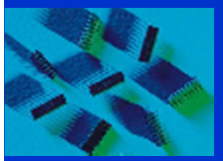


Lecture 1
Overview and Network Models

Textbook: Ch.1 and Ch.2

Main Topics

Chapter 1

- Computer Networking
- Connection and Transmission Mode
- Topology
- Categories of Networks and Internetworks

Chapter 2

- Protocols, Standards and Standard Organizations
- OSI Model: Open System Interconnection by ISO
- TCP/IP Protocol Suite

1. Computer Networking

- Computer Networking facilitates data communication among computing devices
  - ***Data communications*** :The exchange of data between two devices via some form of transmission medium.
- Communication effectiveness depends on
  - Delivery (to the correct destination)
  - Accuracy
  - Timeliness
  - Jitter

Networks

- A network is a set of devices (called *nodes*) connected by media *links* (called communication channels).

- What is a *good* network?

Performance

- A number of measurements, e.g.
  - Propagation/Transmission time
  - Response time
- Performance is often evaluated by two networking metrics:
  - Throughput
  - Delay

Reliability

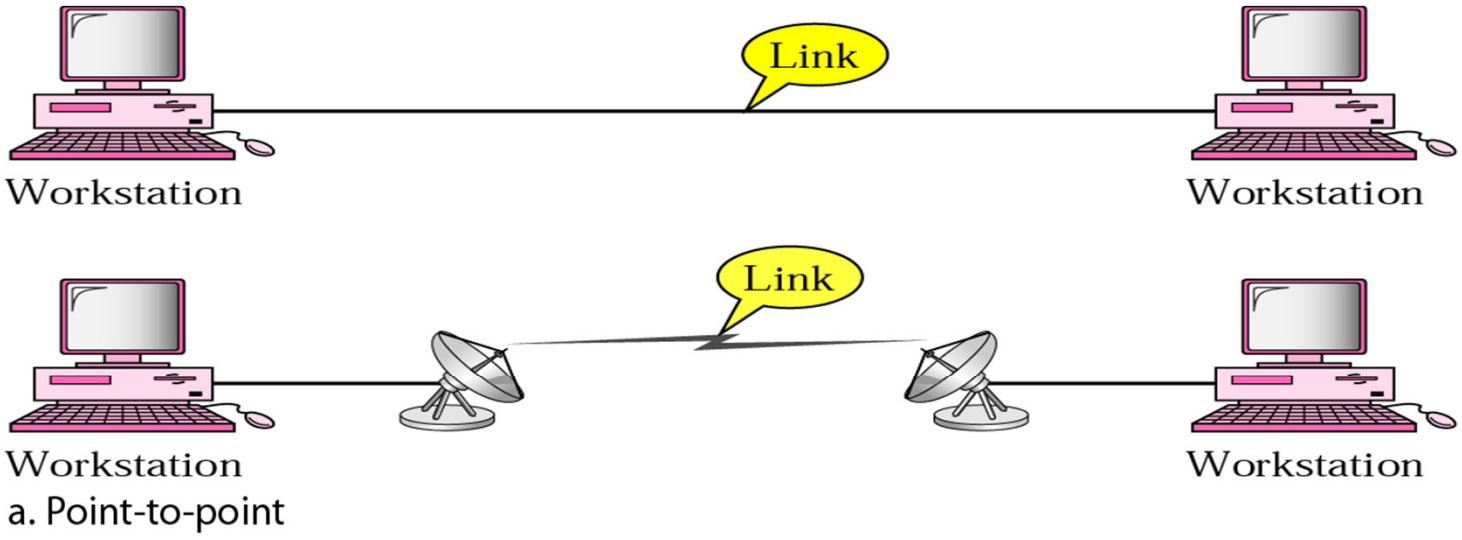
- Frequency of failure
- Recovery time of a network after a failure
  - Catastrophe
    - Fire , earthquake, etc.
    - Backup system
    - Contingency plan
- Resistant to:
  - Unauthorized access
  - Data damage
  - Viruses

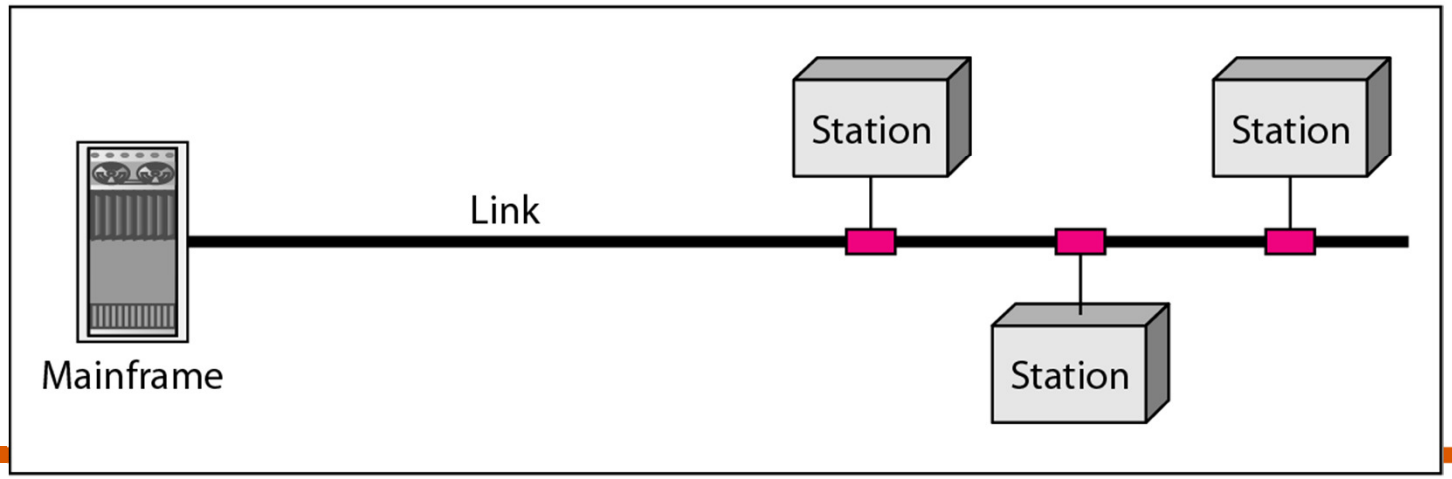
2. Types of Connections

- Defines the attachment of communication devices to a link

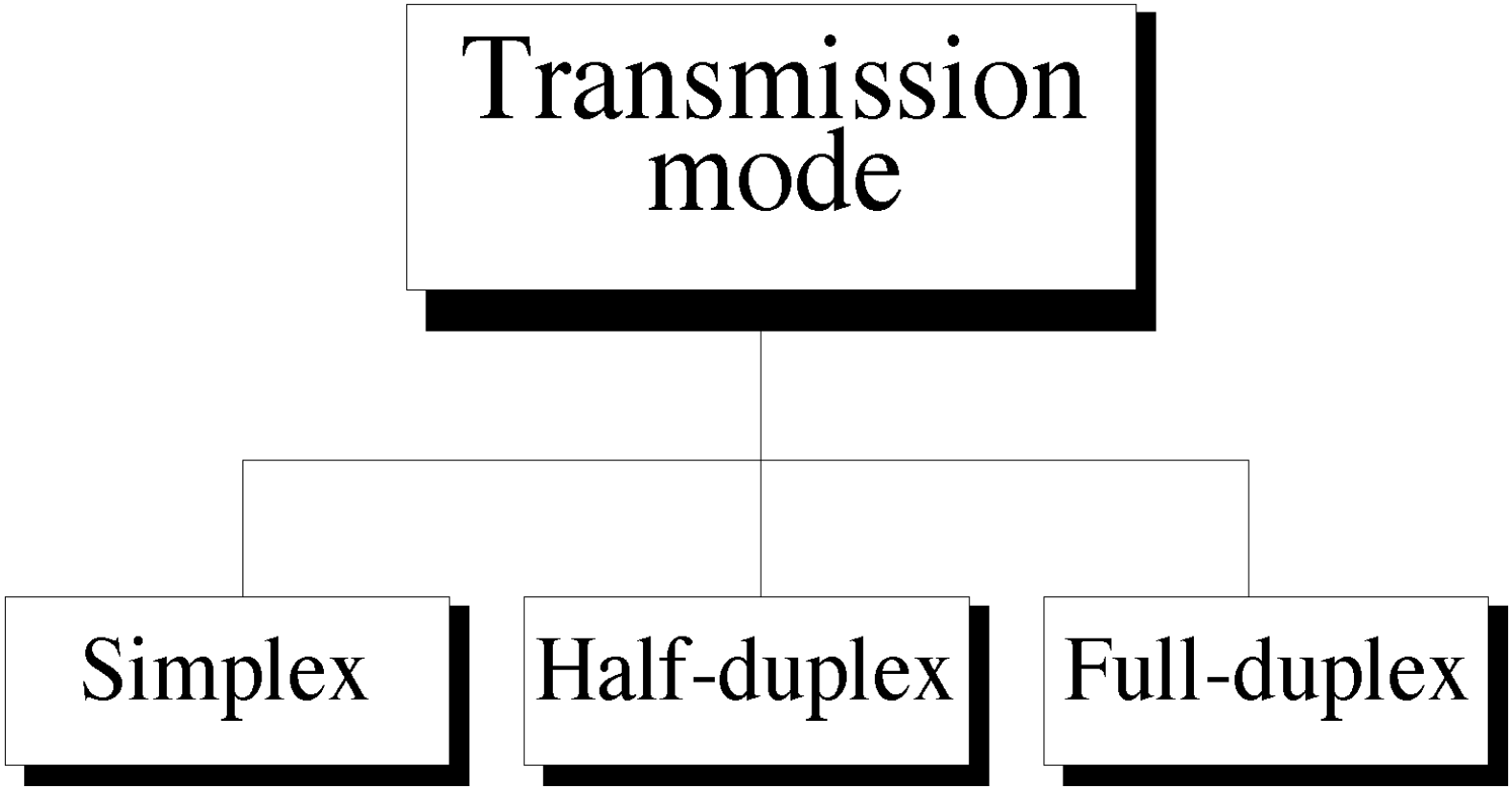
- Two Types:
  - **Point-to-point**: a dedicated link between two devices
  - **Multipoint** (multidrop): more than two devices share a single link

