
Network Models

Protocol Architectures

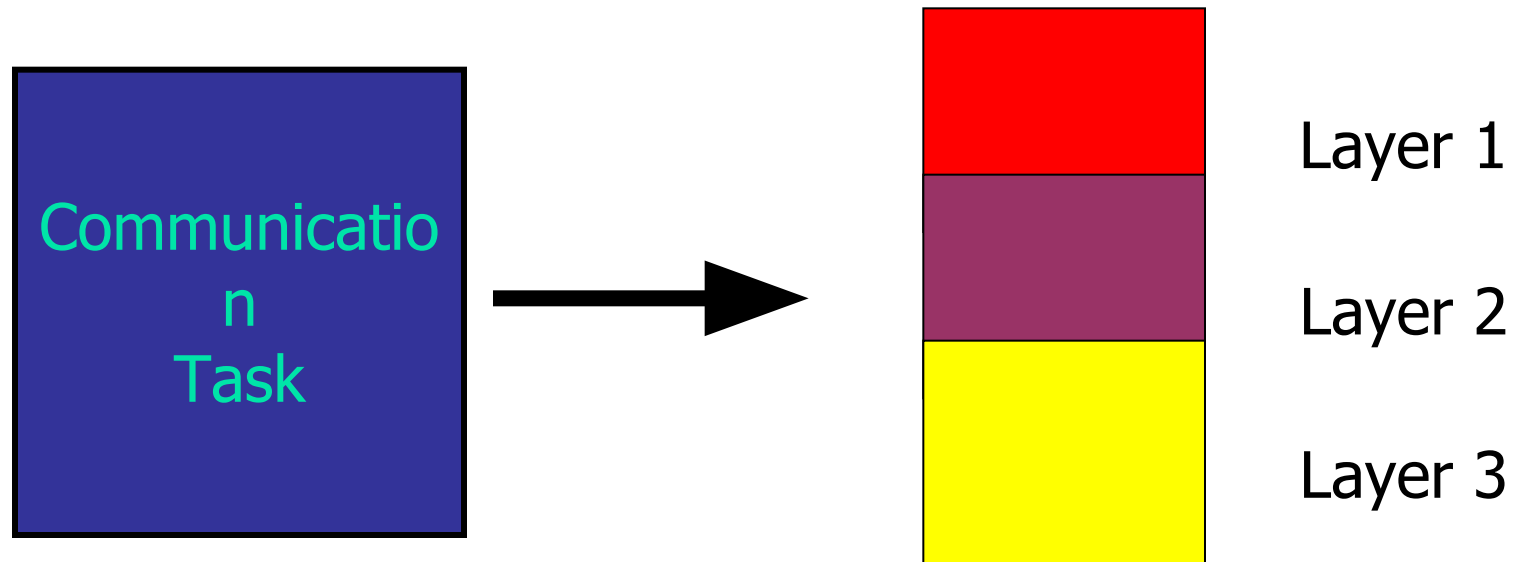
Chapter 2

Objectives

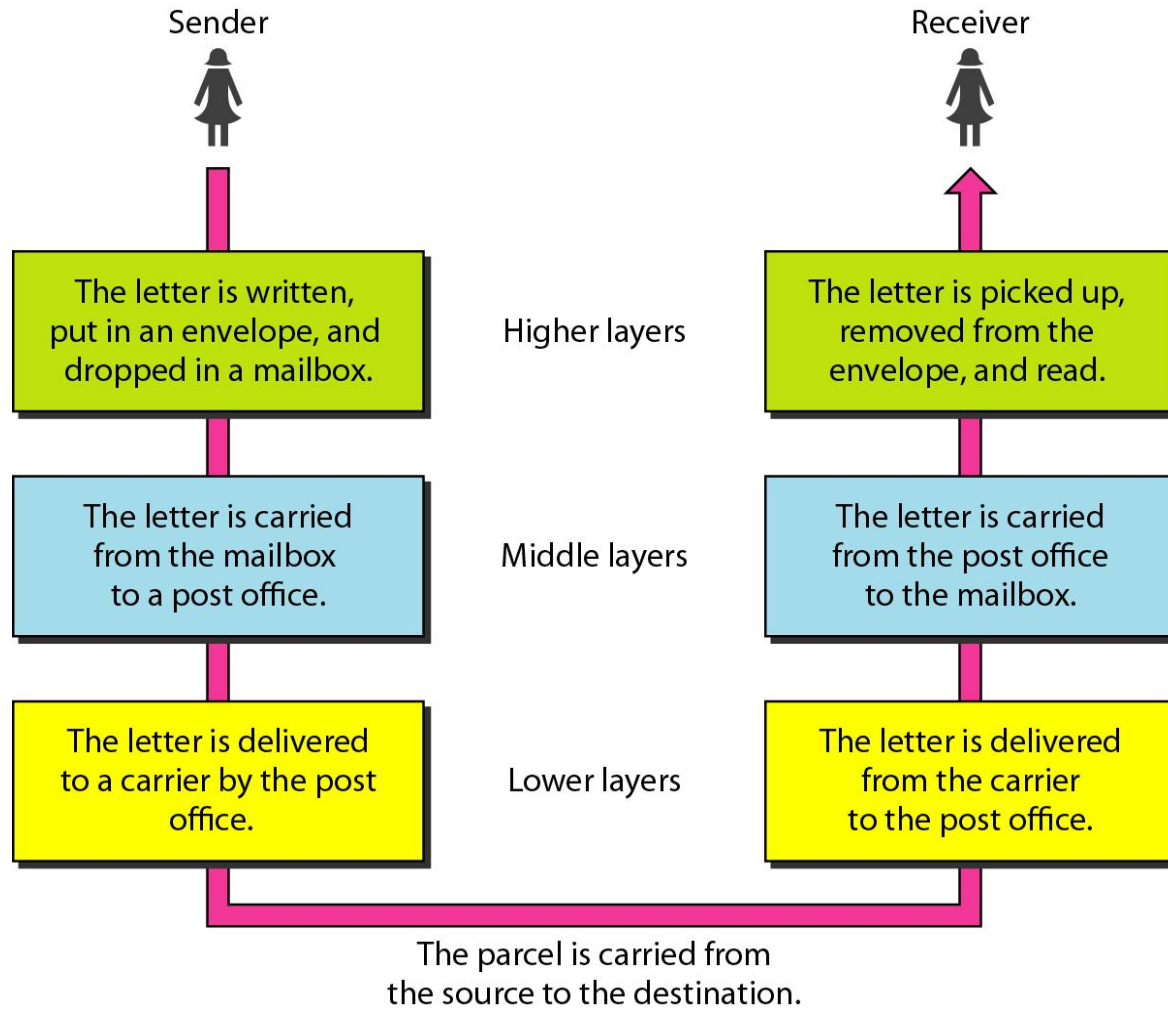
- Layering in communication
- Protocols
- Standards
- Communication Layering
 - OSI Model
 - TCP/IP Model
- Addressing

Layering

- Task of communication broken up into layers



Layers involved in sending a letter



Layers involving calling a friend

Content layer

Where is the Café?

Conversation Protocol Suite

1. Use a Common Language
2. Wait Your Turn
3. Signal When Finished

Rules layer

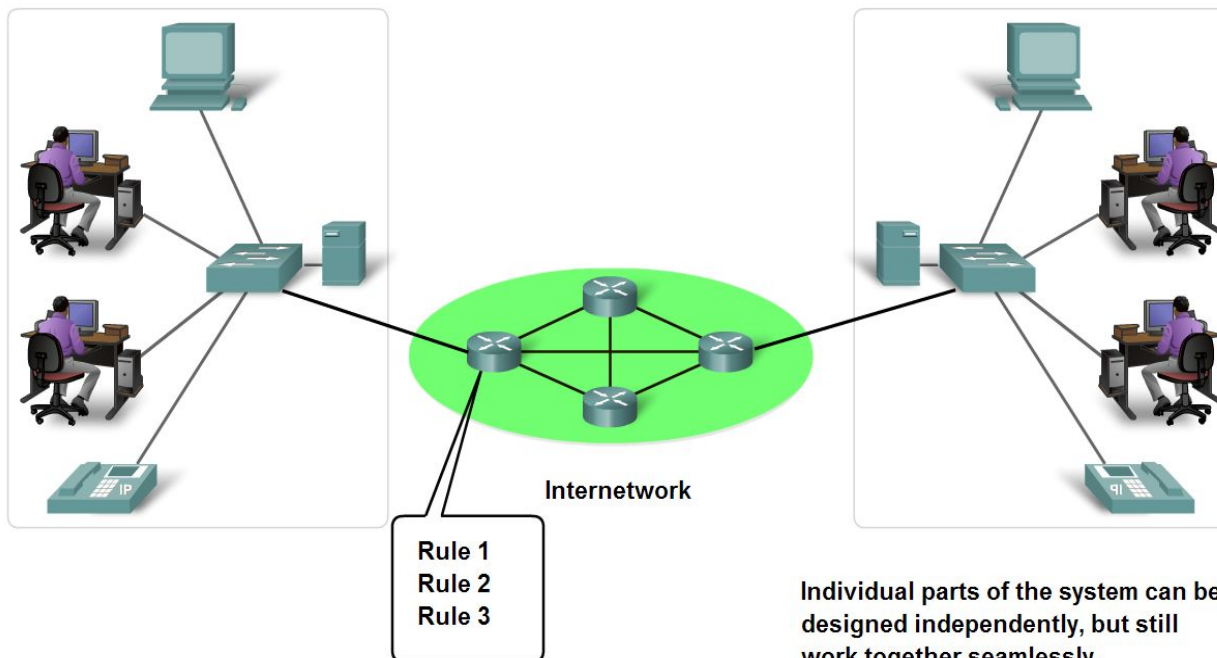
Physical layer



Benefits of using a layered model

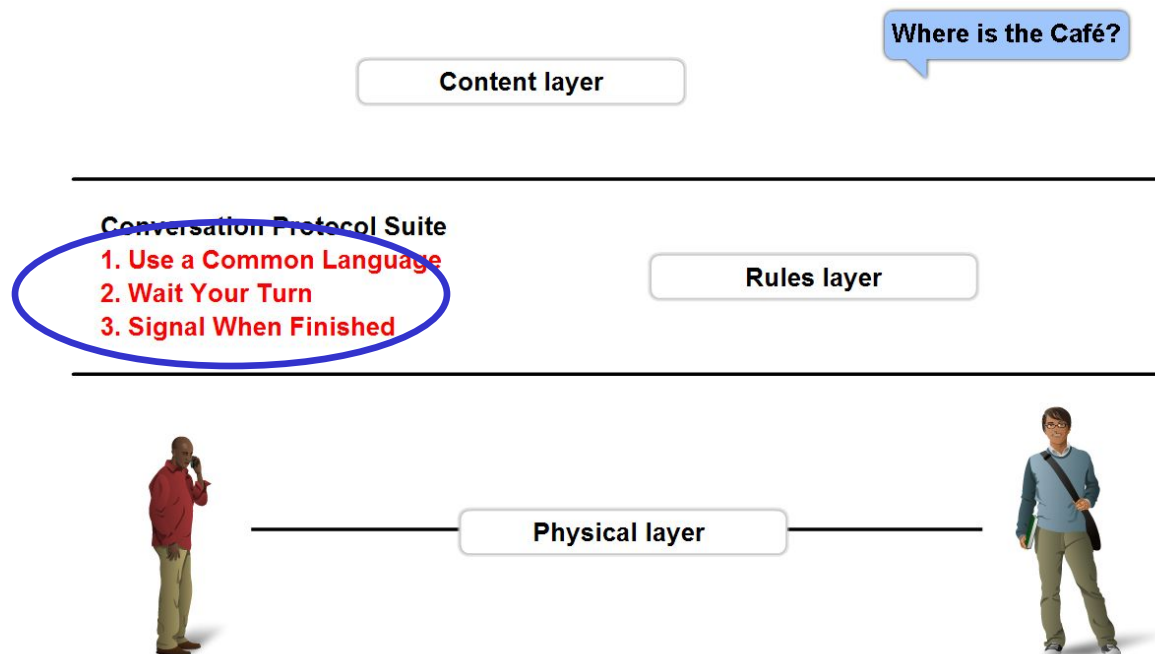
- To find out the **fault** easily.
- **Changes** in one layer do not affect other layers.
- Have **defined information** that they act upon.

Using a layered model helps in the design of complex, multi-use, multi-vendor networks.



Rules that govern communications

- A protocol is a set of predetermined rules.
- Defines:
 - What is communicated??
 - How it is communicated??
 - When it is communicated??



Protocols

- Describe processes such as:

The format or structure of the message. What?

The method by which networking devices share information about pathways with other network How?

How and when error and system messages are passed between devices. How/When?

The setup and termination of data transfer sessions.

What/When/How?

Protocols and Standards

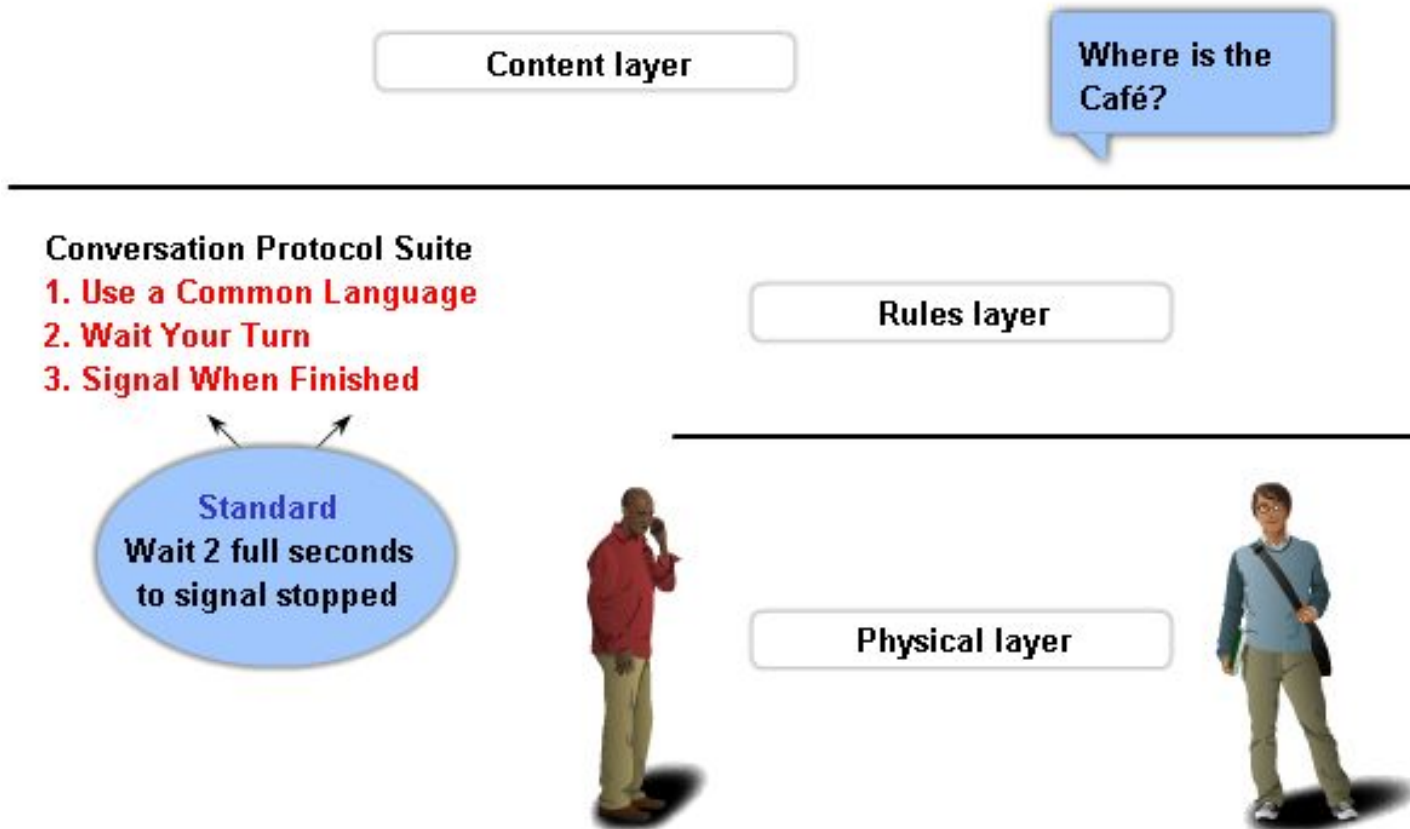
- **Protocols**
- **Standards**
- **Standards Organizations**
- **Internet Standards**

Standards

- Endorsed by the networking industry and approved by a standards organization.
- Benefits:
 - Create and maintain an open and competitive market.
 - Ensured greater compatibility and interoperability.
- Categories
- **De facto:** Standards that have not been approved by an organized body but have been adopted as standards through widespread use
- **De jure:** Those standards that have been legislated by an officially recognized body

Standards and Protocols

Standards are protocols and agreements that are widely used and accepted.



