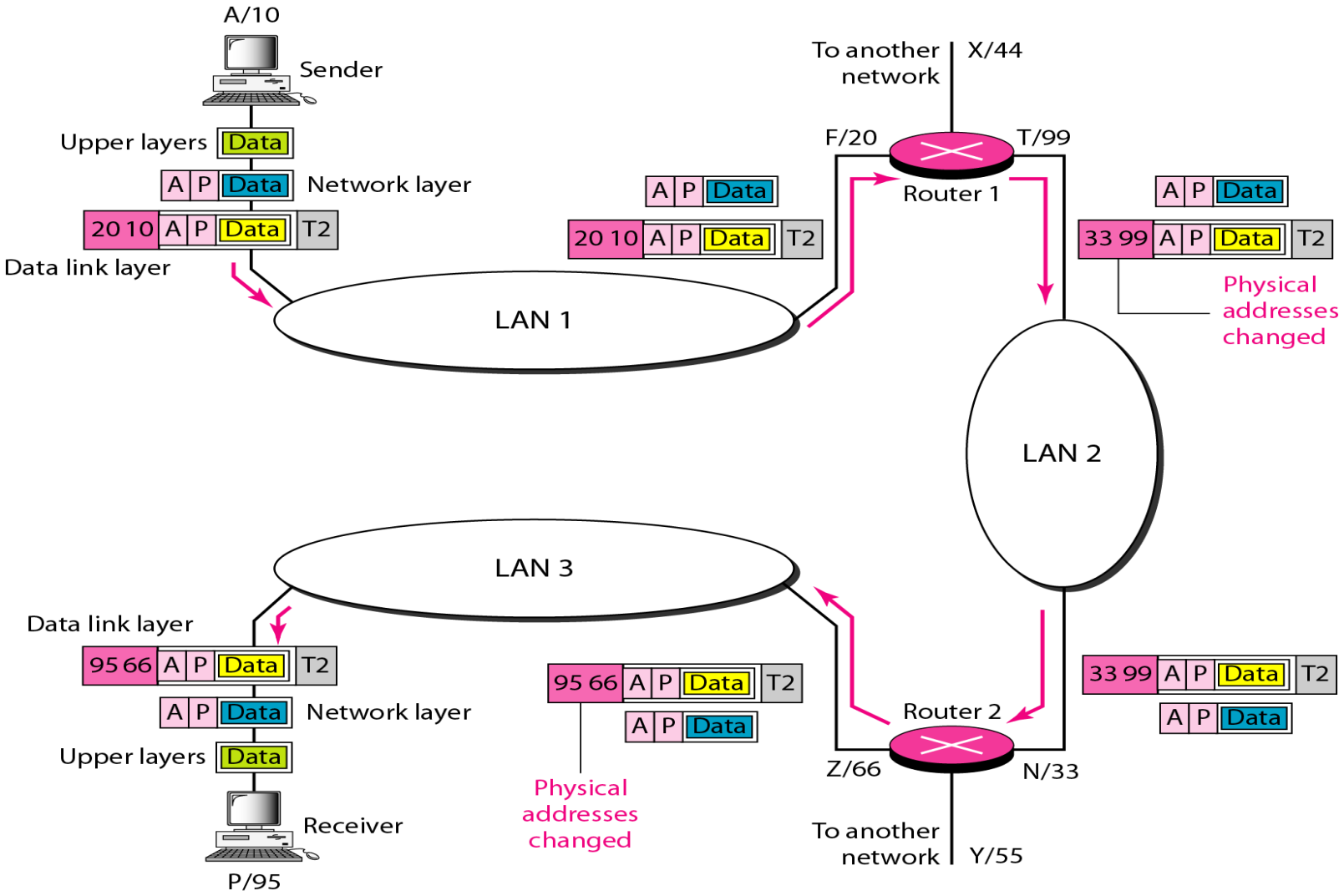
07:01:02:01:2C:4B

A 6-byte (12 hexadecimal digits) physical address.

Example

Figure shows a part of an internet with two routers connecting three LANs. Each device (computer or router) has a pair of addresses (logical and physical) for each connection. In this case, each computer is connected to only one link and therefore has only one pair of addresses. Each router, however, is connected to three networks (only two are shown in the figure). So each router has three pairs of addresses, one for each connection.