Figure 1.3 *Types of connections: point-to-point and multipoint*



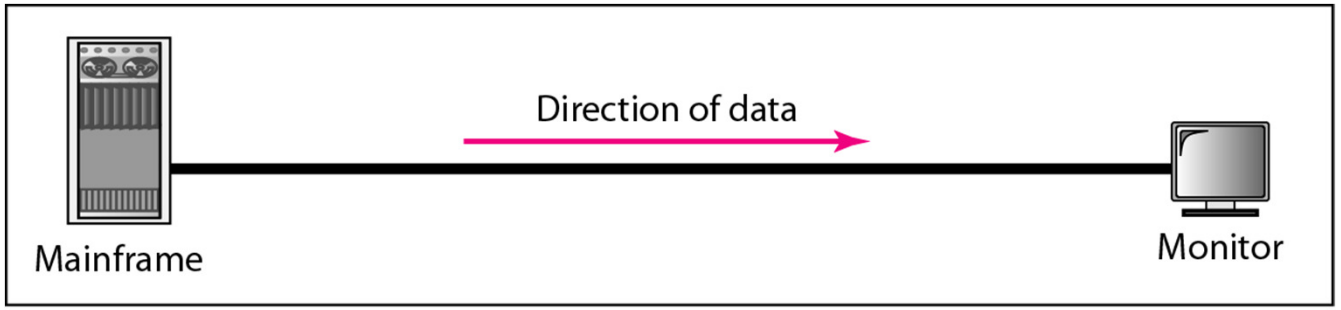


3. Transmission Mode

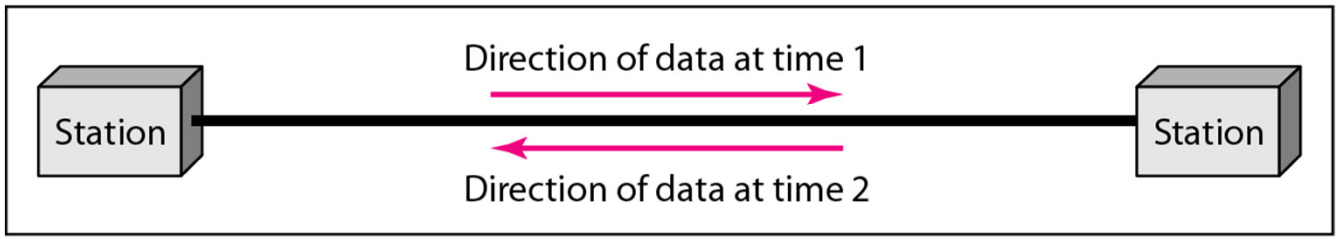


Refers to the direction of information flow

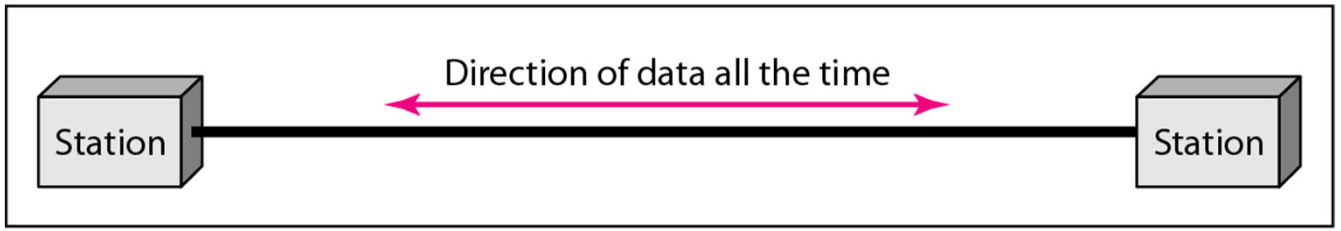
Data flow (simplex, half-duplex, and full-duplex)



a. Simplex - Communication is unidirectional.



b. Half-duplex - Each station can both transmit and receive, but not at the same time.



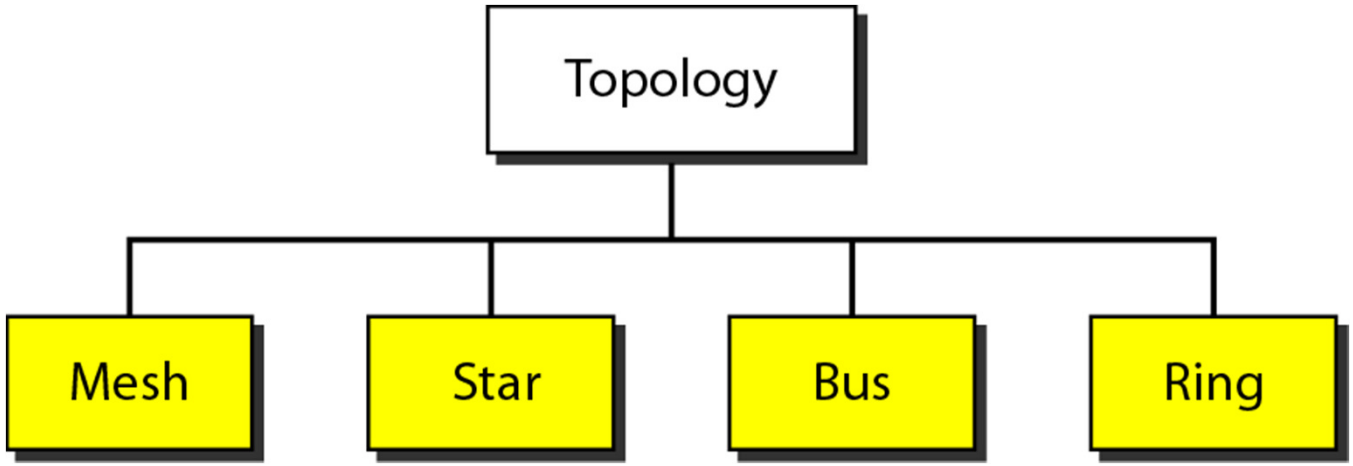
c. Full-duplex - Both stations can transmit and receive simultaneously.

Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*

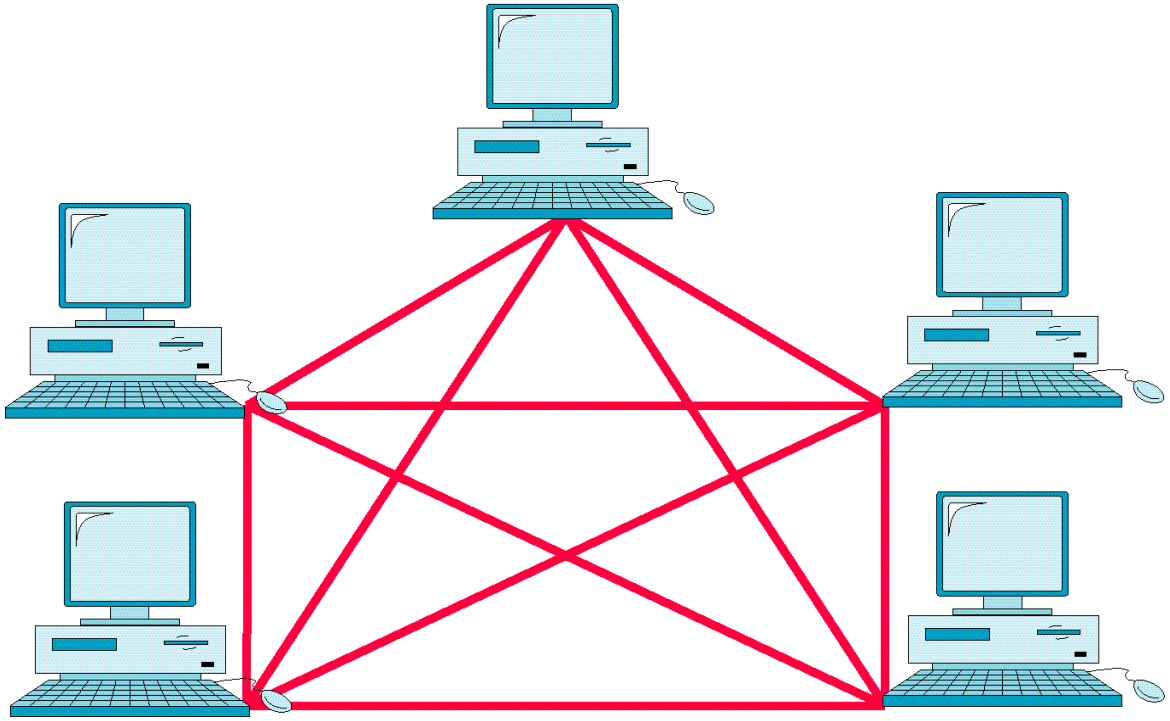
4.Topology

- Defines the physical or logical ***arrangement of links*** in a network
- It is the ***geometric representation*** of the relationship of all the links and nodes to each other (simply speaking, the *shape* of the network)
- A consideration when choosing a topology is the relative status of the devices to be linked
- Relationships: Peer-to peer or Primary-secondary