Standard Organizations

- International Organization for Standardization (**ISO**)
- Institute of Electrical and Electronic Engineers (**IEEE**)
- American National Standards Institute (**ANSI**)
- Telecommunications Industry Association (**TIA**)
- The Internet Engineering Task Force (**IETF**)
- International Telecommunications Union – Telecommunication Standards Sector (**ITU-T**)

Internet Standards

- Formalized regulations and specifications for the Internet by IETF.
- Internet Draft
 - No official status
 - 6 month lifetime
- Request for comment (RFC)
 - Upon recommendation from Internet authorities
 - Different maturity levels
 - Example: Internet Protocol – RFC : 791

Request For Comments RFC



The Internet Engineering Task Force

- [Overview of the IETF](#)
- [The Internet Standards Process](#)
- [IETF Working Groups](#)
- [WG Chairs Web Page](#)
- [Internet-Drafts](#)
- [RFC Pages](#)
- [Educational Materials](#)
- [Mailing Lists](#)
- [IETF Web Tools](#)

- [IESG Activities/Actions](#)
- [Meetings](#)
 - ★ [71st IETF - Philadelphia, PA, USA](#)
(March 9-14, 2008)
- [Proceedings](#)
- [IETF Liaison Activities](#)
- [IETF IPR Disclosure Page](#)
- [The NomCom](#)
- [IETF Secretariat](#)

INTERNET PROTOCOL

DARPA INTERNET PROGRAM

PROTOCOL SPECIFICATION

September 1981

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Communication Process

Layered standards:

- **TCP/IP Protocol Model**

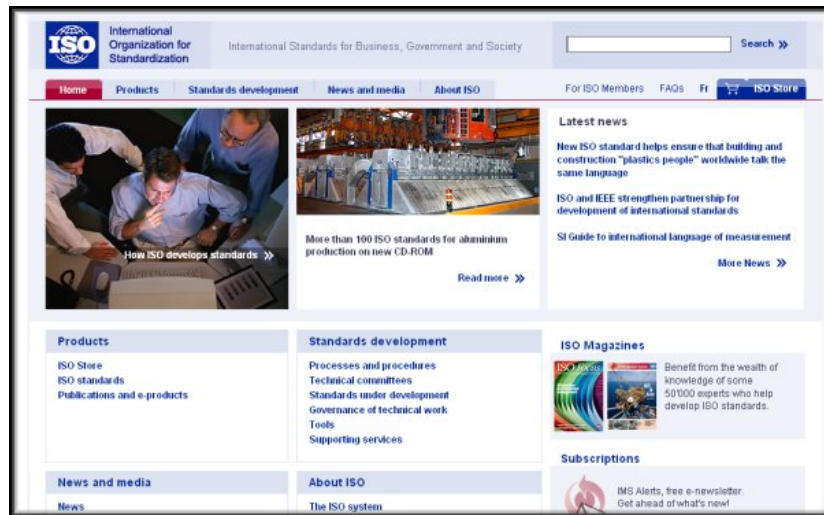
- Open De Facto Standard
- Governed by IETF Working Groups

- **OSI Reference model**

- De Jure Standard

OSI Model

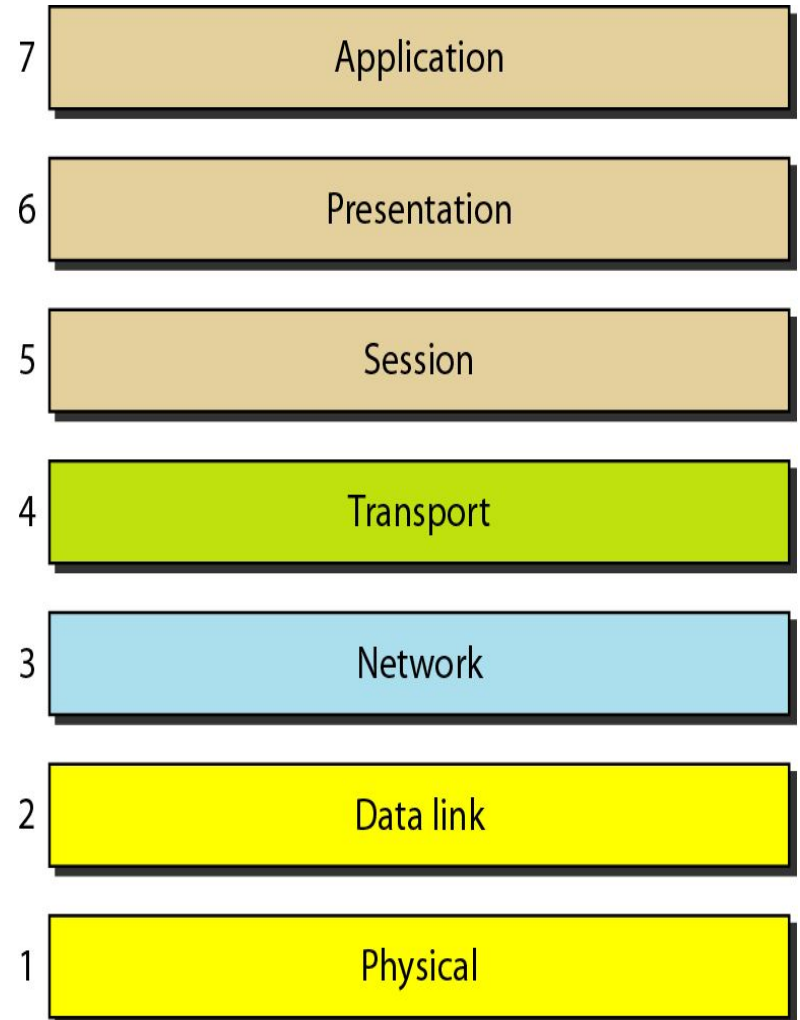
- Open Systems Interconnection (OSI)
- Developed by the International Organization for Standardization (ISO).



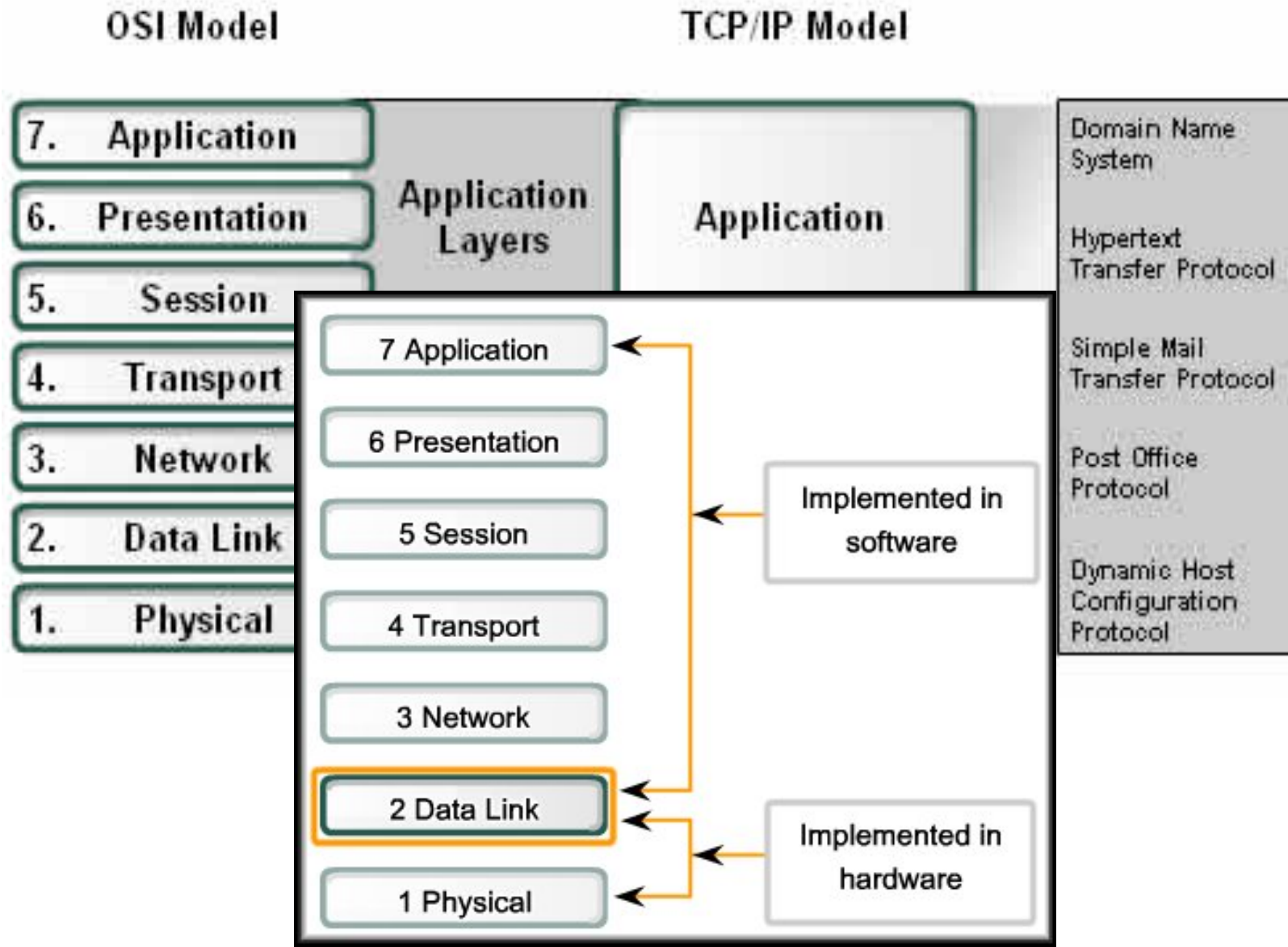
- In 1984.

OSI

- Seven layers
- A theoretical system delivered too late!
- TCP/IP is the de facto standard



OSI & TCP/IP Models



Note

**ISO is the organization.
OSI is the model.**

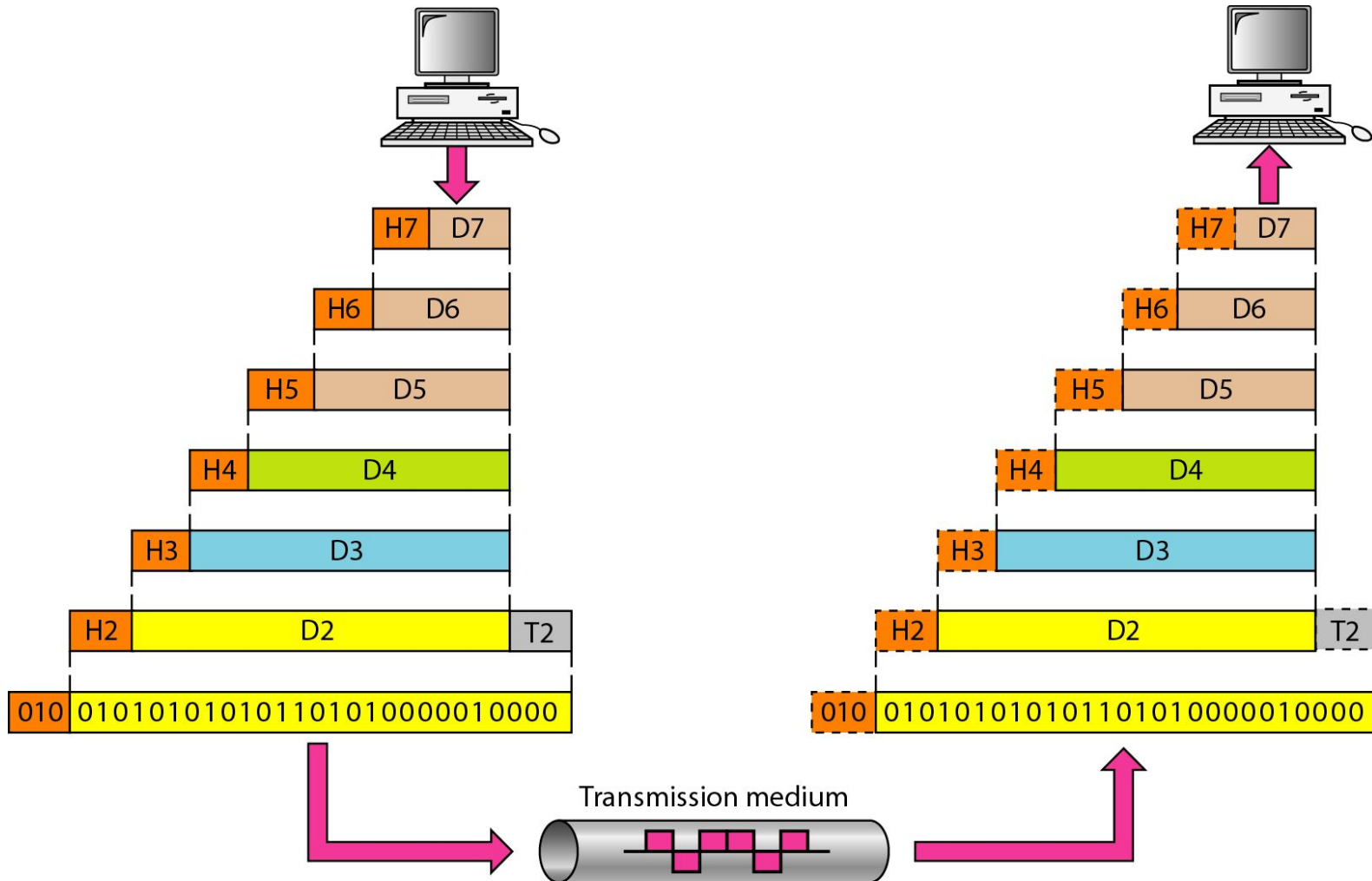
OSI Model- 7 Layers

Layers		<u>CISCO</u>
7	Application	All
6	Presentation	People
5	Session	Seem
4	Transport	To
3	Network	Need
2	Data Link	Data
1	Physical	Processing

Primary concern:
Communications
between
applications

Primary concern:
Moving raw data
cross the network

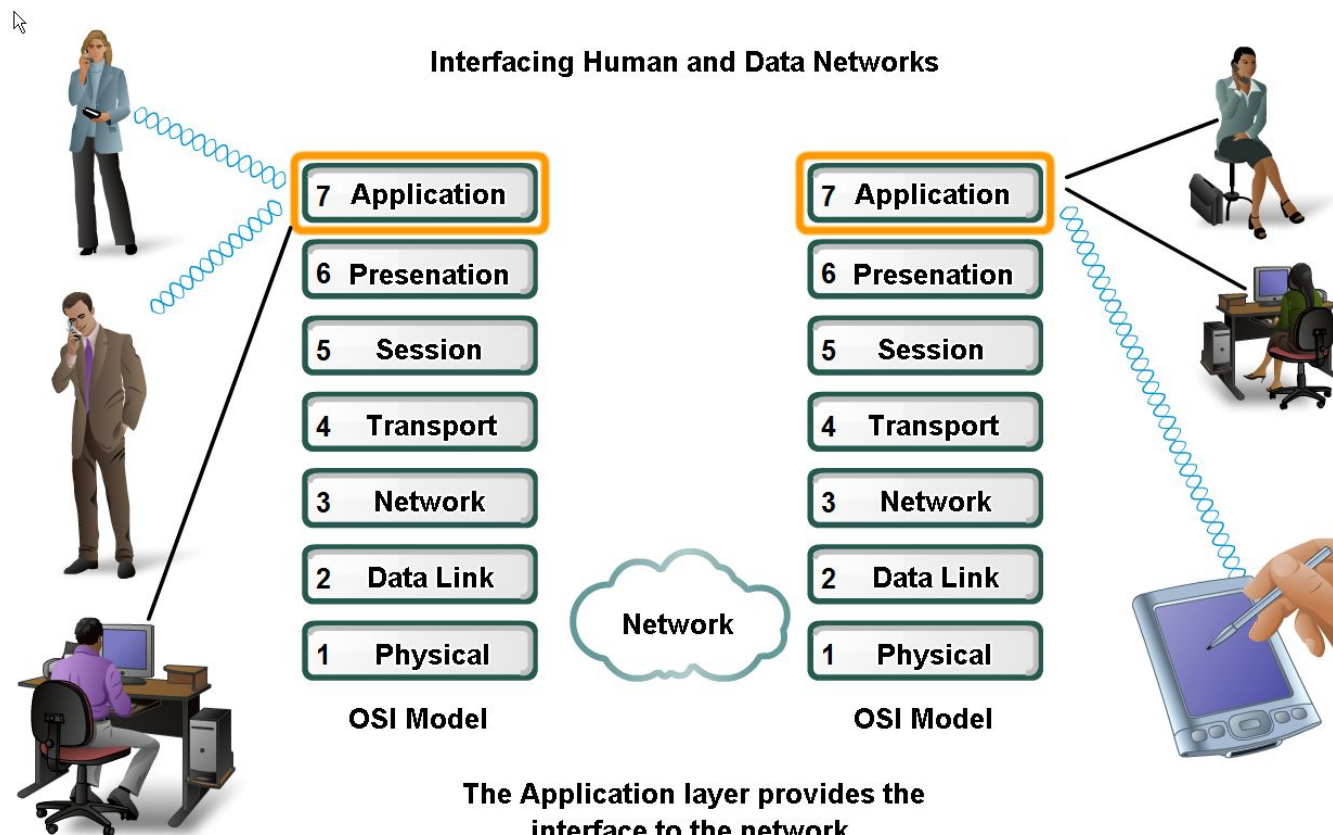
An exchange using the OSI model



APPLICATION LAYER

Applications

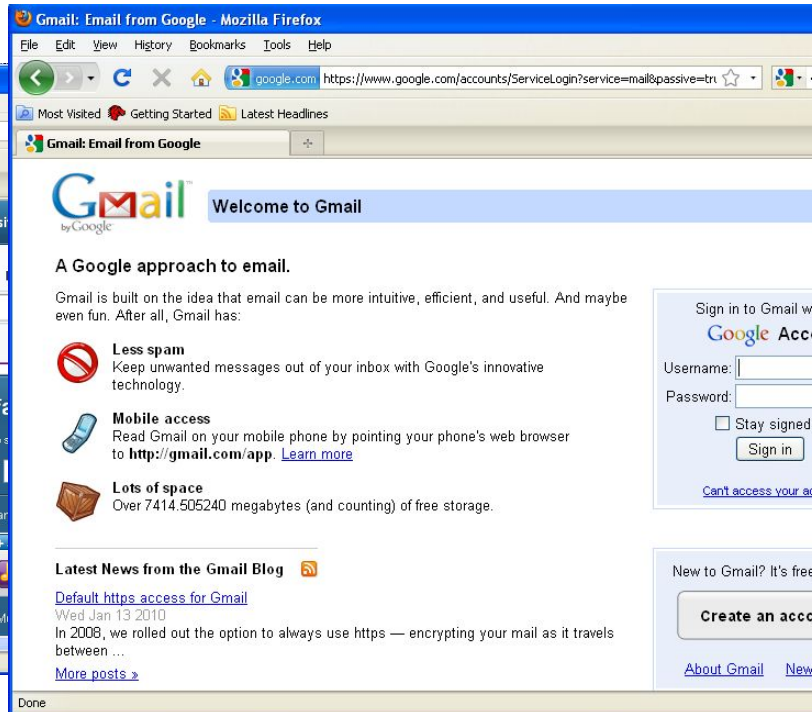
- The Interface Between Human and Data Networks
- Responsible for providing services to the user.



Applications in Application layer



Web Page



Email



Instant messaging

Application Layer

The Human Network Generates Data

Application layer services initiate the data transfer.

Software and hardware convert communication to a digital format.

People create the communication.

People



Software and hardware



The Application layer prepares human communication for transmission over the data network.