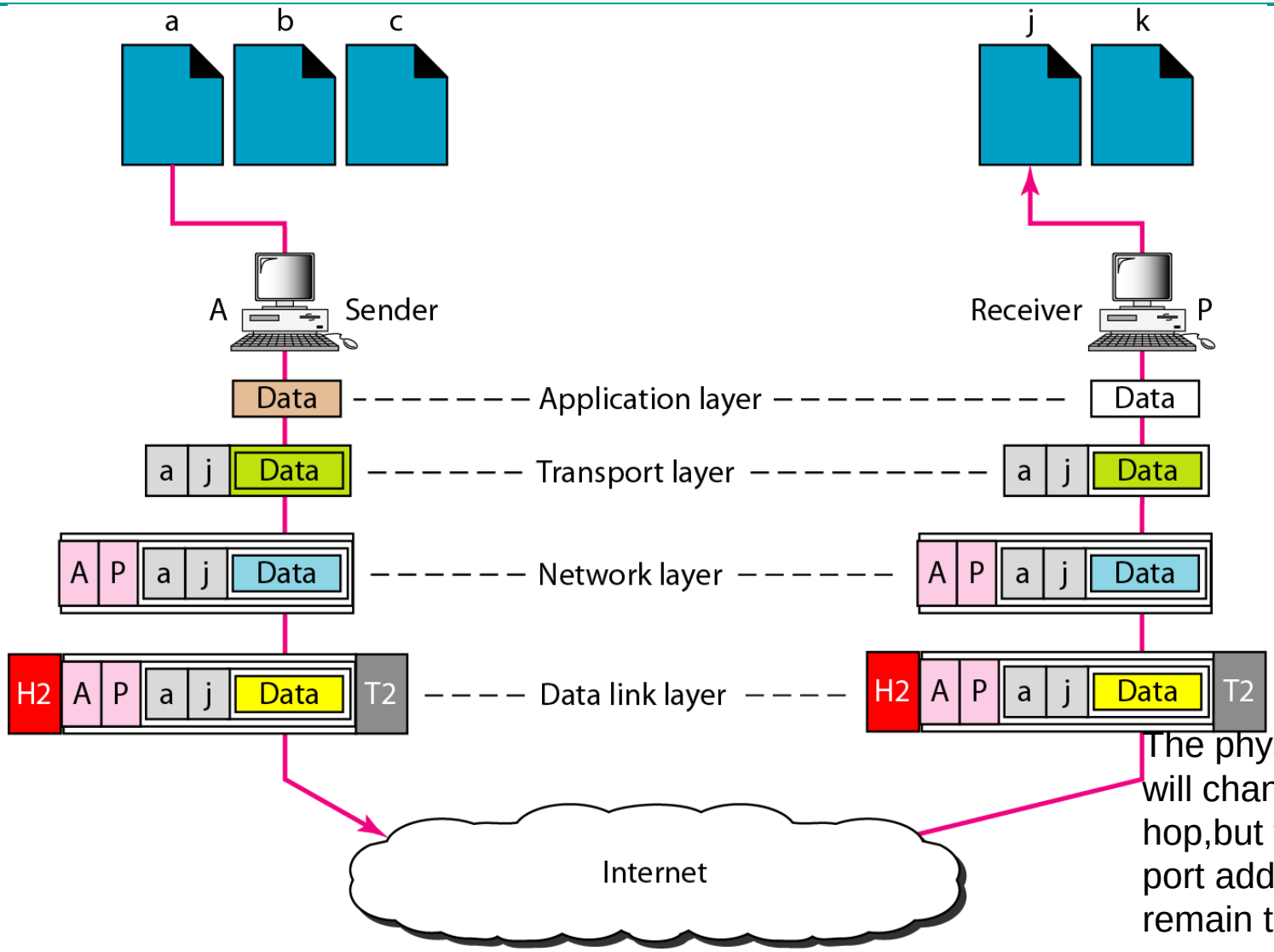
IP addresses



Example

Figure shows two computers communicating via the Internet. The sending computer is running three processes at this time with port addresses a, b, and c. The receiving computer is running two processes at this time with port addresses j and k. Process a in the sending computer needs to communicate with process j in the receiving computer. Note that although physical addresses change from hop to hop, logical and port addresses remain the same from the source to destination.

Port addresses



The physical addresses will change from hop to hop,but the logical and port addresses usually remain the same.