Figure 1.4 *Categories of topology*



Mesh Topology



- *A fully connected mesh topology (five devices)*
- ***How many links are needed?***

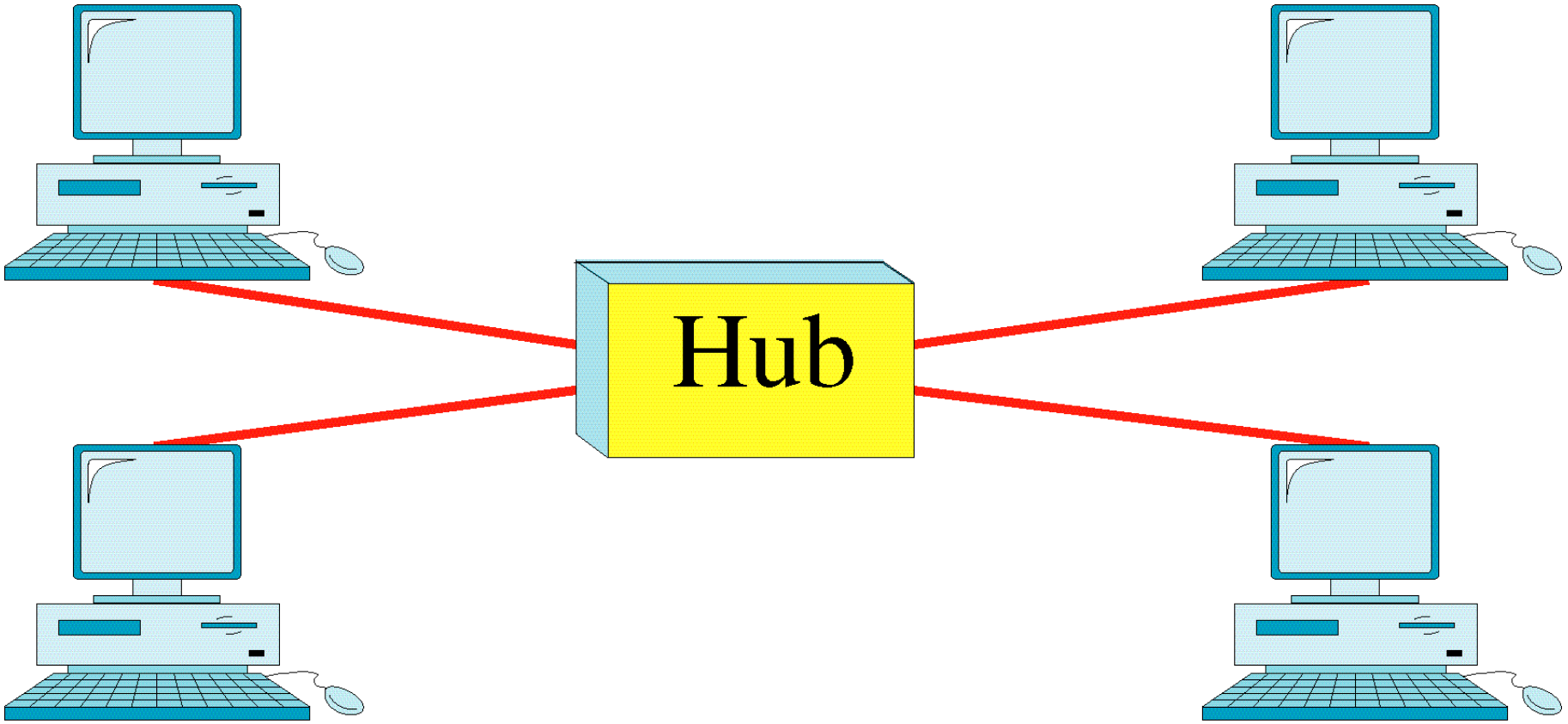
Mesh Topology

- Every device has a dedicated point-to-point link to every other device
- A fully connected mesh network has
  n(n-1)/2 physical channels
  to link n devices
- Convenient for peer-to-peer transmission
- What are the advantages of Mesh topology? What are the costs?

Mesh Topology

- **Advantages**
  - Dedicated links eliminate the traffic problem
  - Robust: failure of one link does not affect the whole network
  - Privacy/Security provided by dedicated links
  - Easy fault identification and isolation
- **Disadvantages**
  - Expensive
    - cost of cabling and
    - the I/O ports

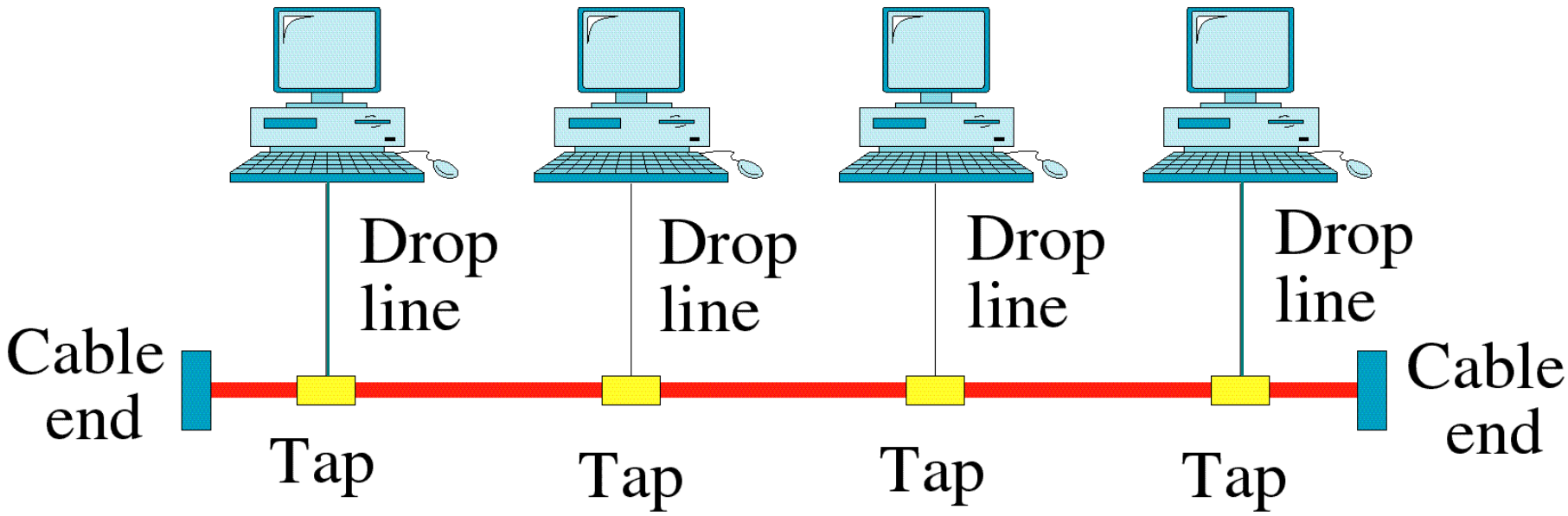
Star Topology



Star Topology

- Each device has a dedicated link only to a ***central controller*** (called a hub) which acts as an exchange
- ***No direct traffic*** between devices
- Advantages:
  - Less expensive for cabling and I/O ports
  - Robustness, easy fault identification and isolation
- Disadvantage:
  - **Single point of failure** (what if the hub goes down?)