7 Application

6 Presentation

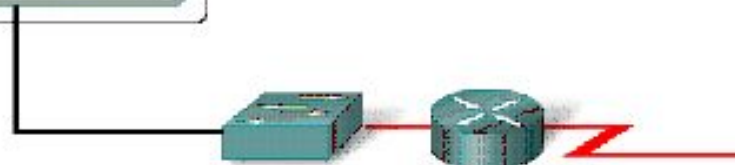
5 Session

4 Transport

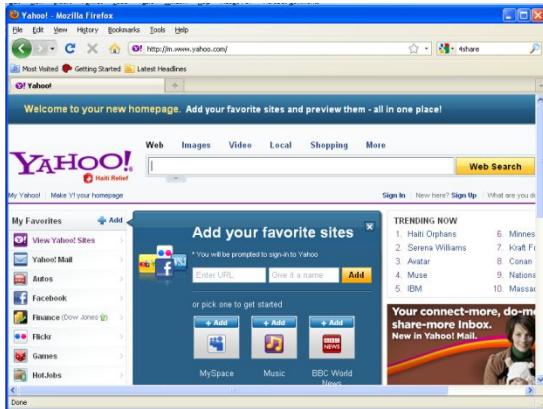
3 Network

2 DataLink

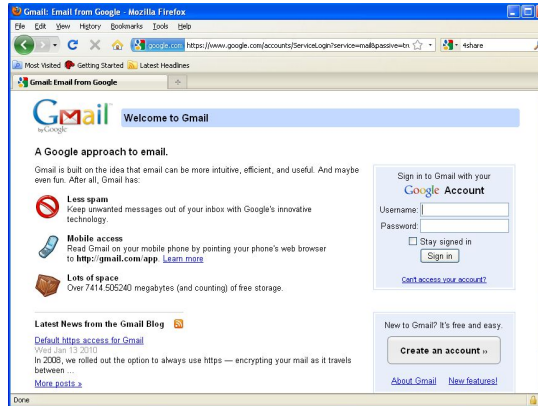
1 Physical



Applications in Application layer



Web Page



Email

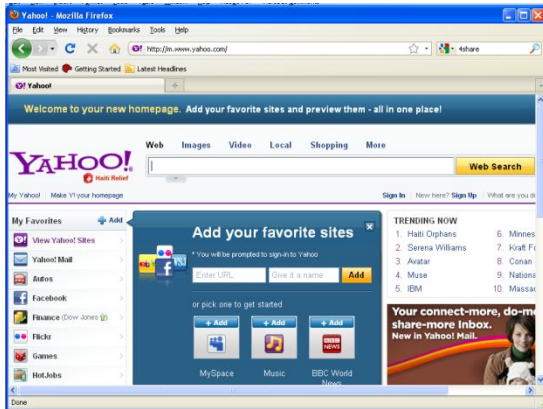


Instant messaging

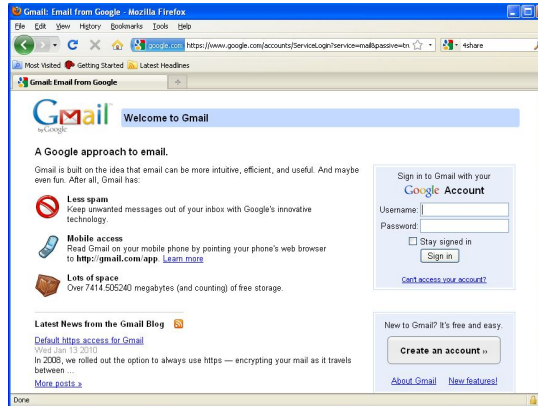


To Presentation Layer

Application layer



Web Page



Email

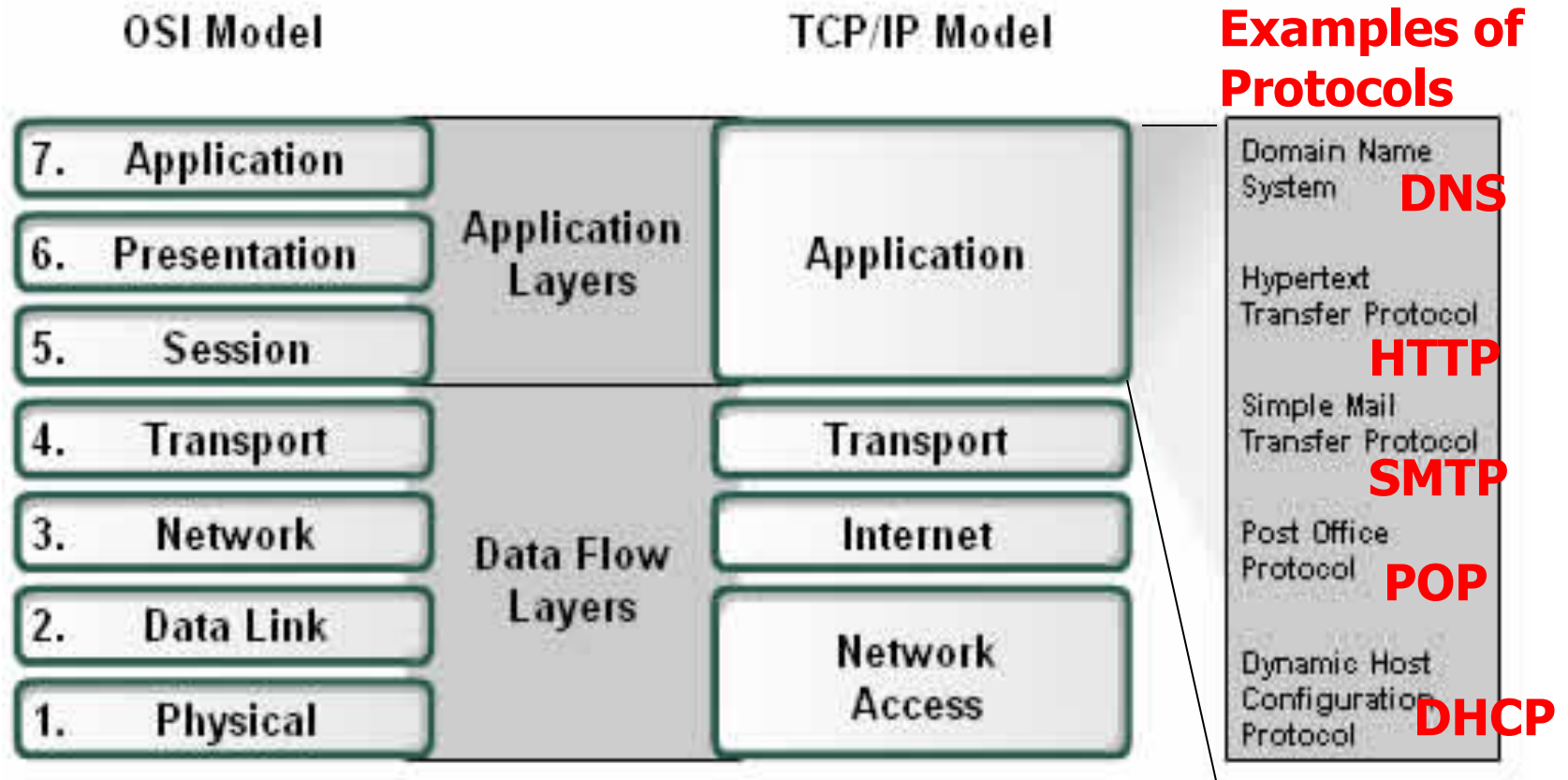


Instant messaging



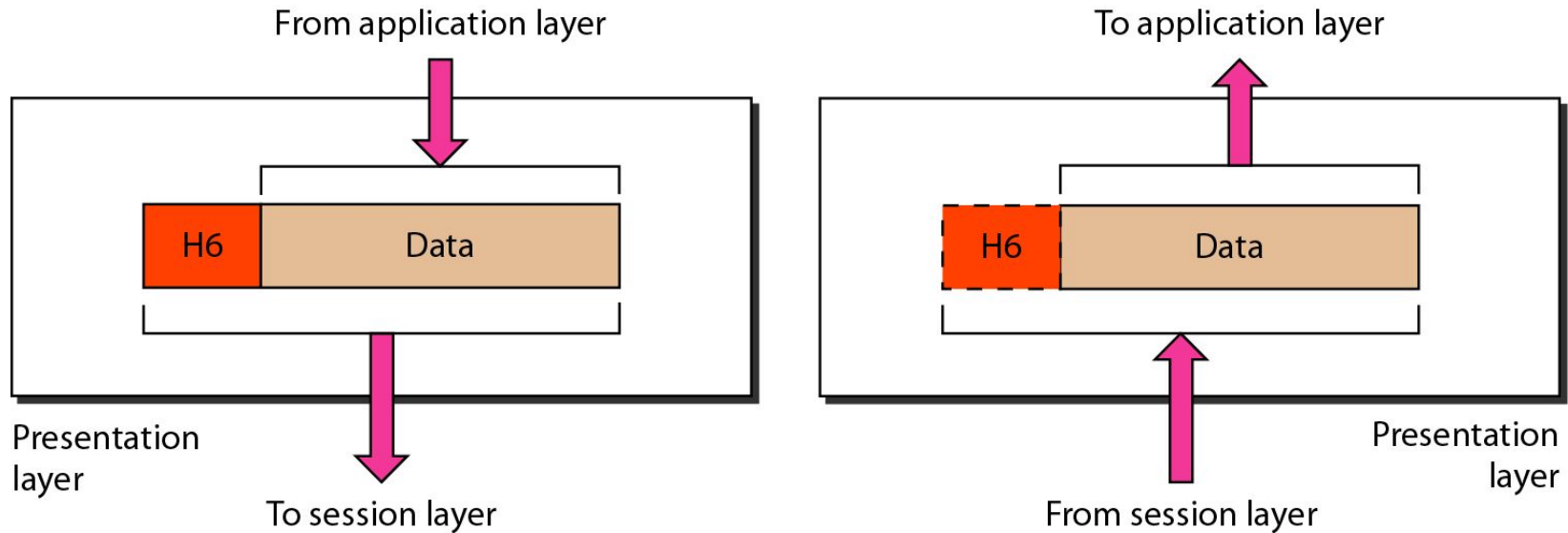
From Presentation Layer

Application Layer



PRESENTATION LAYER

Presentation layer



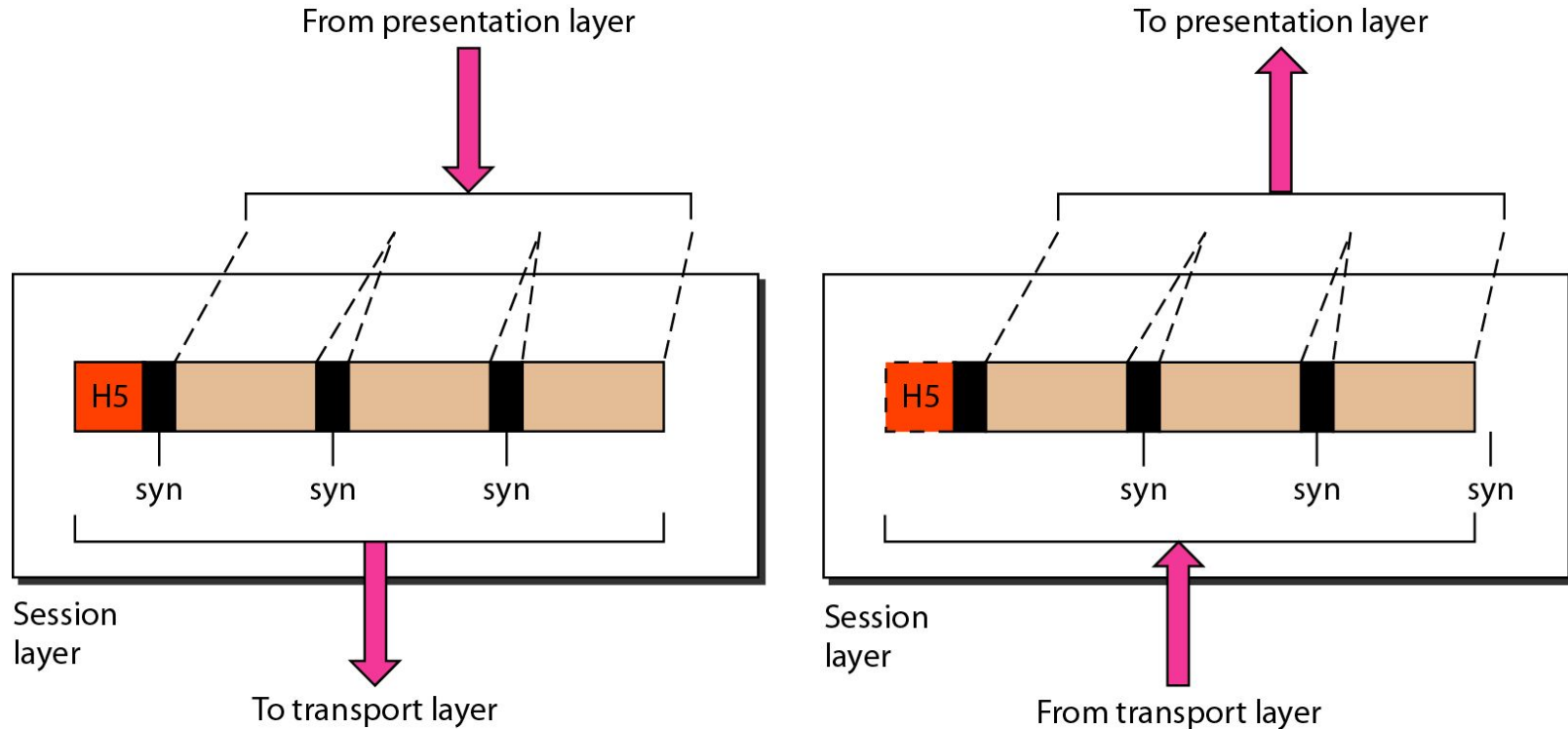
The presentation layer is responsible for translation, compression, and encryption.

Presentation Layer

- 3 primary functions:
 - Coding and conversion
 - Compression of the data
 - Encryption of the data
- Presentation layer implementations are not typically associated with a particular protocol stack.

SESSION LAYER

Session layer



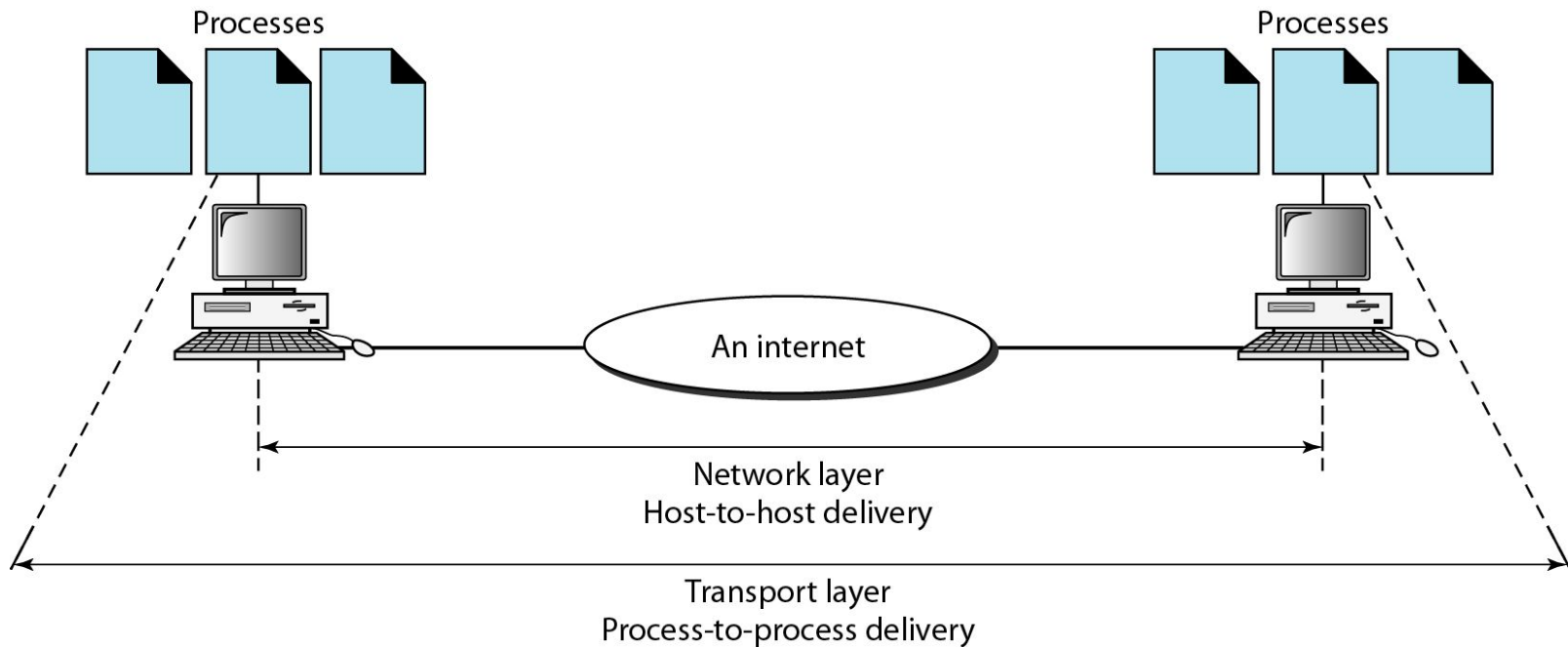
The session layer is responsible for dialog control and synchronization.

Session Layer

- It handles the exchange of information
 - to initiate dialogs,
 - keep them active, and
 - to restart sessions that are disrupted or idle for a long period of time
- Most applications, like web browsers or e-mail clients, incorporate functionality of the OSI layers 5, 6 and 7.

TRANSPORT LAYER

Transport layer



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

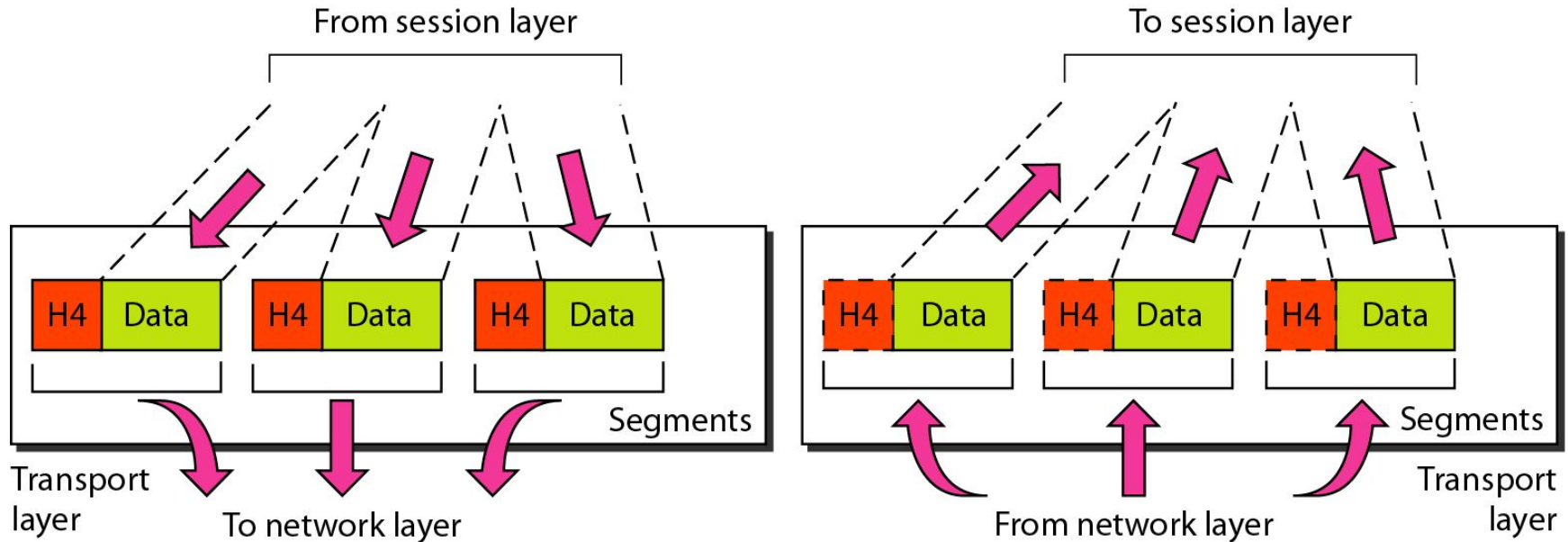
Functions– Transport Layer

- Segmentation and Reassembly
- Adds Port Address and Sequence Number.
- Connection Control
- Flow and Error Control
- Multiplexing

Transport Layer PDU is called **Segments**.

Common Protocol used in Transport Layer is **TCP**

Transport layer



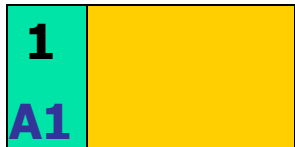
- Segments data received from application layer into small parts.
- Transport Layer Protocol Data Unit is called **Segments**.

Function: Segmentation



Data from Application layer

Received by Transport Layer



1

Segments into small parts

2

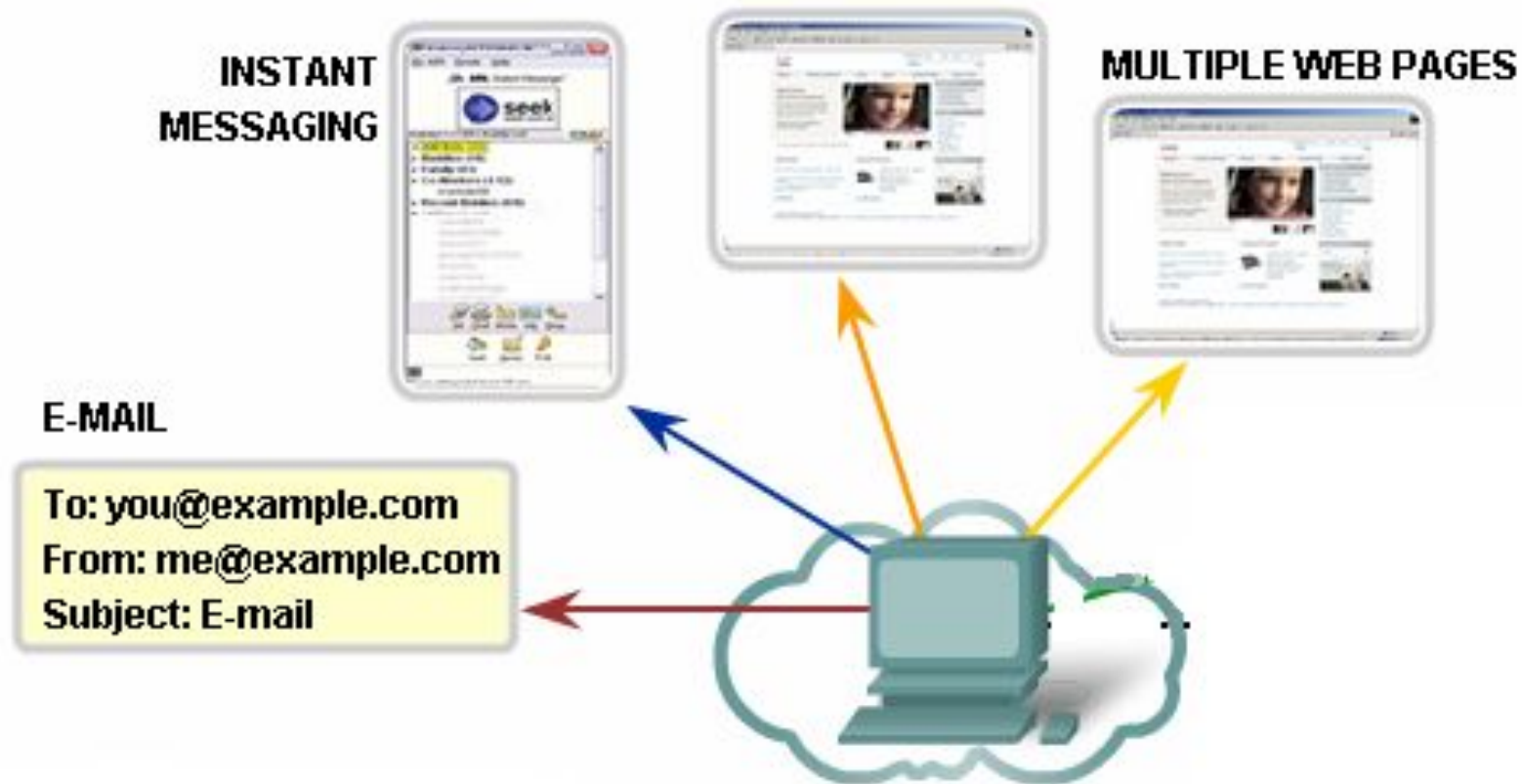
Add a number to identify the application.

3

Add a number sequence the segmented parts.

Identifying Different Applications

Transport Layer Services



■ Port Numbers

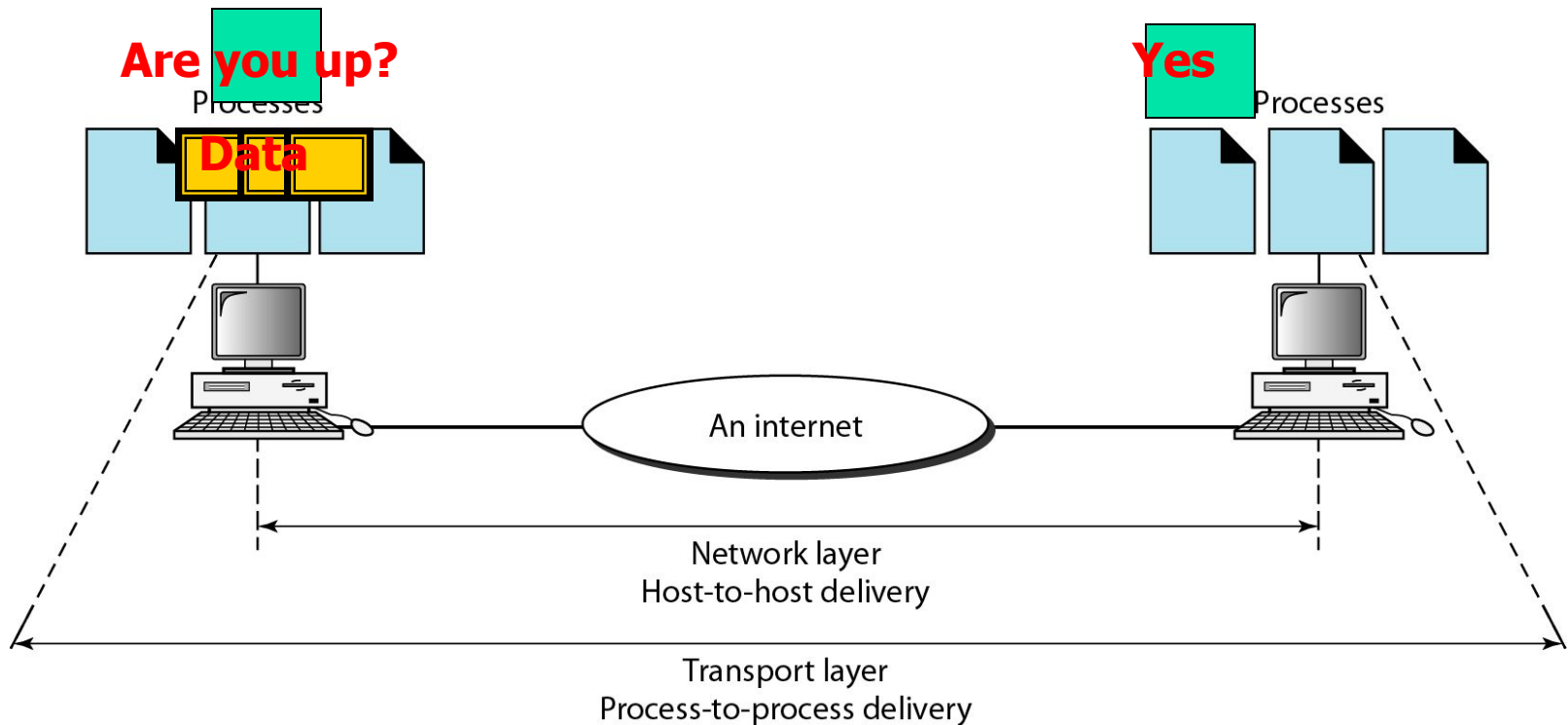
Port Address

- To define multiple processes running in a computer.
- 16-bit in length

80

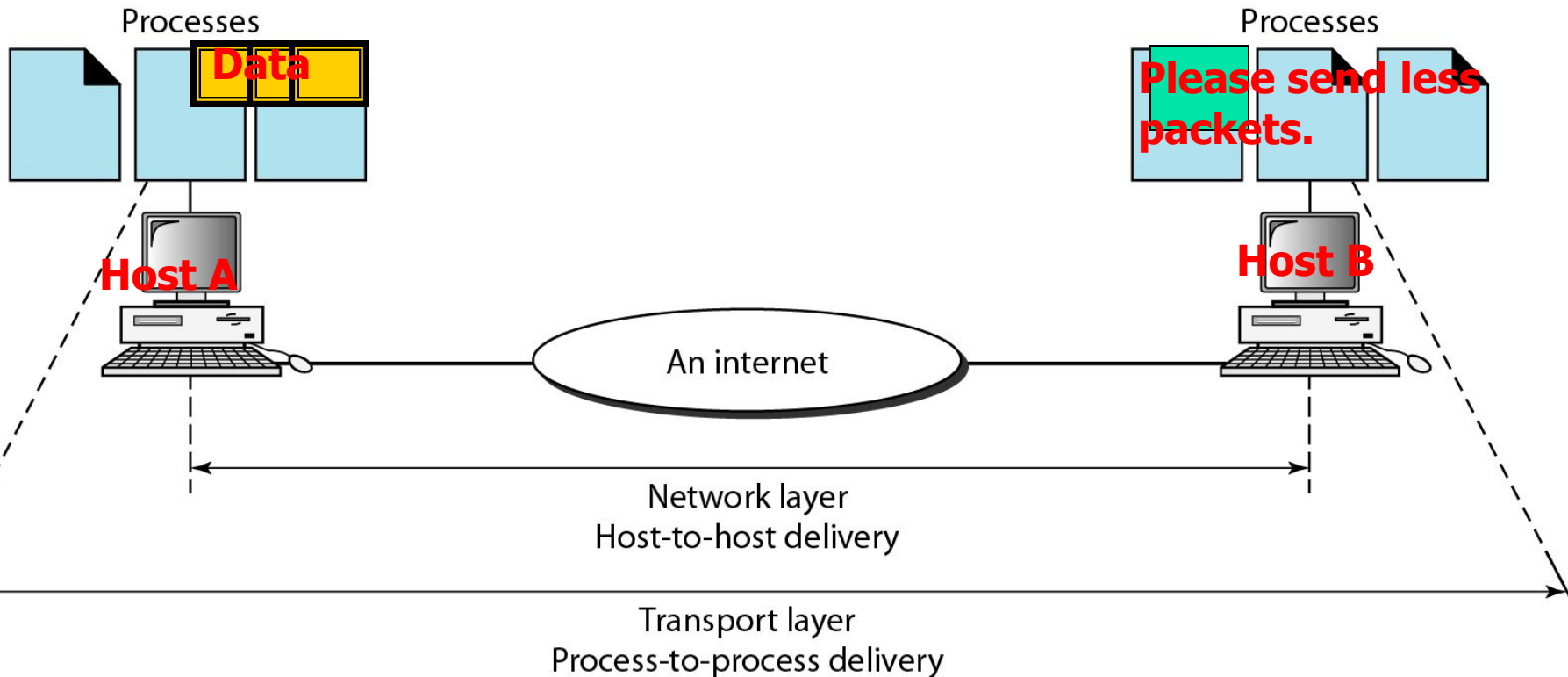
**A 16-bit port address represented
as one single number.**

Function: Connection Control

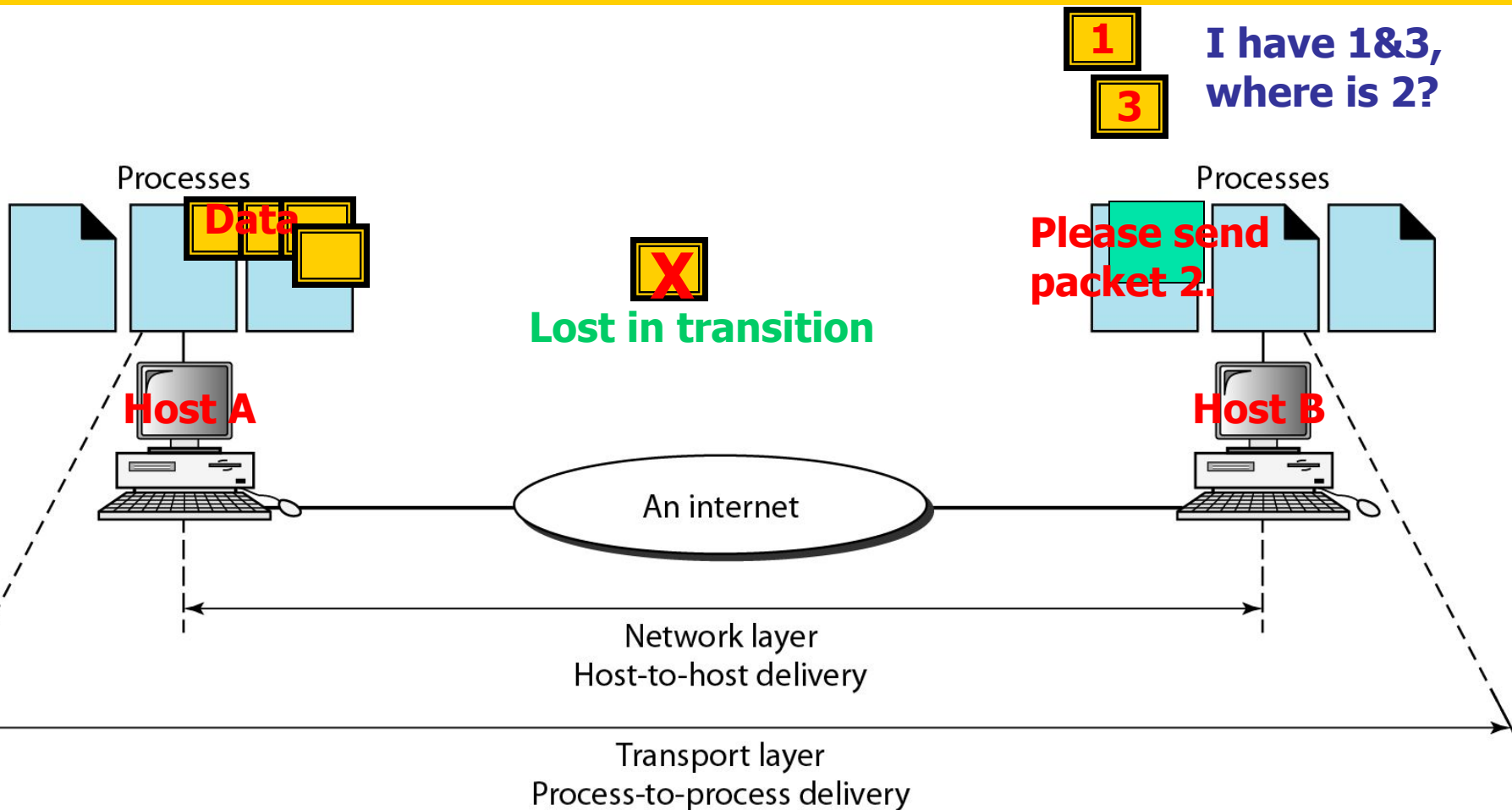


Function: Flow Control

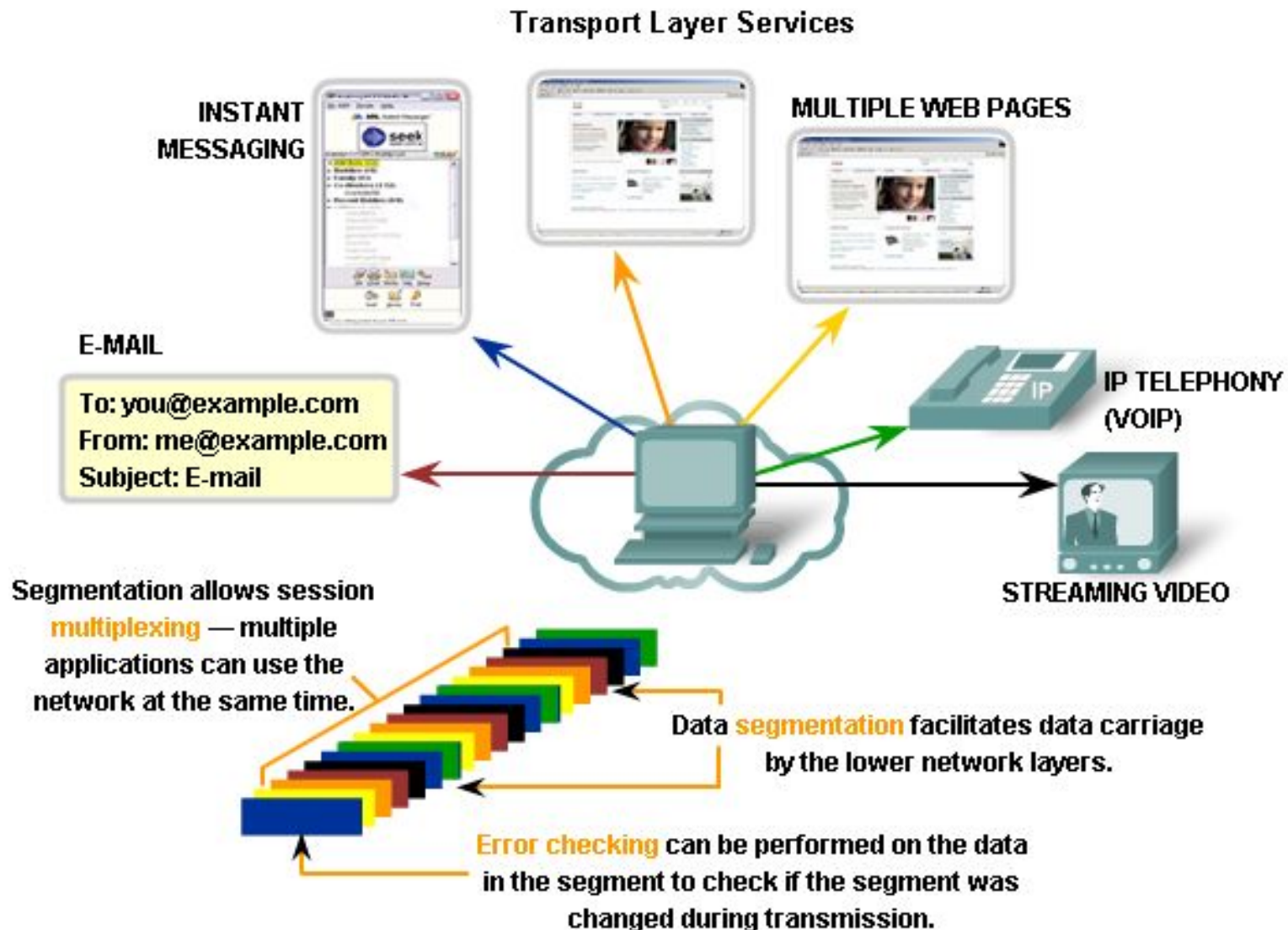
- Host B has too many packets to process.
- Buffer to store incoming packets overflows