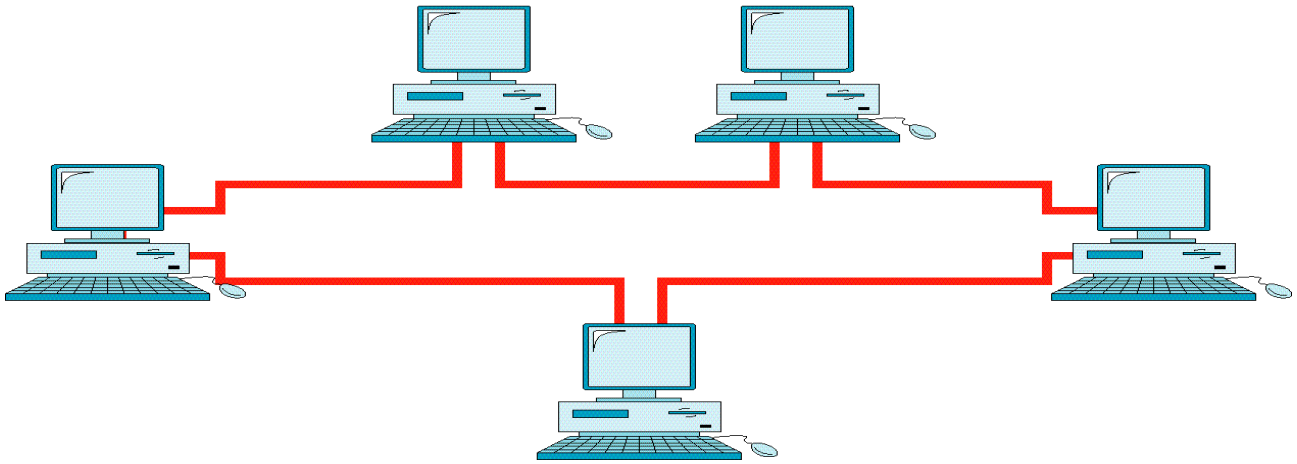
Bus Topology

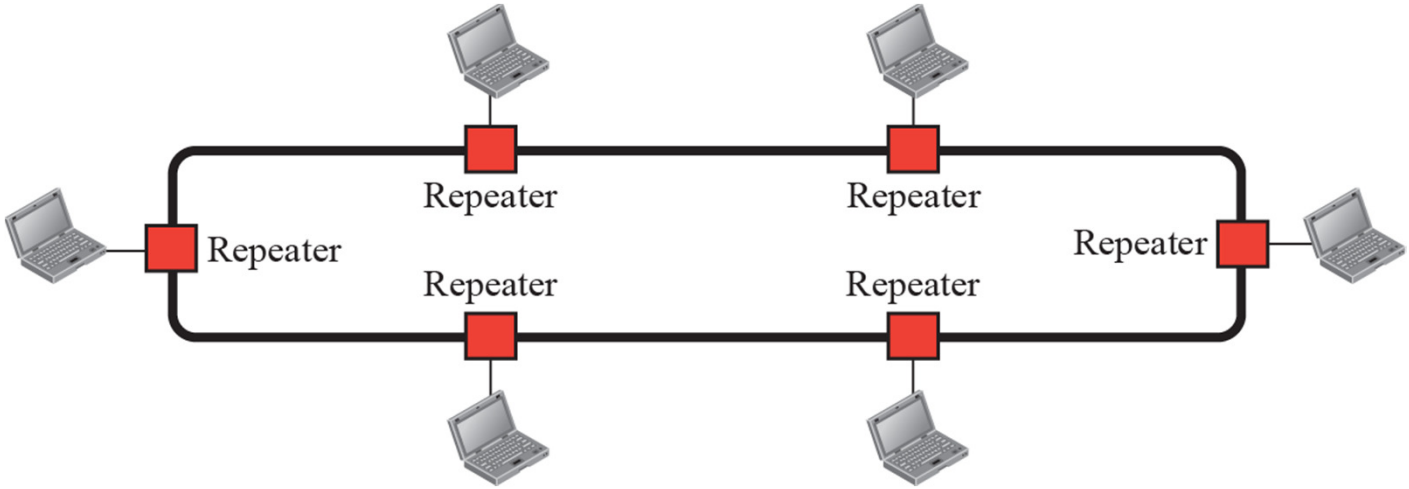


Bus Topology

- One **long cable** acts as a backbone to link all the devices
- A **broadcast** channel
- Easy installation, least cabling
- Due to power loss; no. of taps and distance between taps are limited
- Difficult reconfiguration and fault isolation

Ring Topology

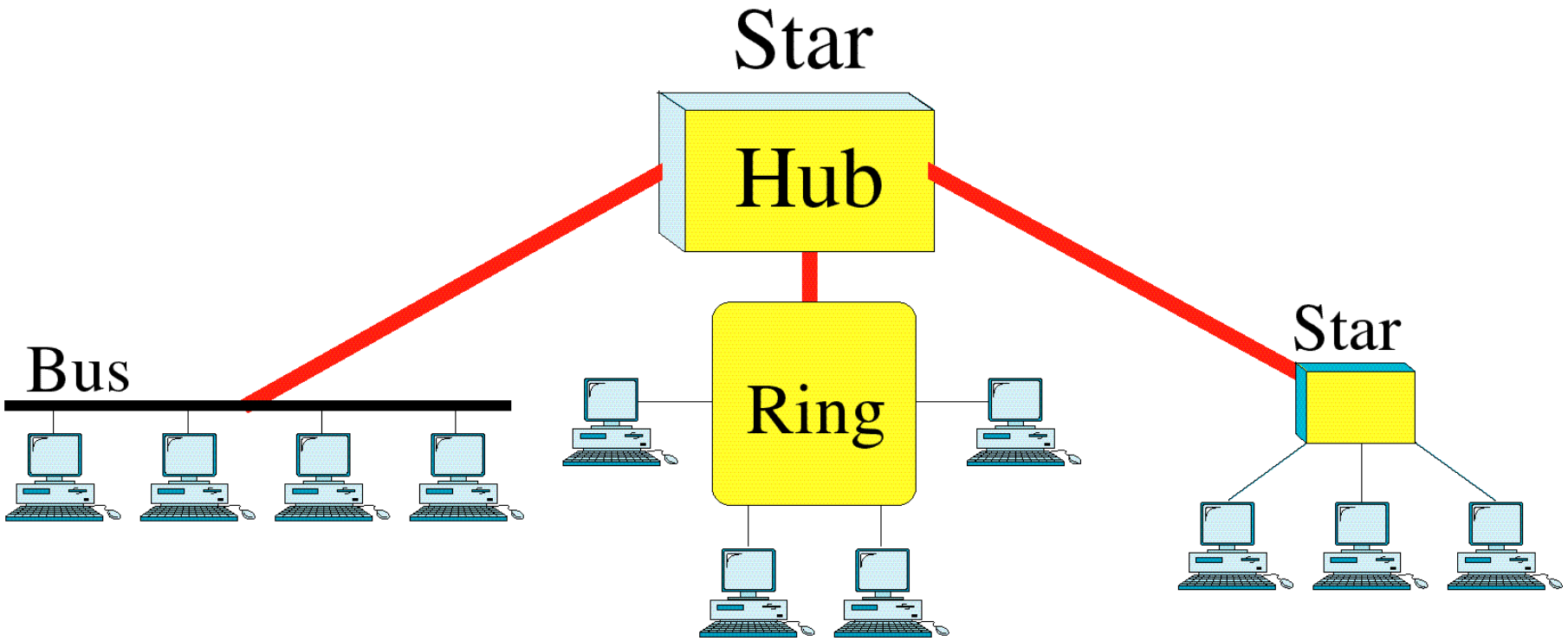




Ring Topology

- Each device has a dedicated link **only with the two neighbor devices**
- A signal is passed along the ring in **one direction** from device to device (which has a repeater)
- Relatively easy to install and reconfigure
- Constraints on maximum ring length & no. of devices
- Unidirectional traffic: a break in the ring can disable the entire network

Hybrid Topology



Hybrid Topology

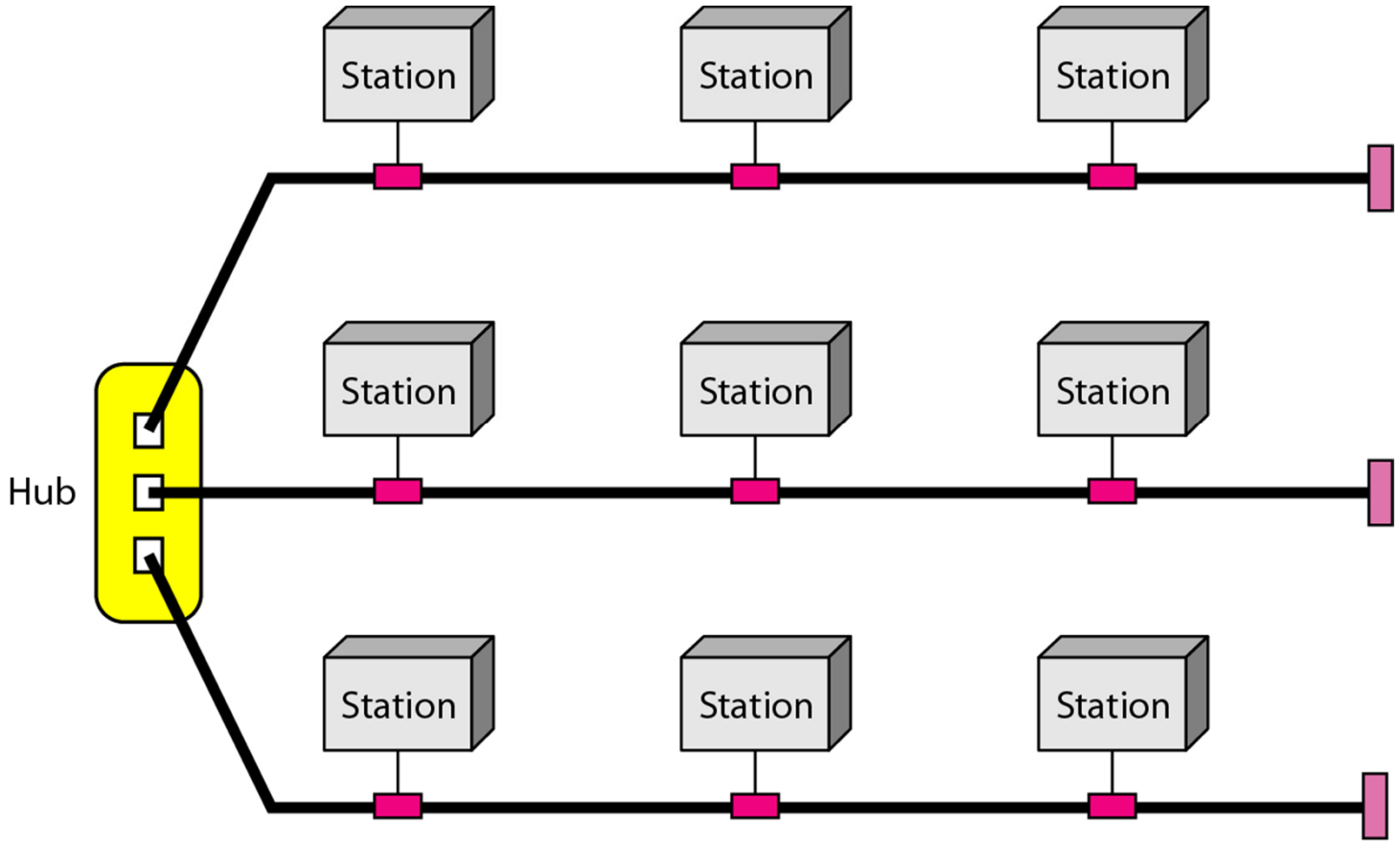
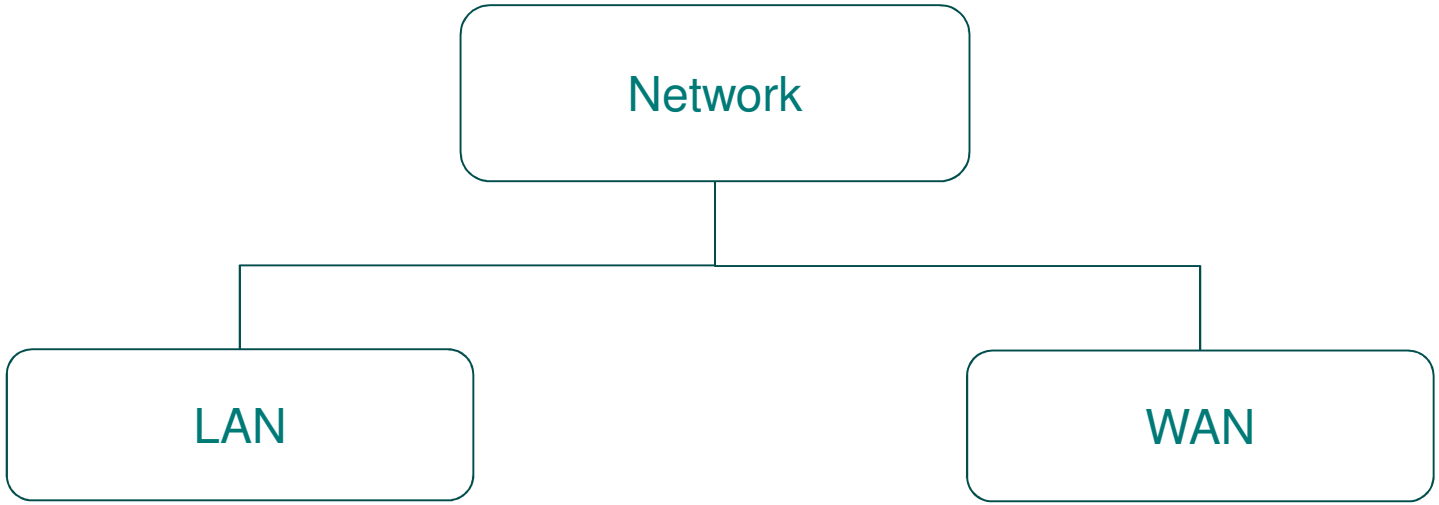


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*

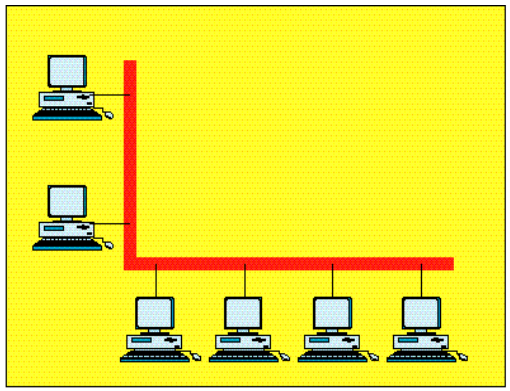
5. Categories of Networks

Classify by its size, ownership, covering distance and physical architecture

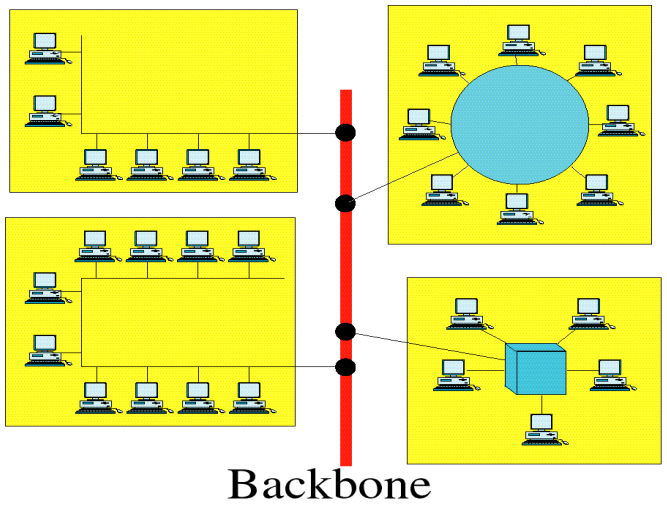


Local Area Network

- LAN is usually privately owned
- Connecting hosts in a single office, building, or campus.



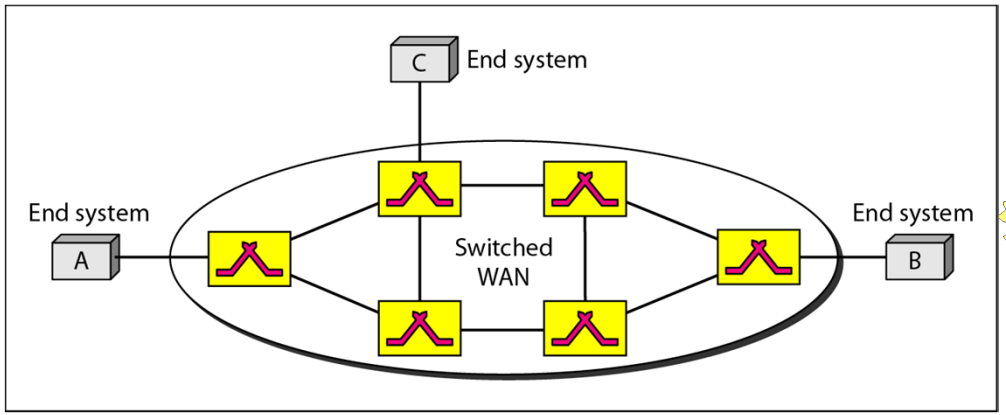
Single building LAN



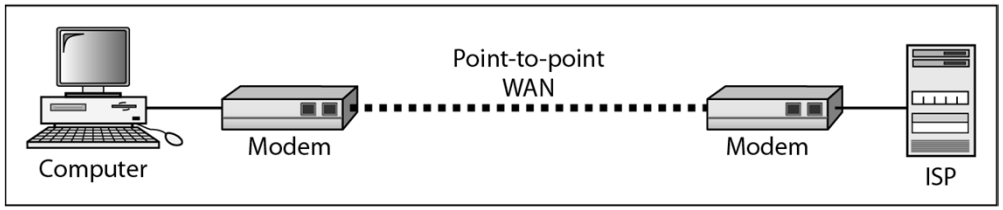
Multiple building LAN

Wide Area Network

- Connecting devices in a wider geographical area, e.g. town, country, or even the world.



a. Switched WAN



b. Point-to-point WAN

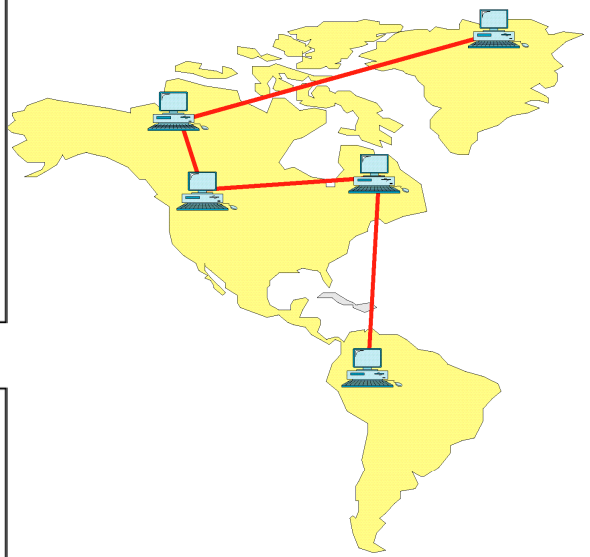
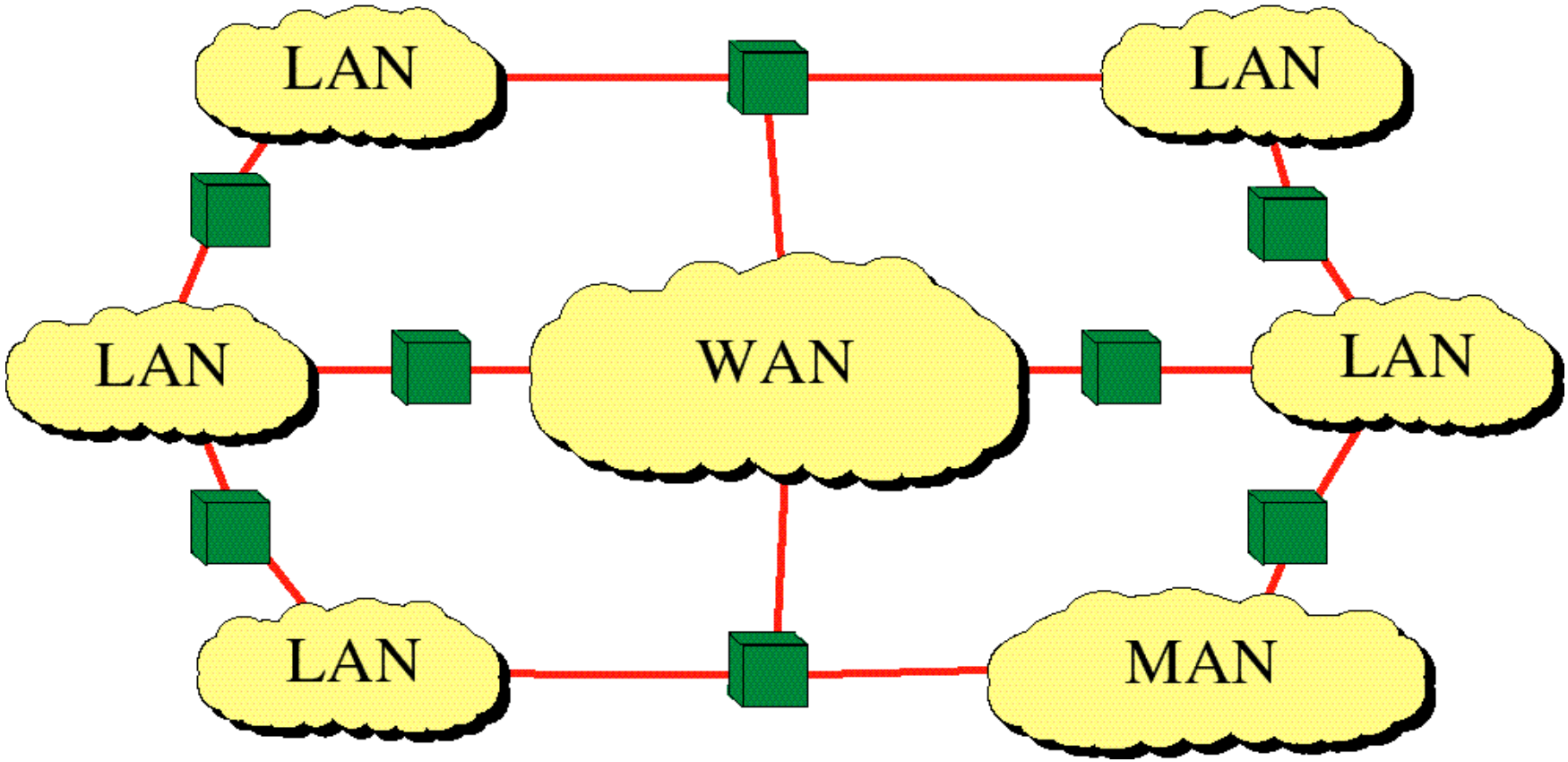