Function: Error Control

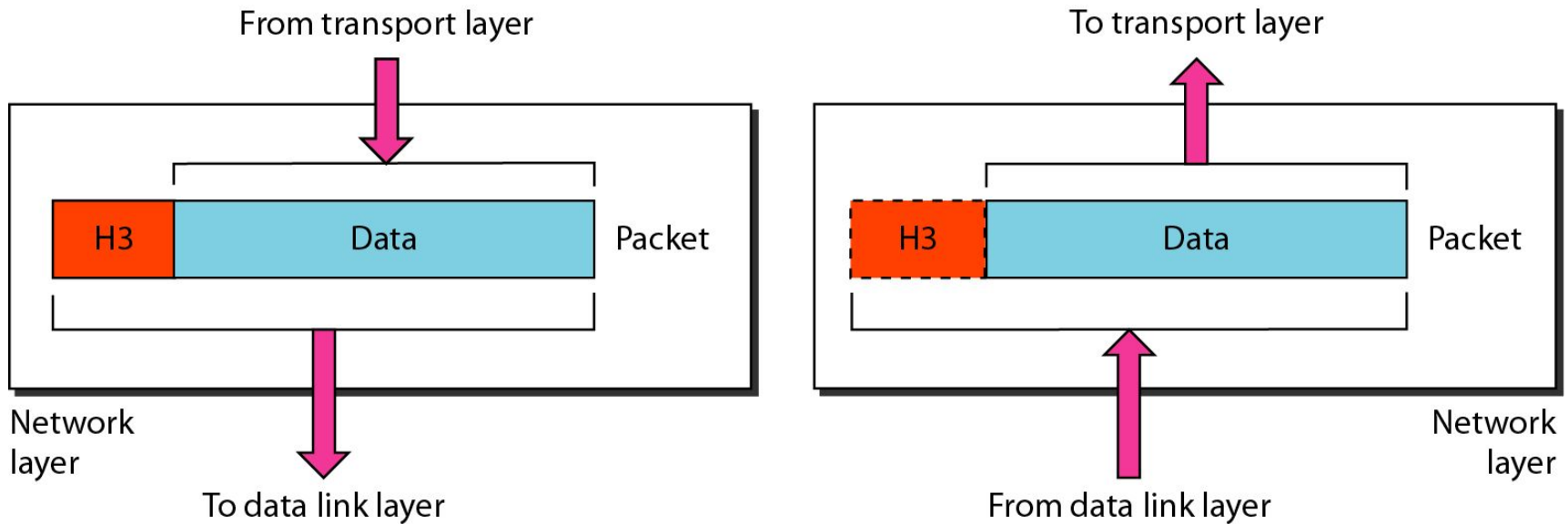


Functions– Multiplexing



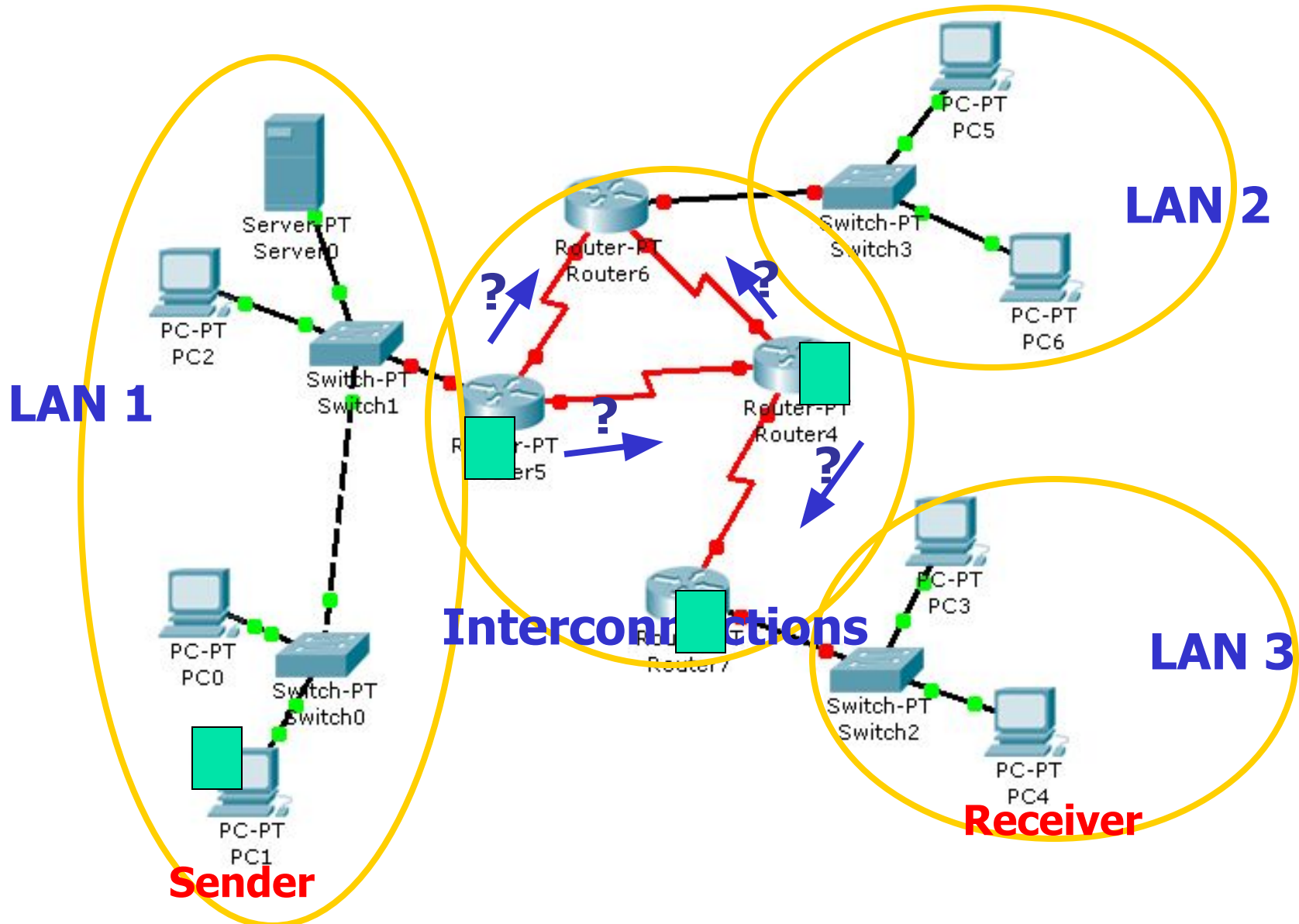
NETWORK LAYER

Network layer



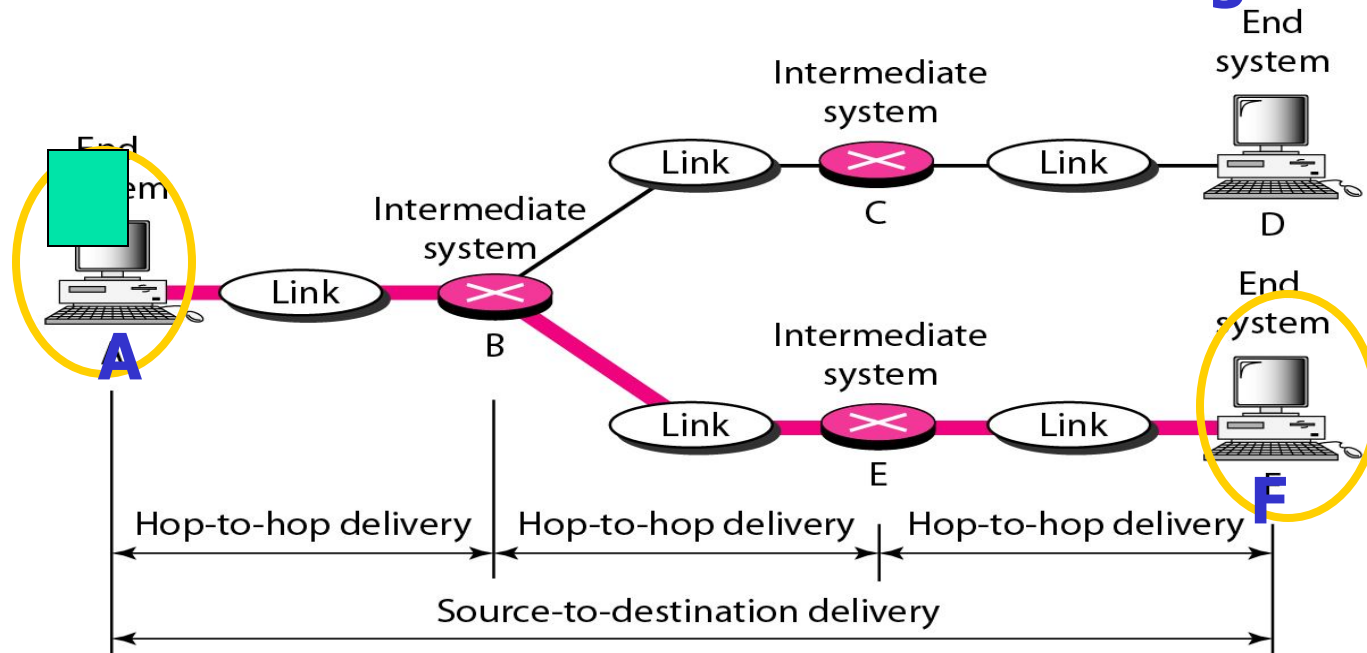
The network layer is responsible for the delivery of individual packets from the source host to the destination host.

Example

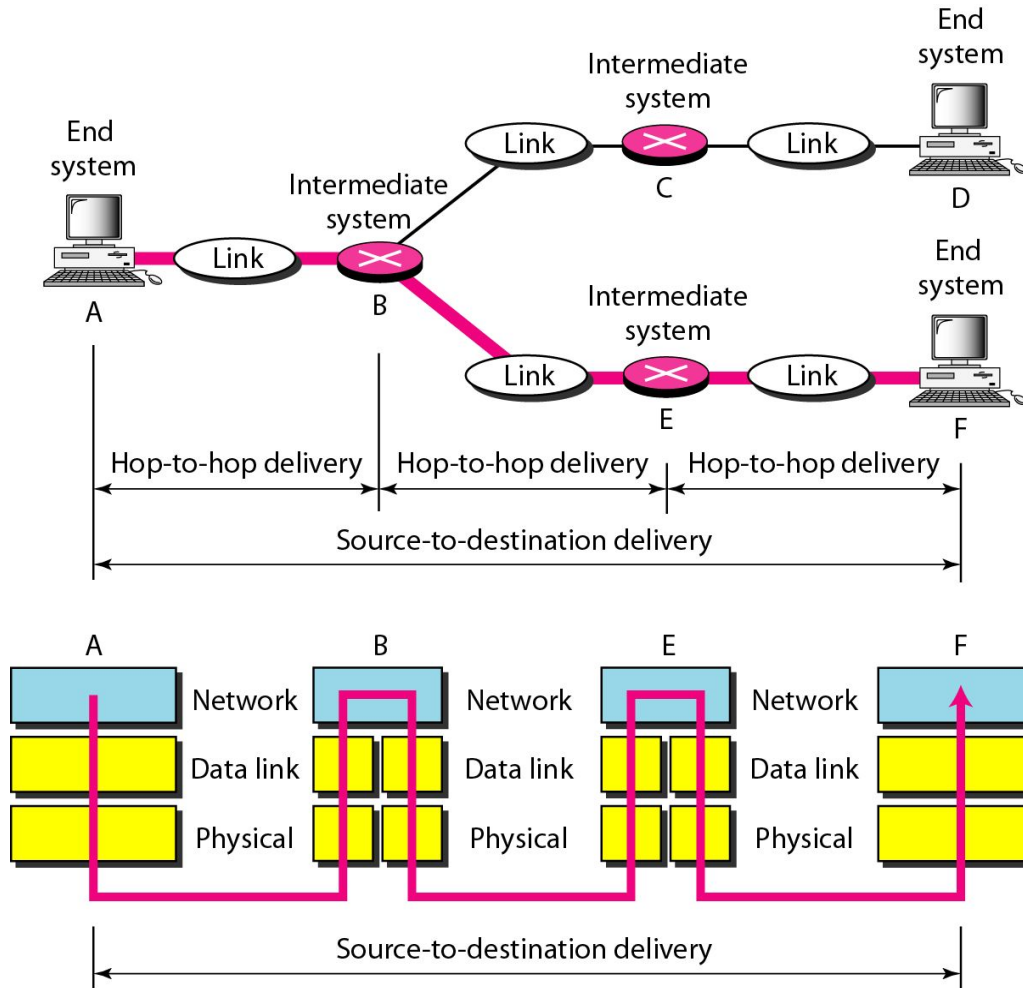


Source-to-destination delivery

- Functions :
 - Adds an address to identify sender and receiver hosts. **Adds Logical Addressing**
 - Decides which path to take. **Routing**



Source-to-destination delivery



- Network Layer PDU is called **Packets**.
- Common Network layer Protocol is called **Internet Protocol (IP)**

Logical Addresses :: IP Address

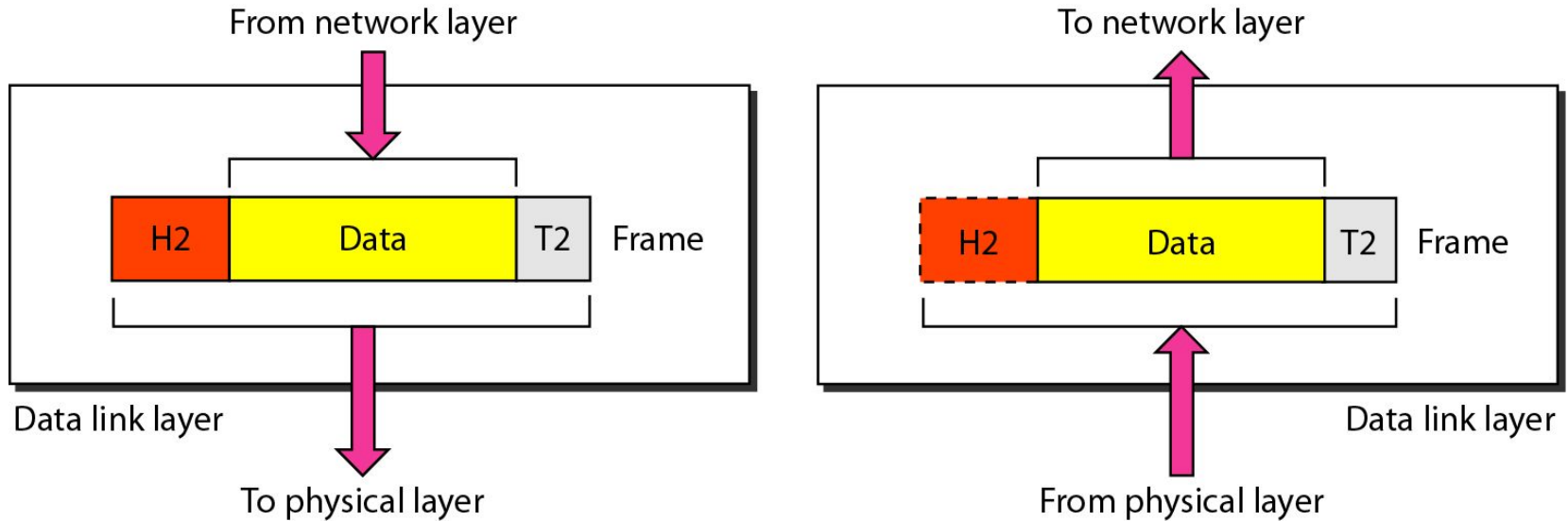
- Universal address, each host uniquely defined.
- 32-bit address also known as **IP Address**.
- Independent of underlying physical networks.

192.168.10.1

32 bits written in dotted decimal notation. Each decimal represented by 8 bits.