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

Internetwork

(Internet) is a network of networks



Example of LAN and WAN

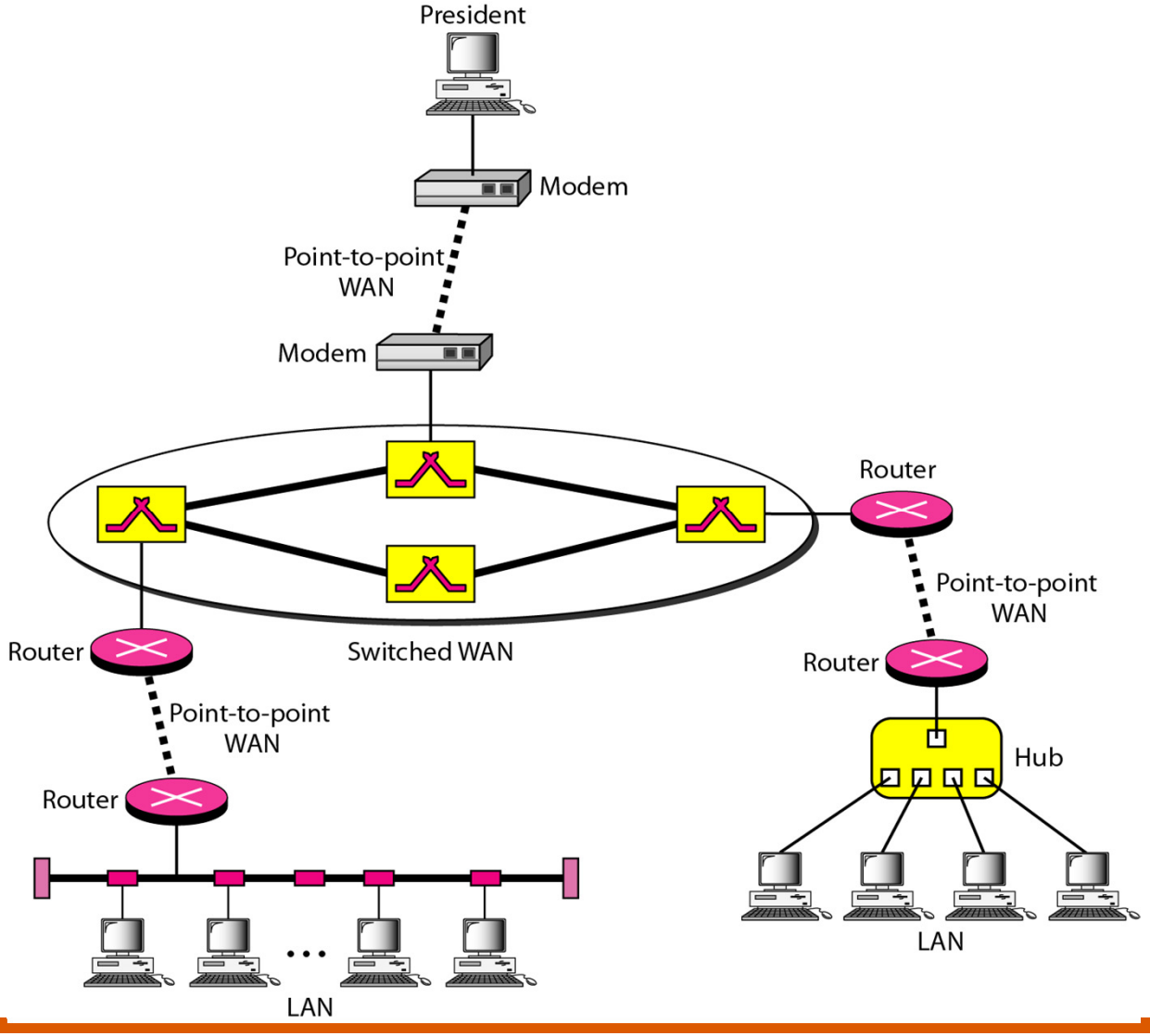


Figure 1.12 *A heterogeneous network made of four WANs and two LANs*

6. Protocols

- A ***set of rules*** (conventions) that govern all aspects of information exchange.
- The key elements:
  - *Syntax* : Structure or format of the data
  - *Semantics* : Meaning of different part
  - *Timing* : When to send and how fast

Standards

- Provides a model for development that makes it possible for a product to work regardless of the individual manufacturer.
- Ensures that products from different manufacturers can work together
- ISO – International Standards Organization
- ANSI – American National Standards Institute
- IEEE – Institute of Electrical and Electronics Engineers

Layering in Network Models

- Data communication systems consists of a lot of rules and procedures for different functions

- Divide the complex tasks into layers for simpler implementation and maintenance
  - Each layer only focuses on its own task
  - Protocols are designed for specific layers