DATALINK LAYER

Data link layer



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

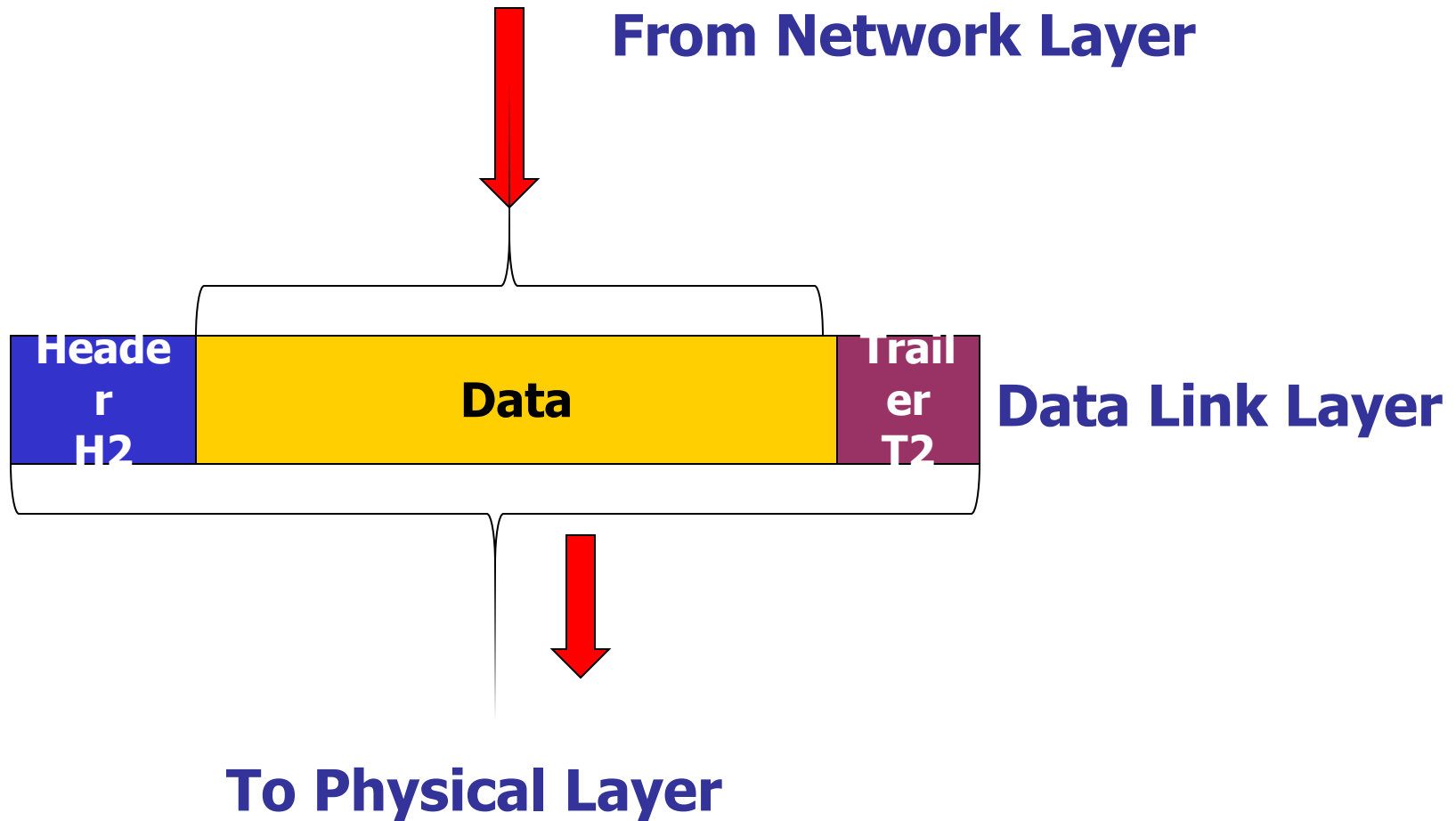
Functions-Data Link Layer

- Framing.
- Physical Addressing
- Flow Control
- Error Control
- Access Control

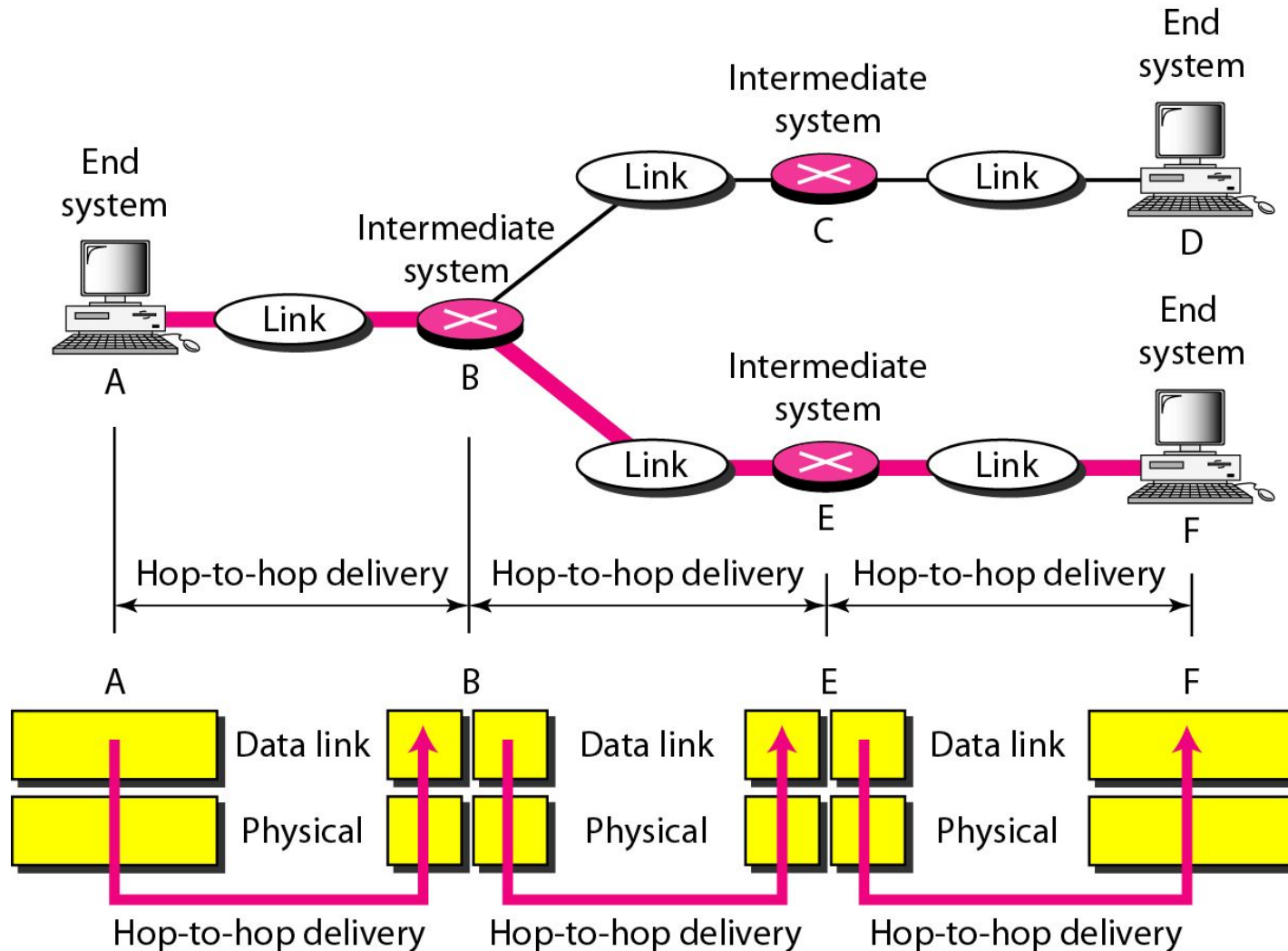
Data Link Layer PDU is called **Frames**.

Data Link Layer Protocol varies.

Functions : Framing



Hop-to-hop delivery



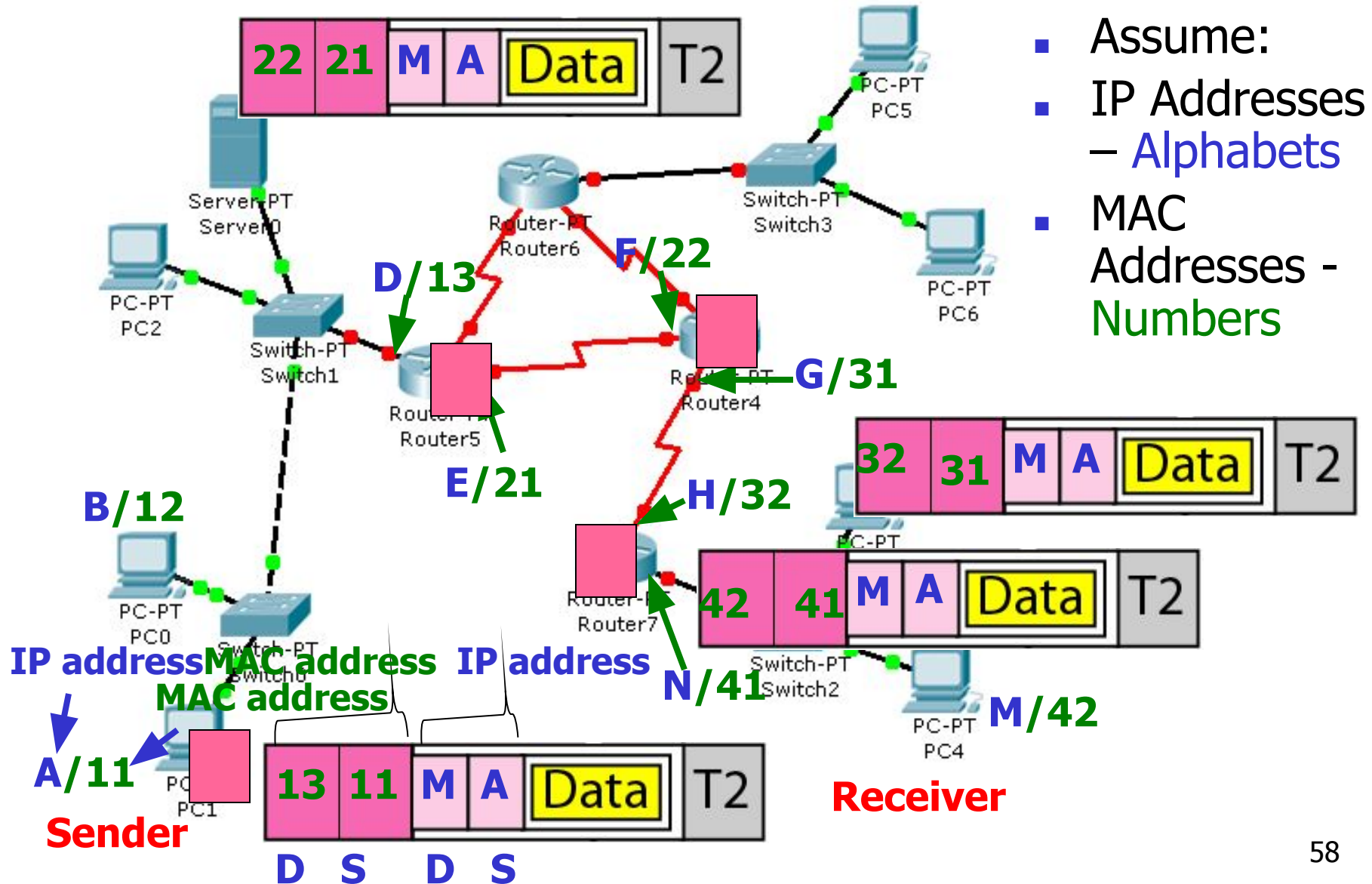
Physical Address : MAC Address

- Every interface/port has an unique identifying number.
- Given by manufacturer.
- 48 bits long, represented by 12 hexadecimal digits.

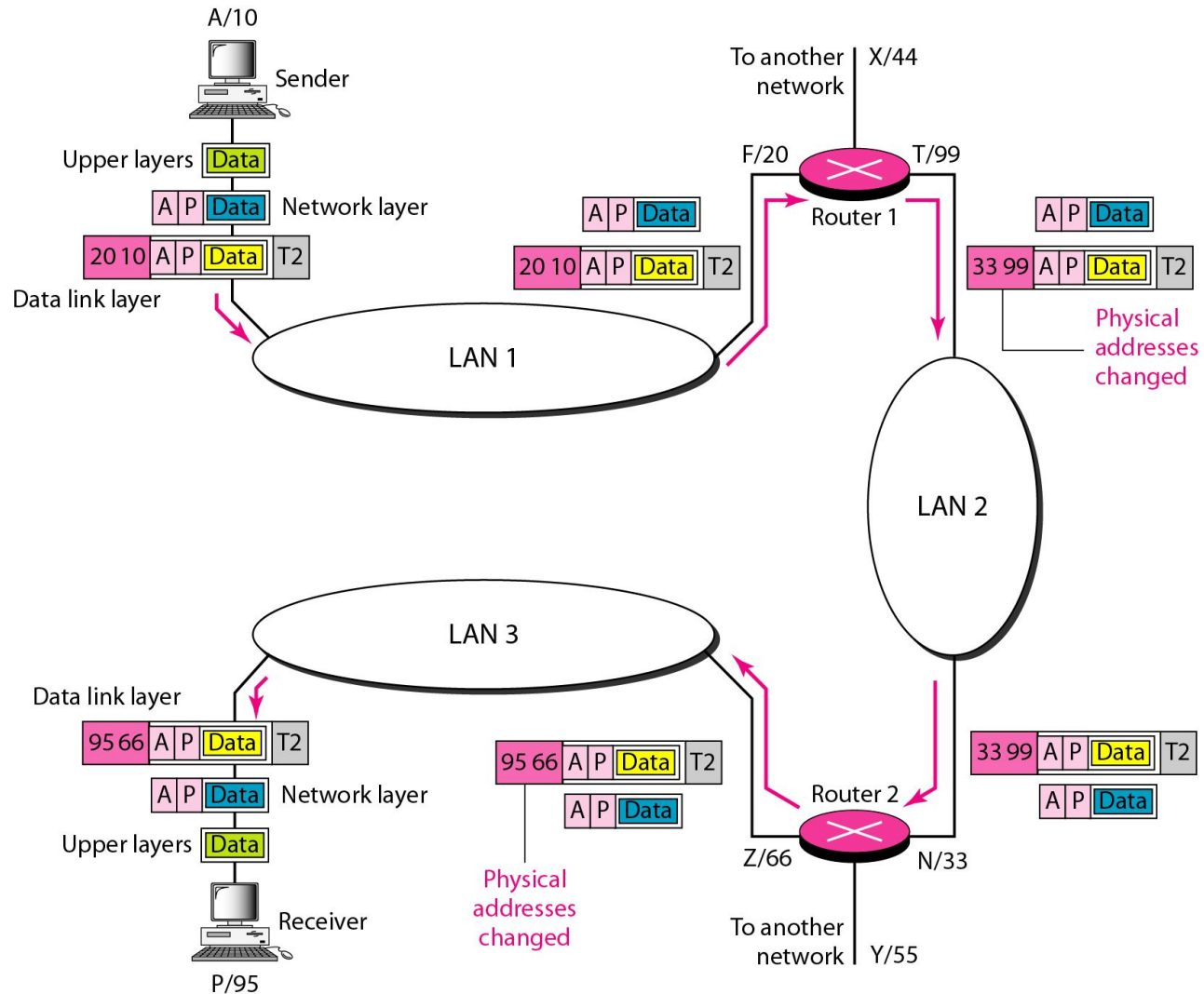
07:01:02:01:2C:4B

Also known as MAC (Media Access Control) Address.

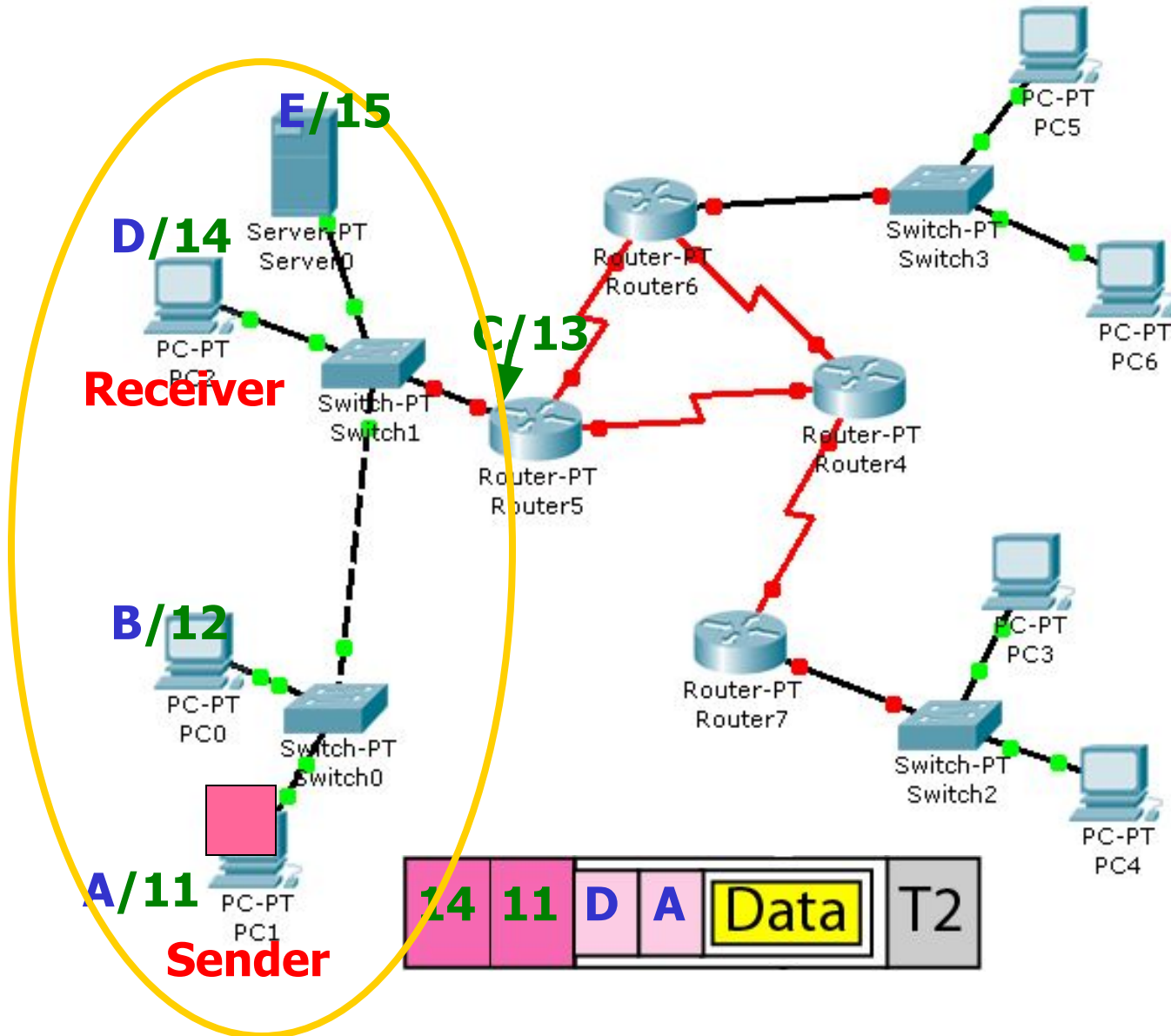
Addressing



Addressing



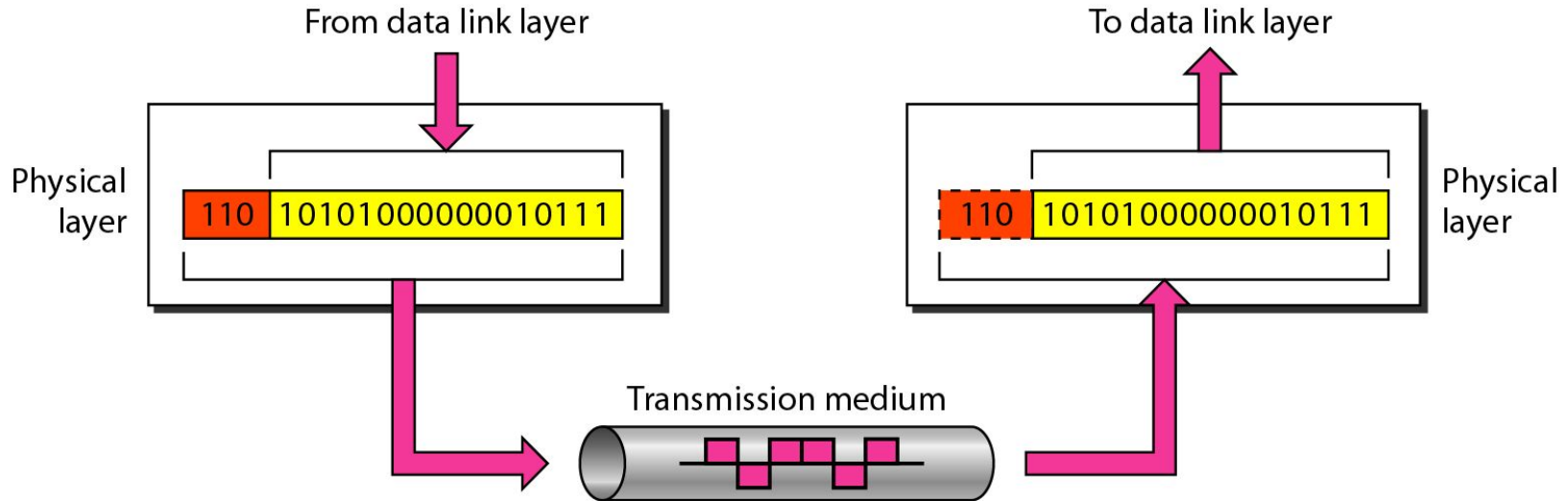
Addressing-Within the same network



- Assume:
- IP Addresses – Alphabets
- MAC Addresses - Numbers

PHYSICAL LAYER

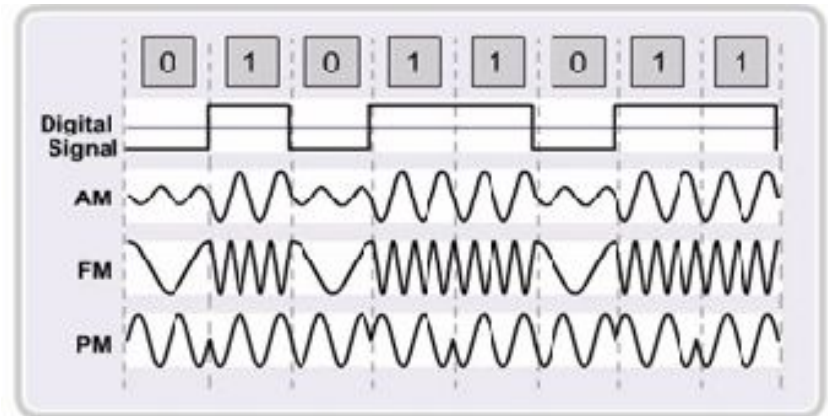
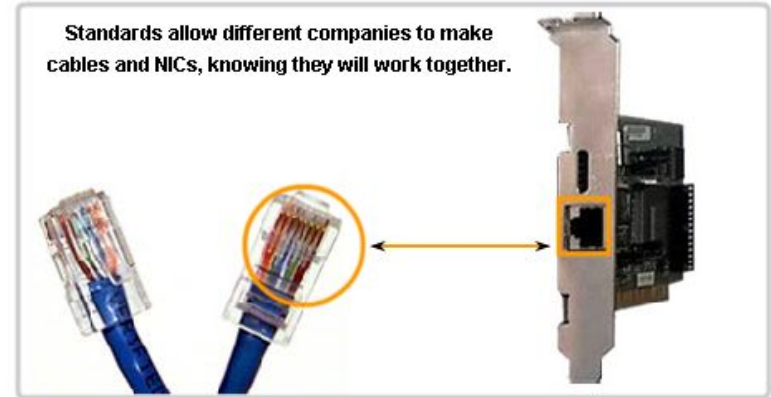
Physical layer



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

Functions-Physical Layer

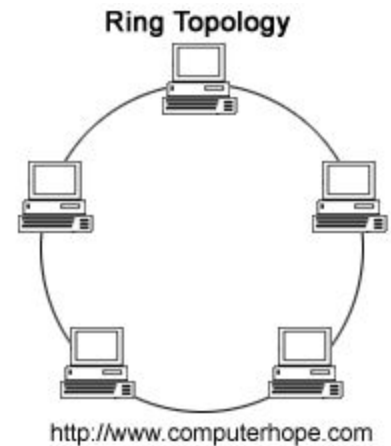
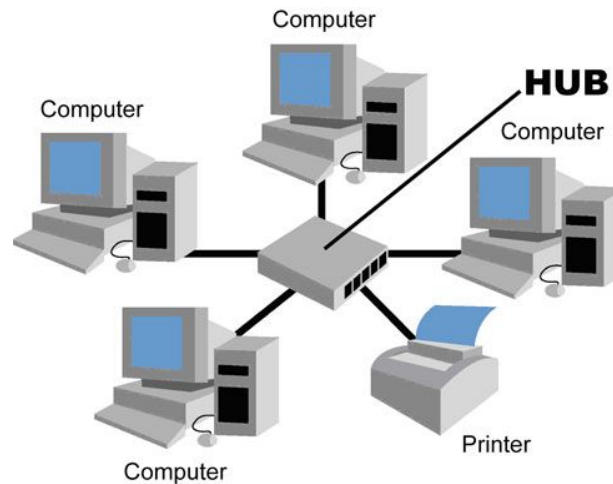
- Physical Characteristics of interfaces and medium.
- Representation of bits
- Data Rate
- Synchronization of bits



Functions-Physical Layer

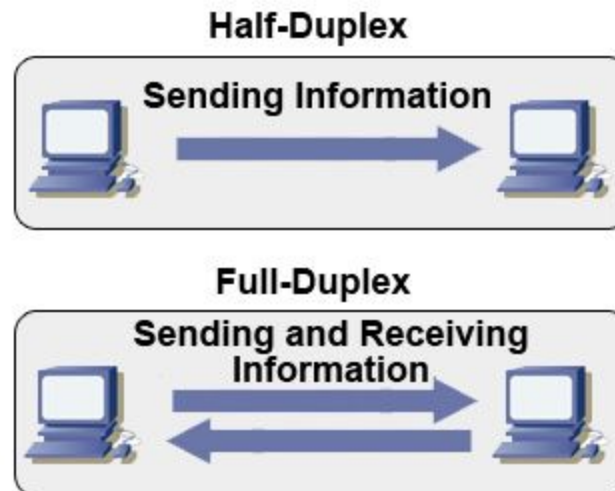
■ Physical Topology

- Bus
- Ring etc

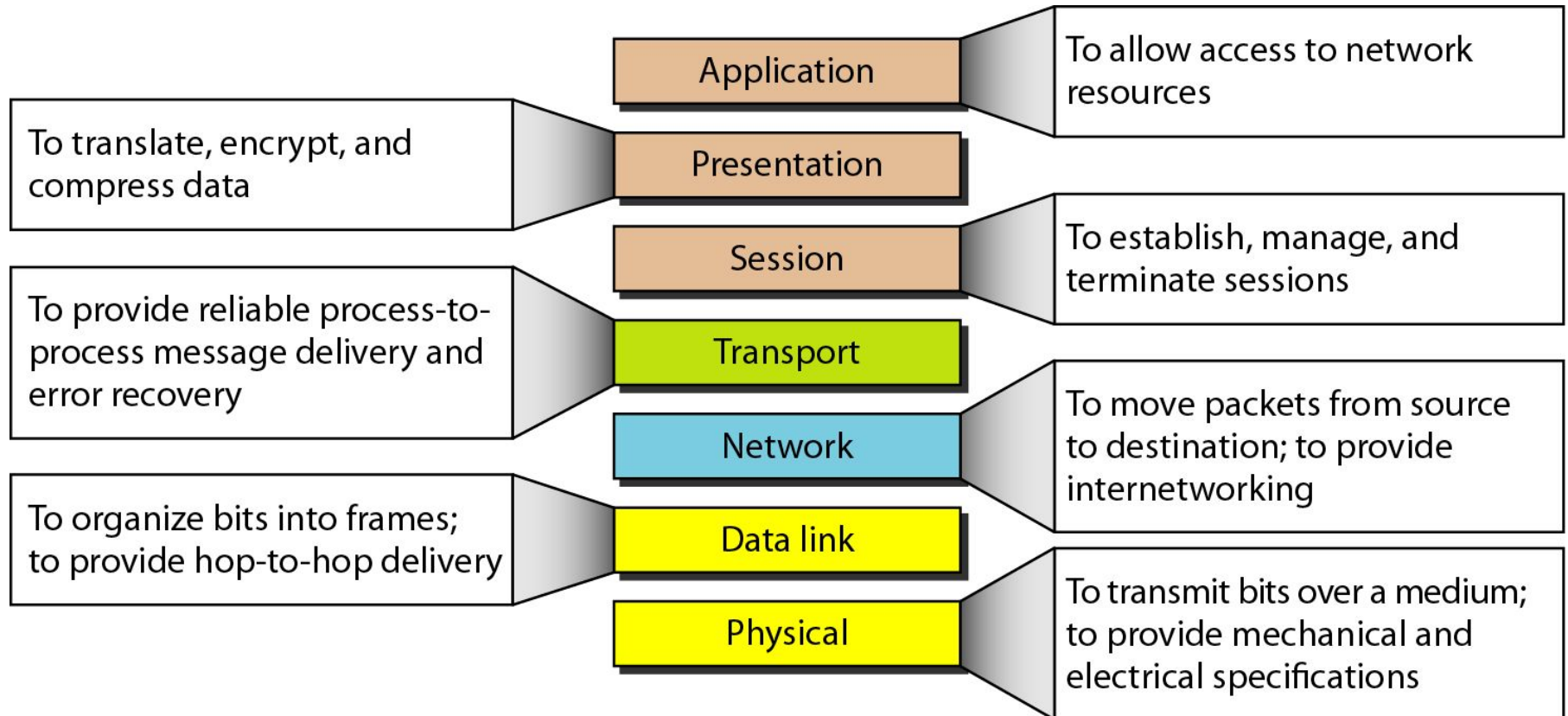


■ Transmission Modes

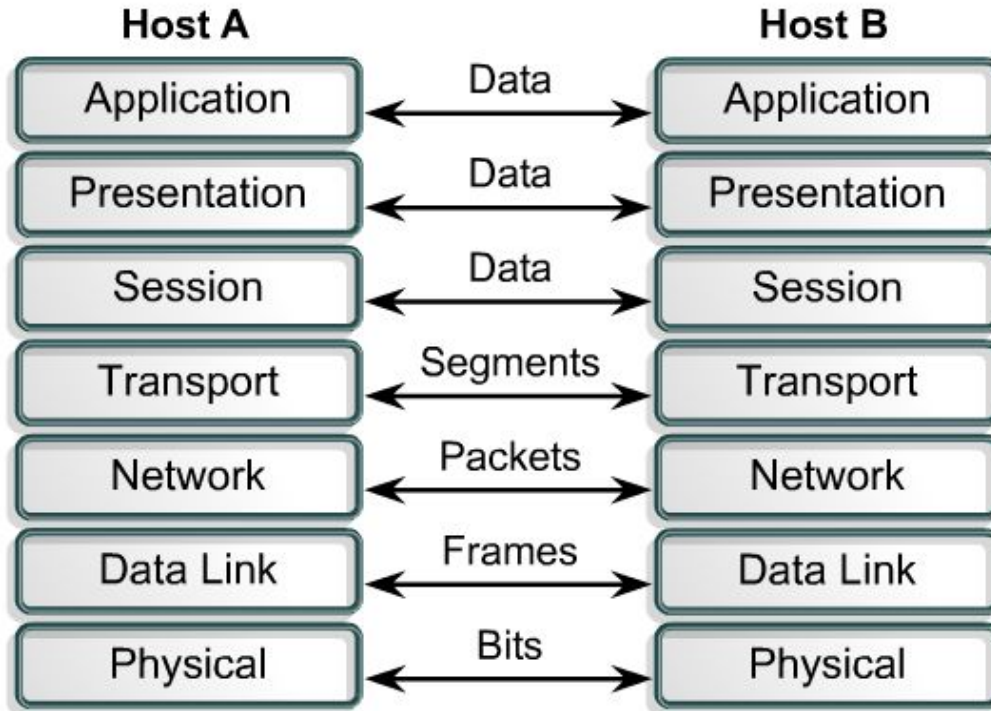
- Simplex
- Half Duplex
- Full Duplex



Summary of OSI Layers



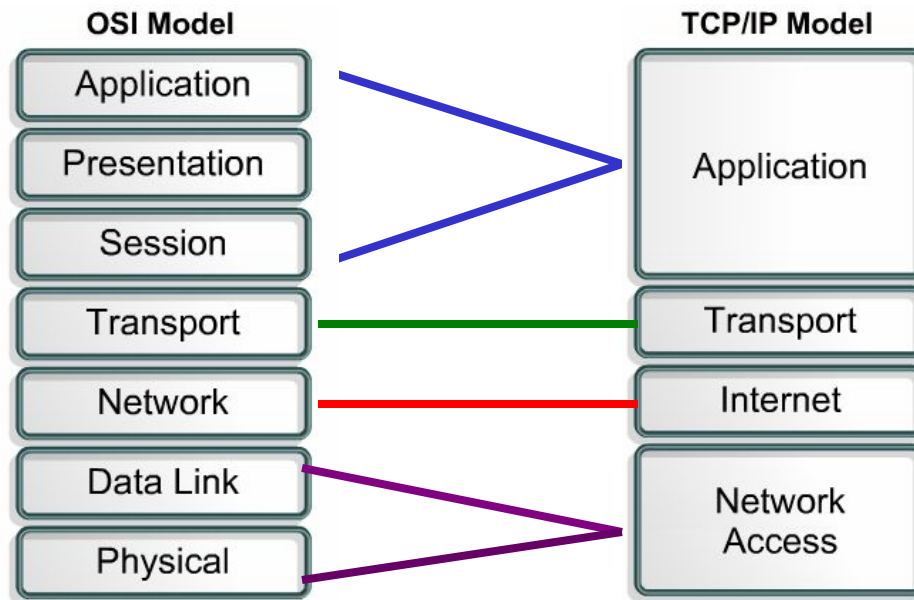
Summary



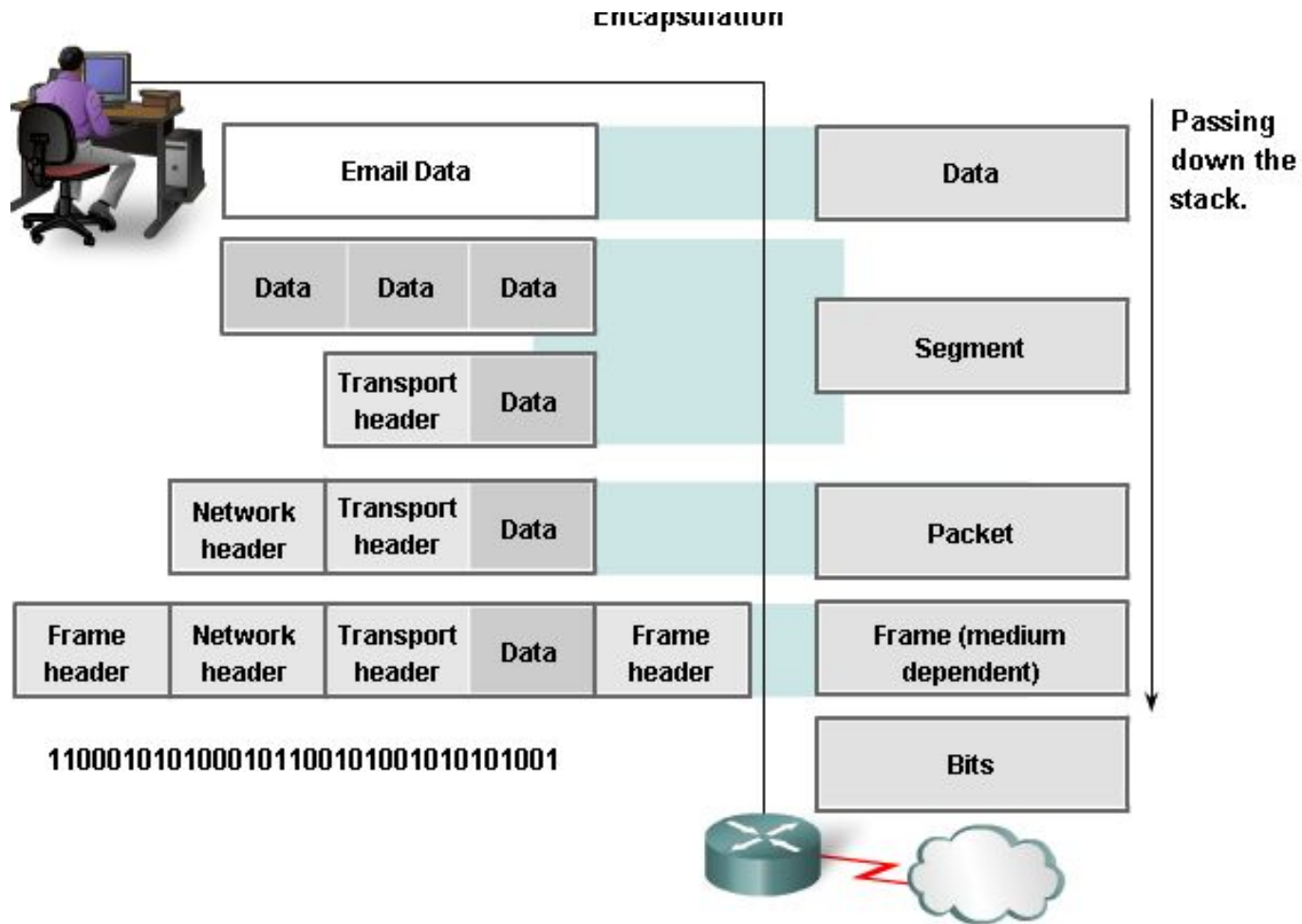
- PDUs
- Encapsulation
- Headers and trailers