Consider the scenario

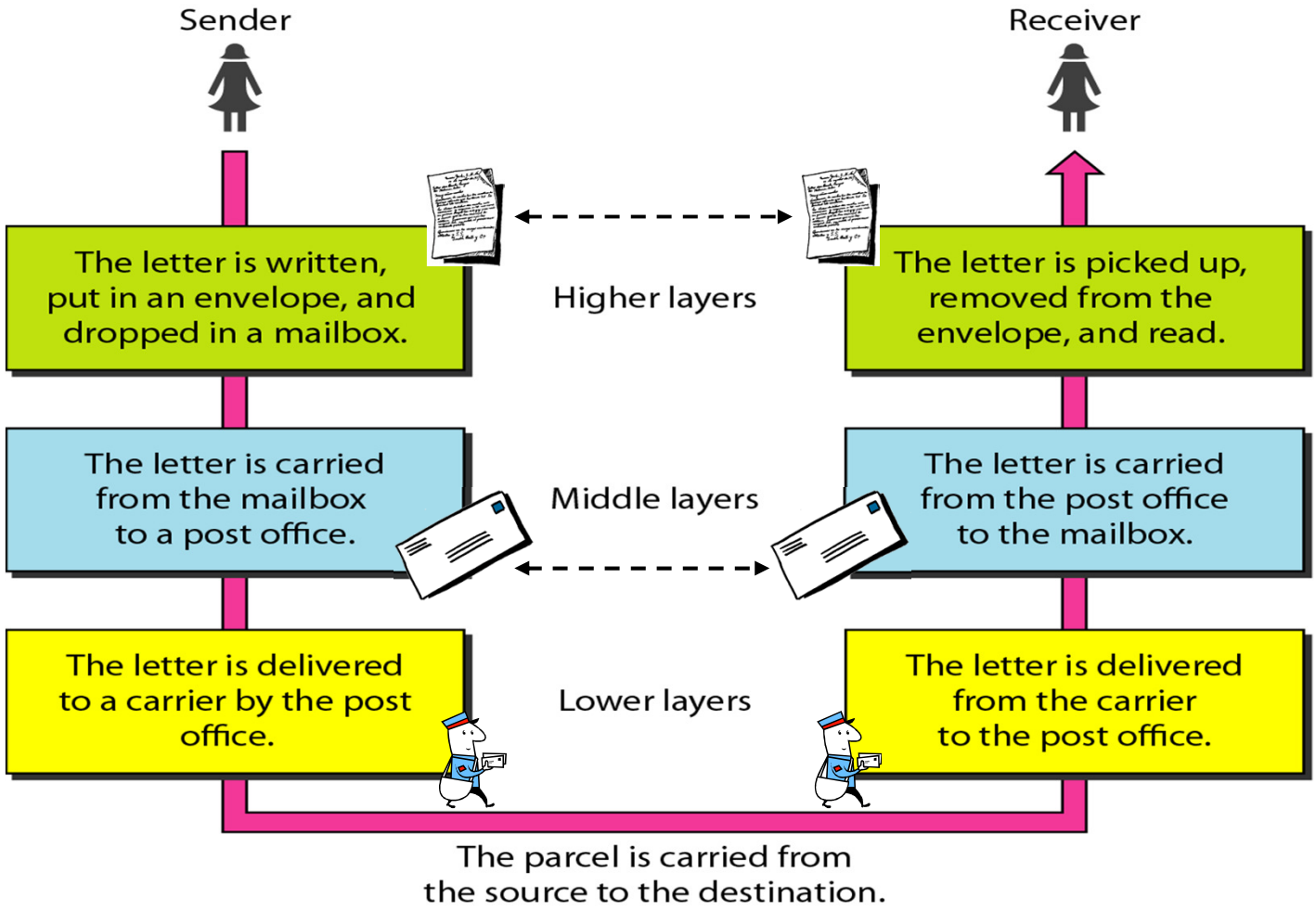
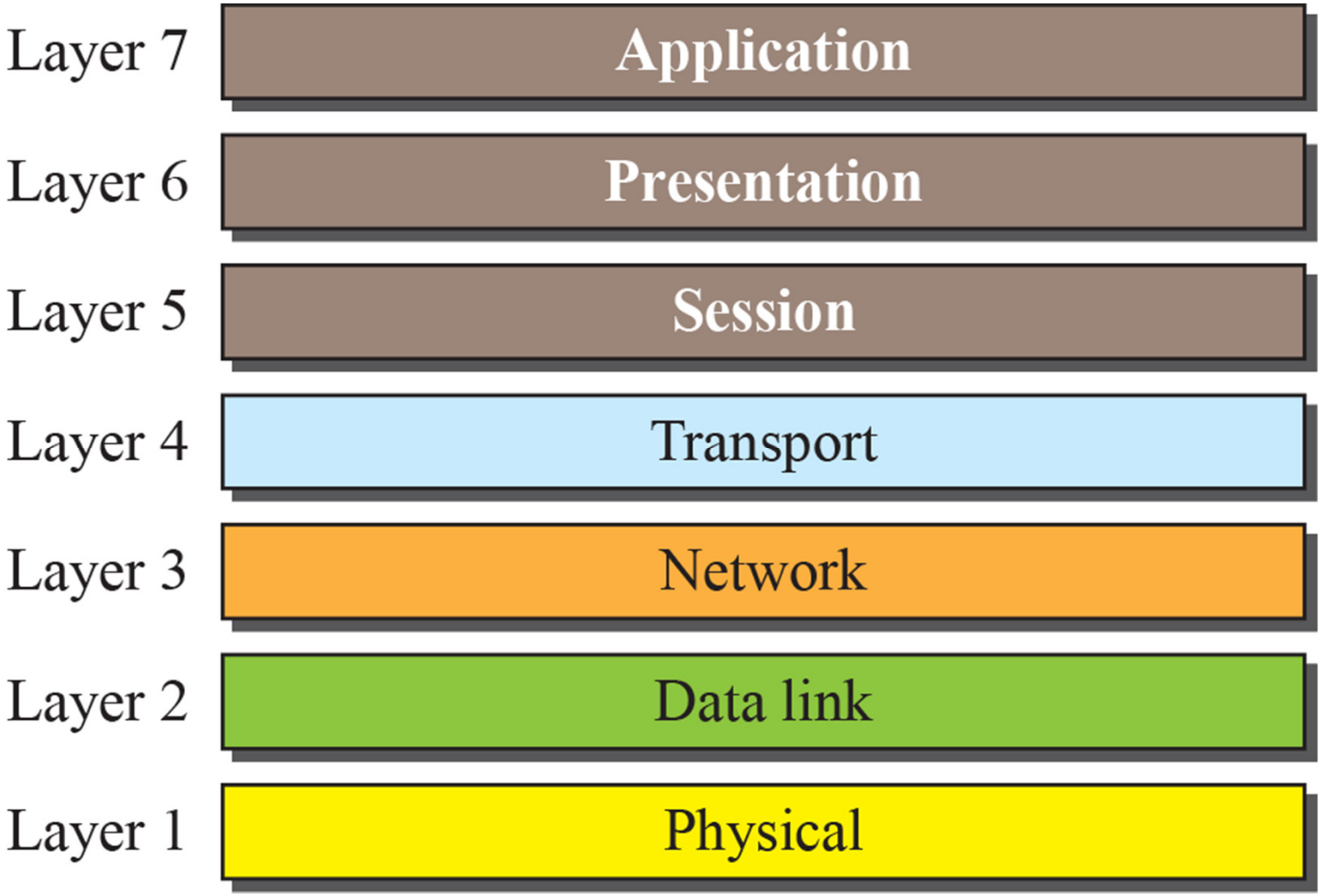


Figure 2.1 Tasks involved in sending a letter

OSI Model

- 7- layered architecture
- Provides guidelines for the development of universally compatible architecture, hardware and software
- Each layer
  - *provides* ***services*** to the layer **above**
  - While *utilizing* the **services** of the layer **below**
- Communications between computers is a peer-to-peer process using the protocols appropriate to a given layer

OSI Model



Functions of layers

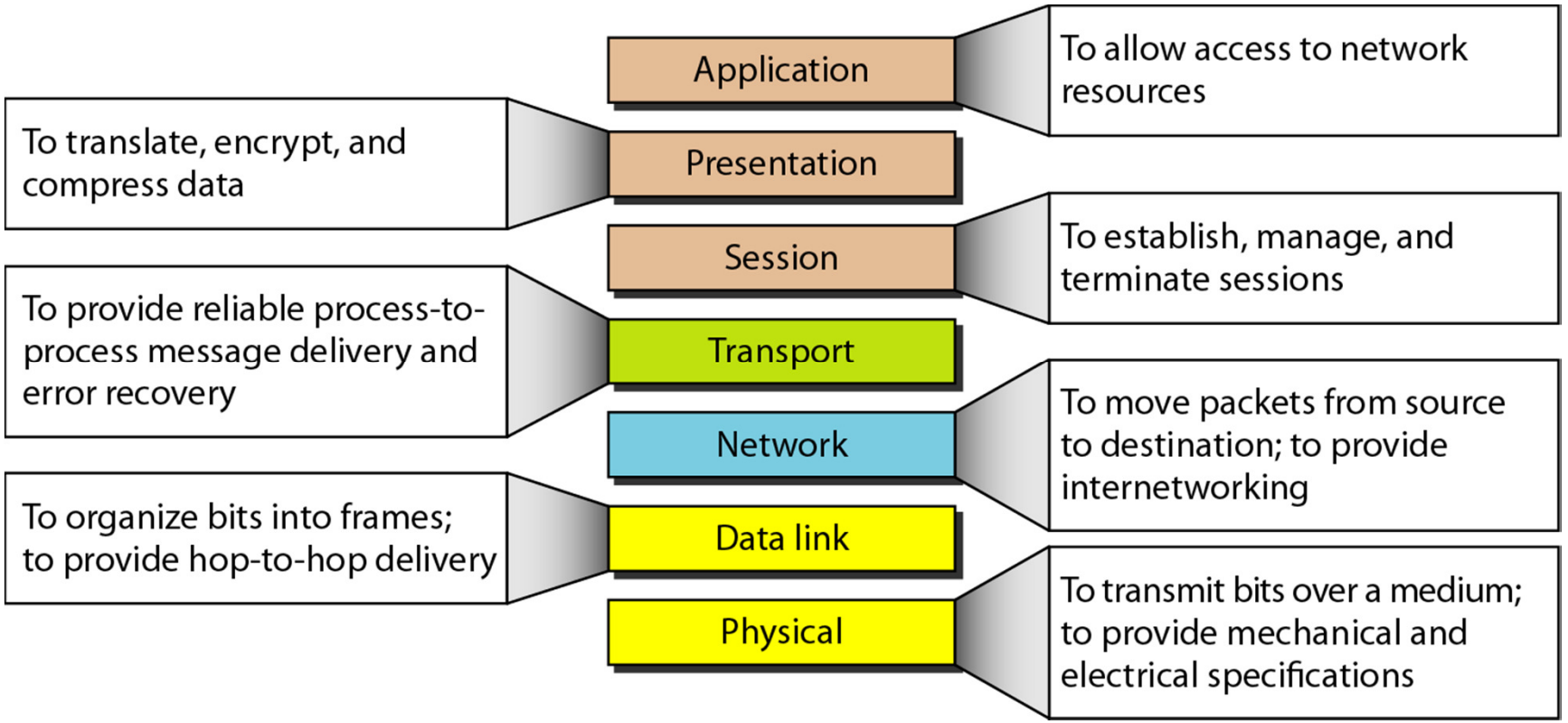
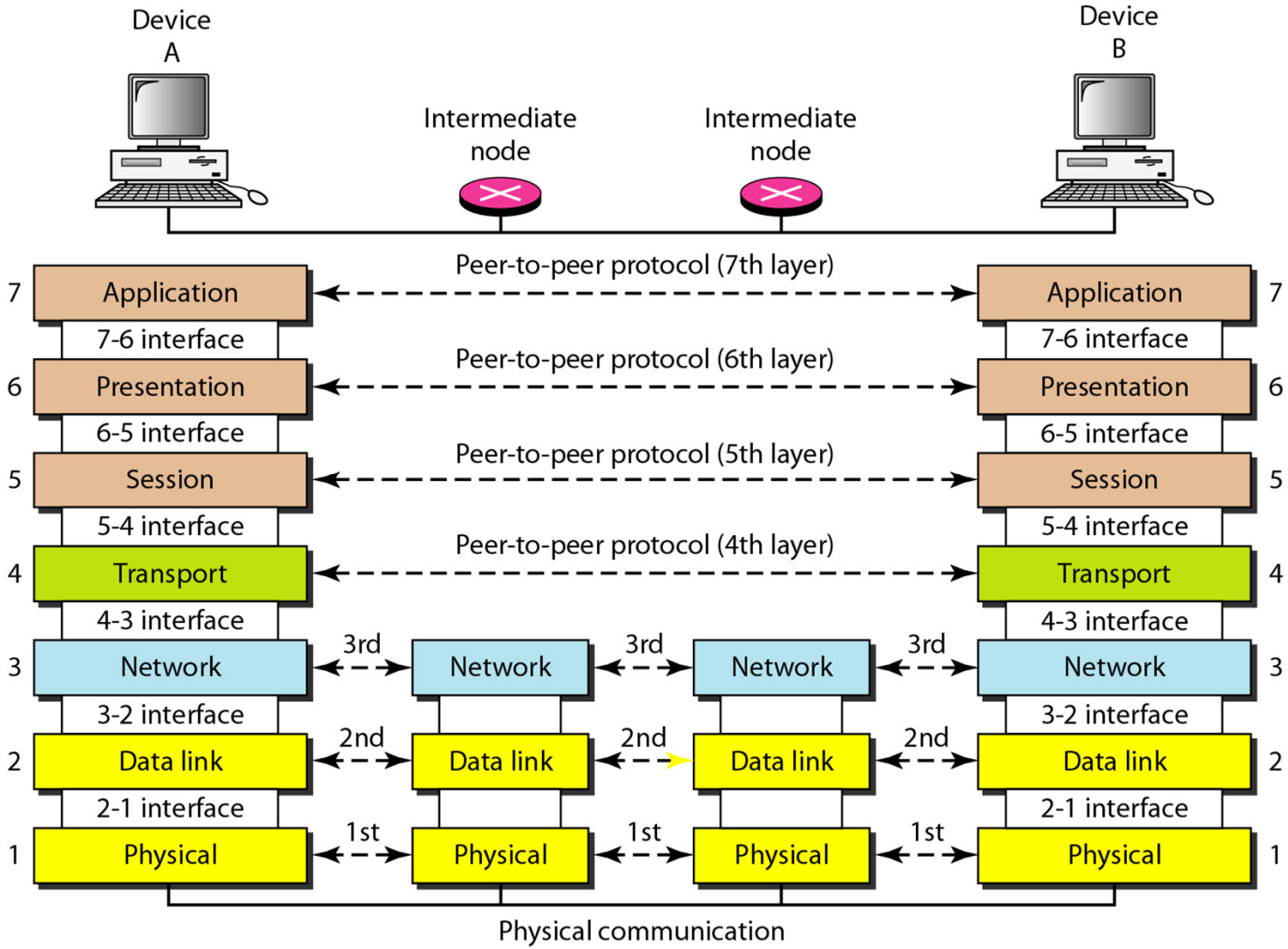