TCP/IP

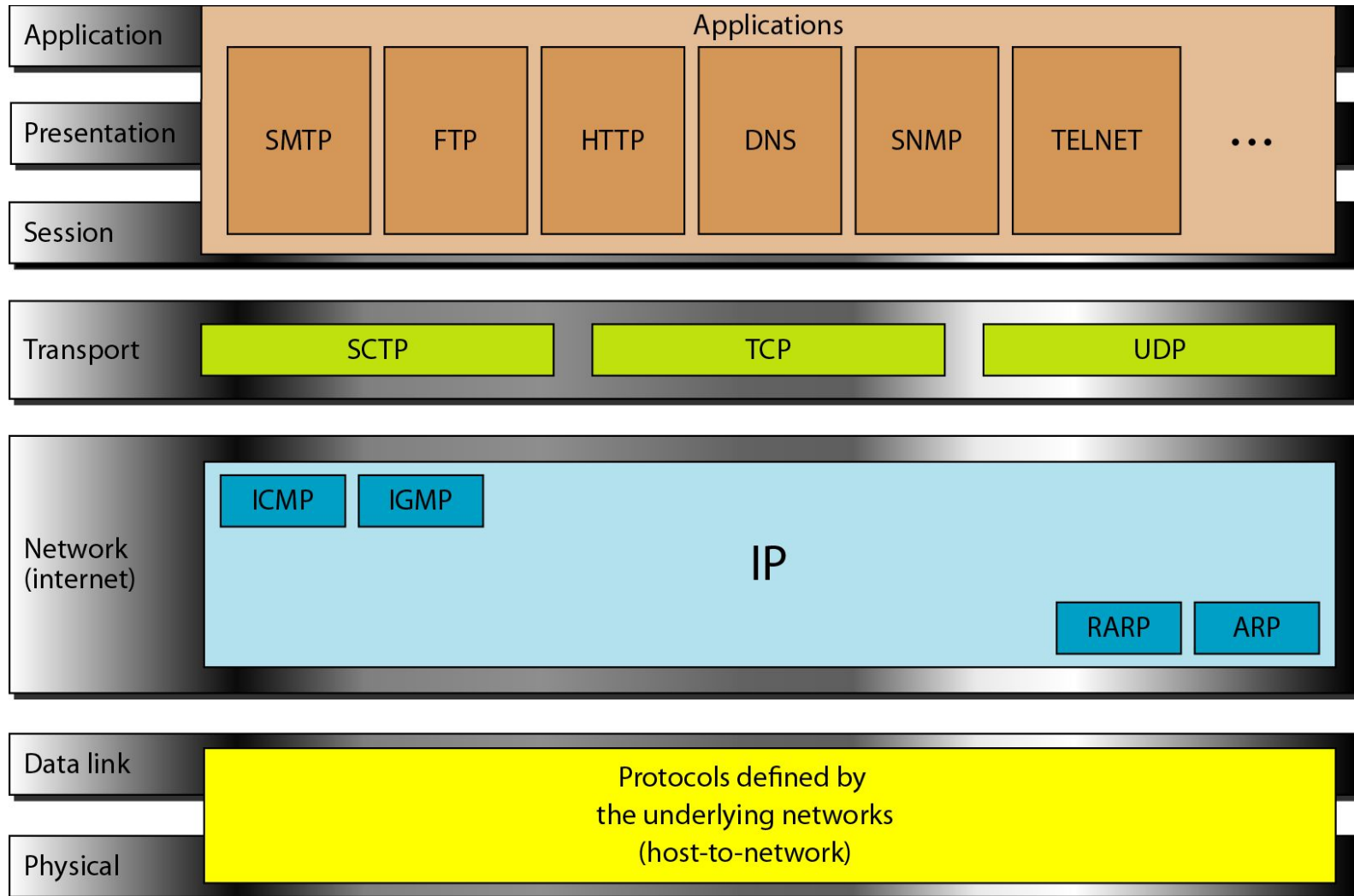
- Developed by the US Defense Advanced Research Project Agency (DARPA) for its packet switched network (ARPANET)
- Used by the global Internet.
- De Facto Standard



TCP/IP Encapsulation

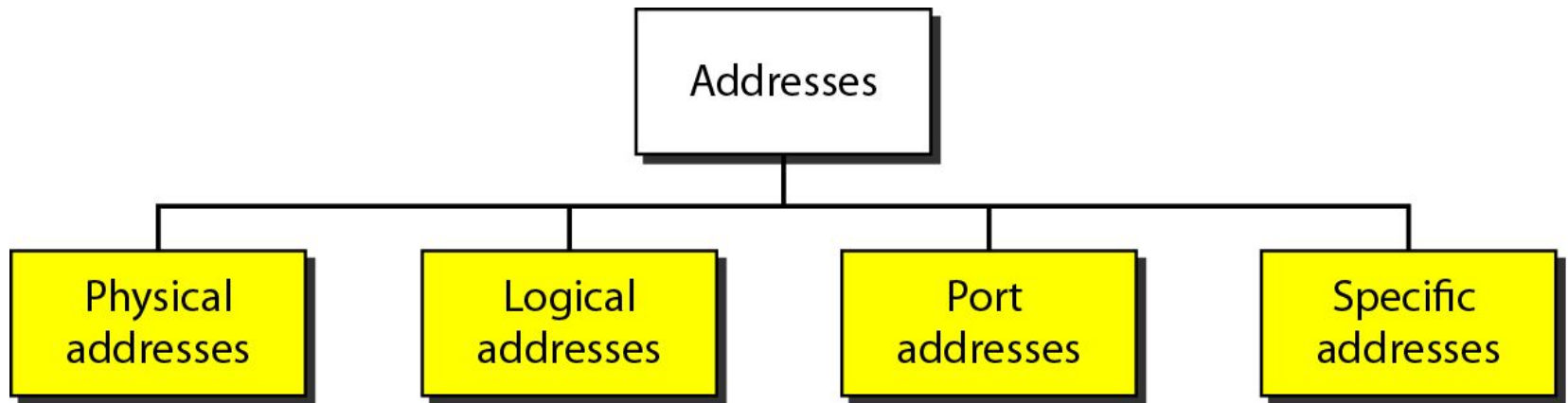


TCP/IP and OSI model

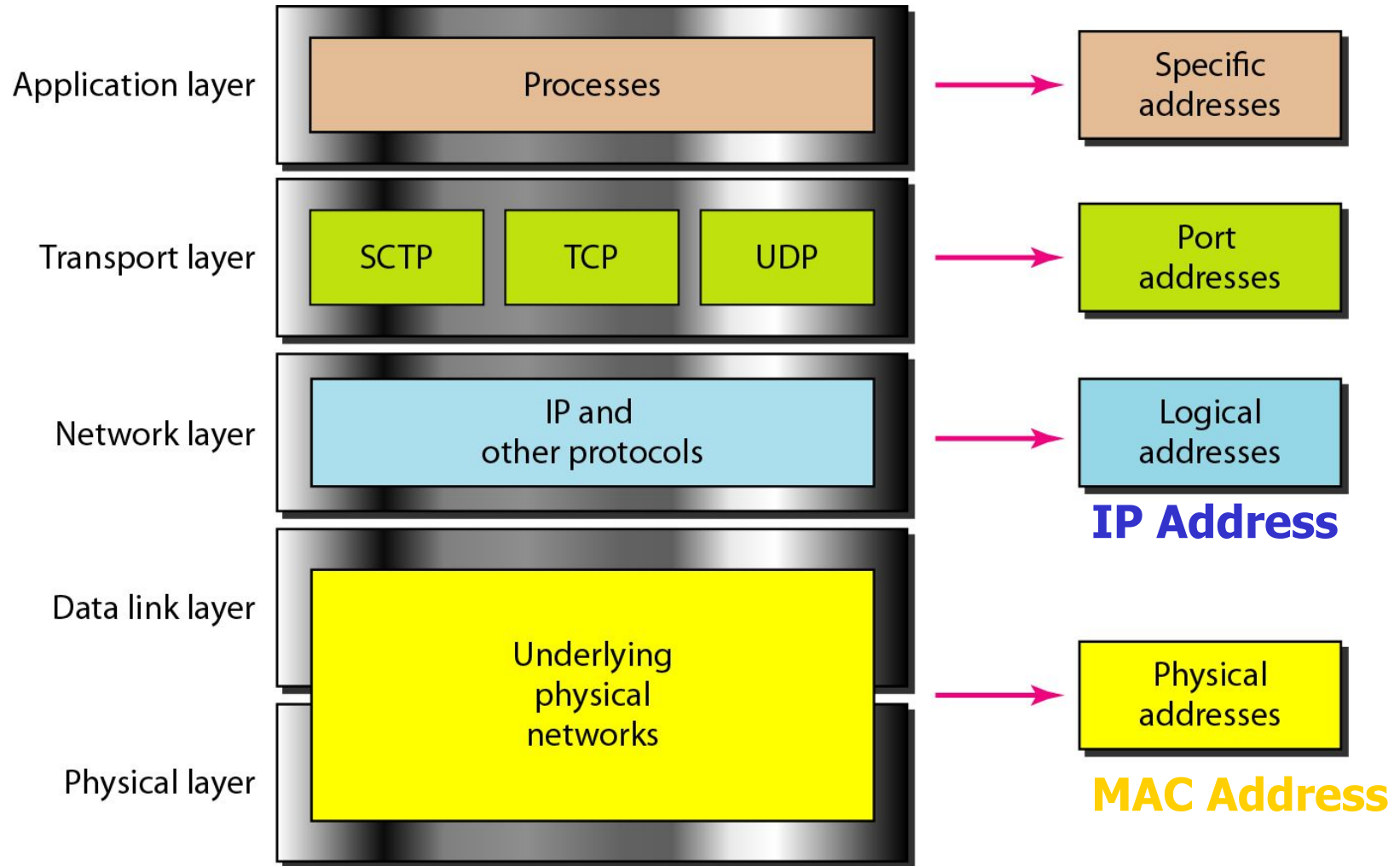


Addressing Summary

- Four levels of addresses are used in an internet employing the TCP/IP protocols



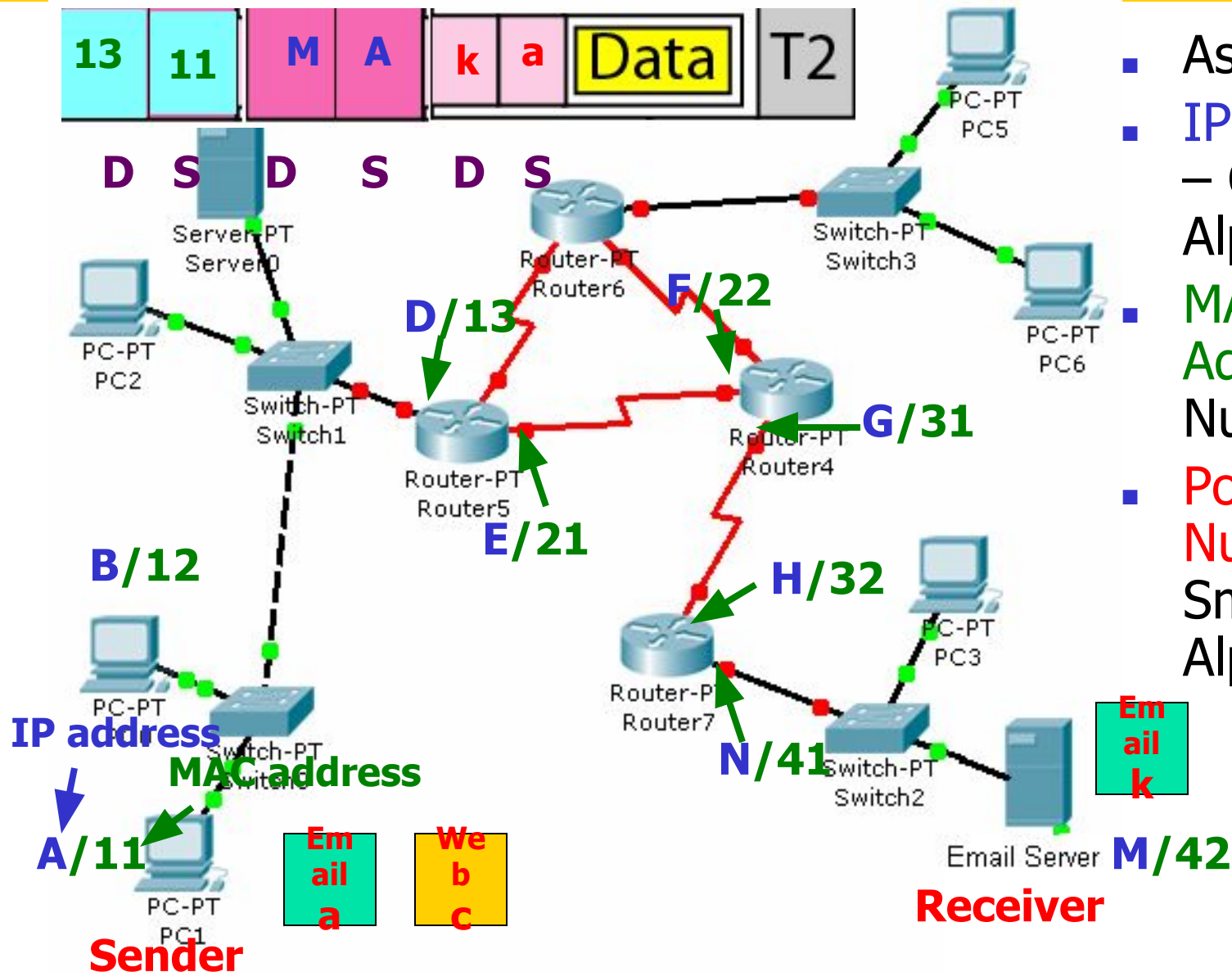
Relationship of layers and addresses in TCP/IP



Specific Addresses

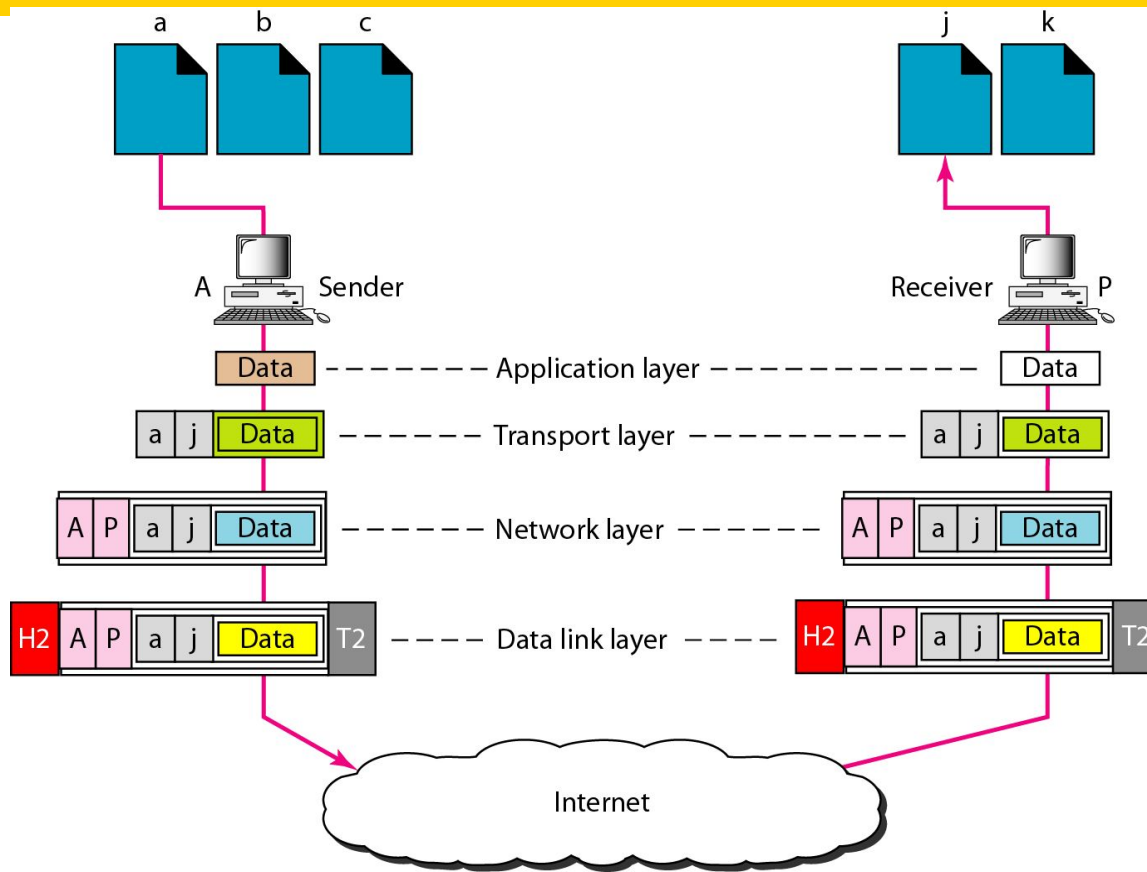
- Applications having user friendly addresses.
- Email addresses or URLs.
 - john@gmail.comjohn@gmail.com or www.bracu.ac.bd
- These are converted into corresponding port and logical addresses by the sending computer.

Addressing Review



- Assume:
- IP Addresses – Capital Alphabets
- MAC Addresses – Numbers
- Port Numbers- Small Alphabets

Addressing Review



Although physical addresses change from hop to hop, logical and port addresses remain the same from the source to destination.

END