Figure 2.15

Figure 2.3 *The interaction between layers in the OSI model*



TCP/IP Protocol Suite

- 5-layered architecture
- Being used by current Internet

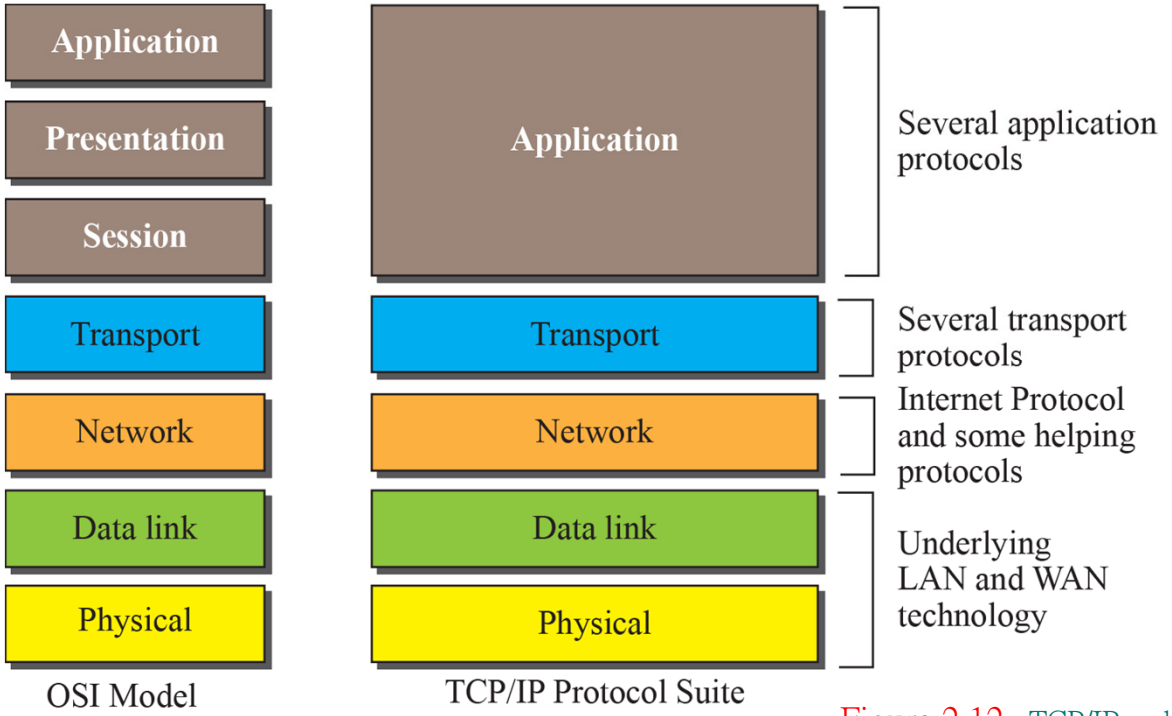


Figure 2.12: TCP/IP and OSI model

Communication through the Internet

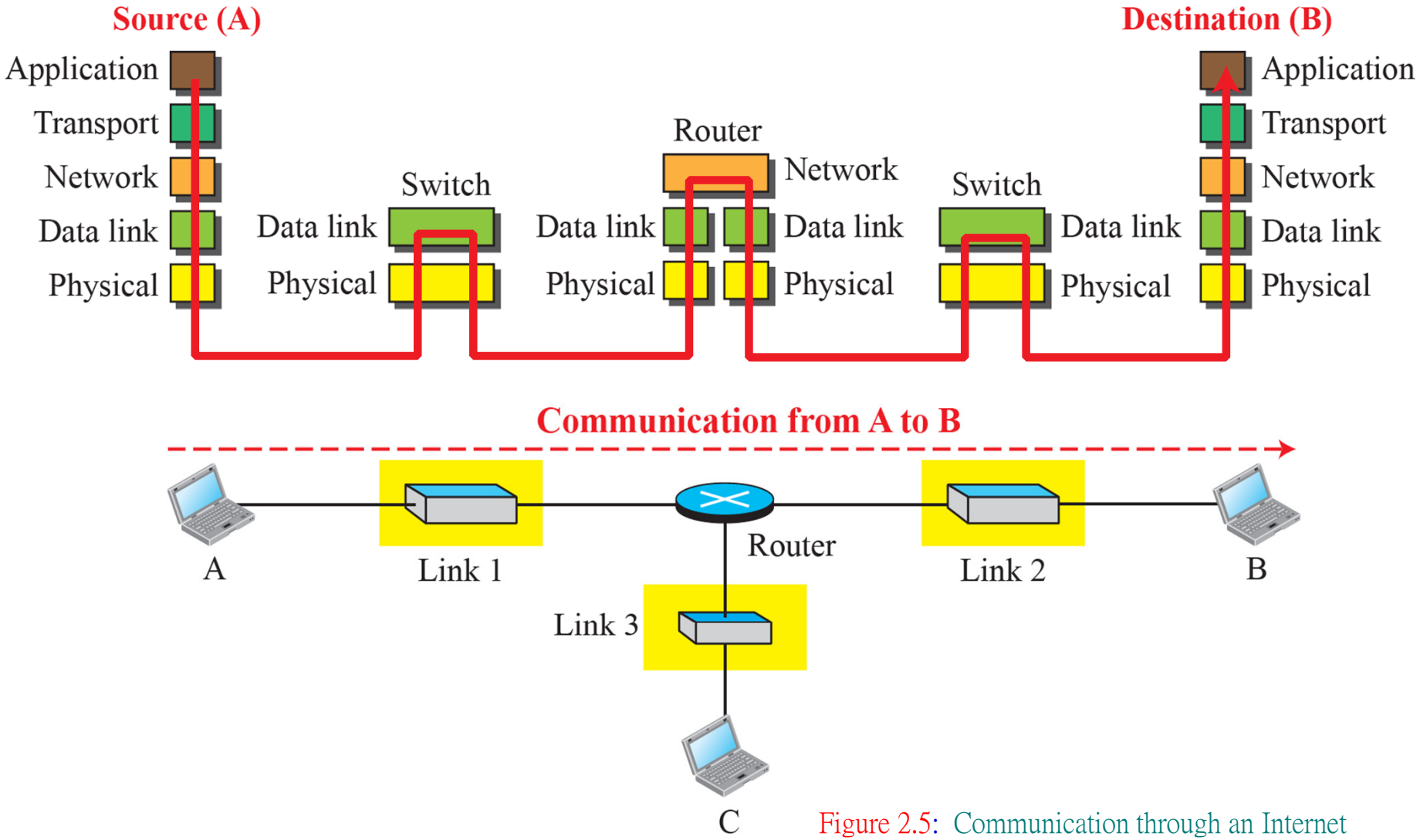


Figure 2.5: Communication through an Internet

How data is transmitted

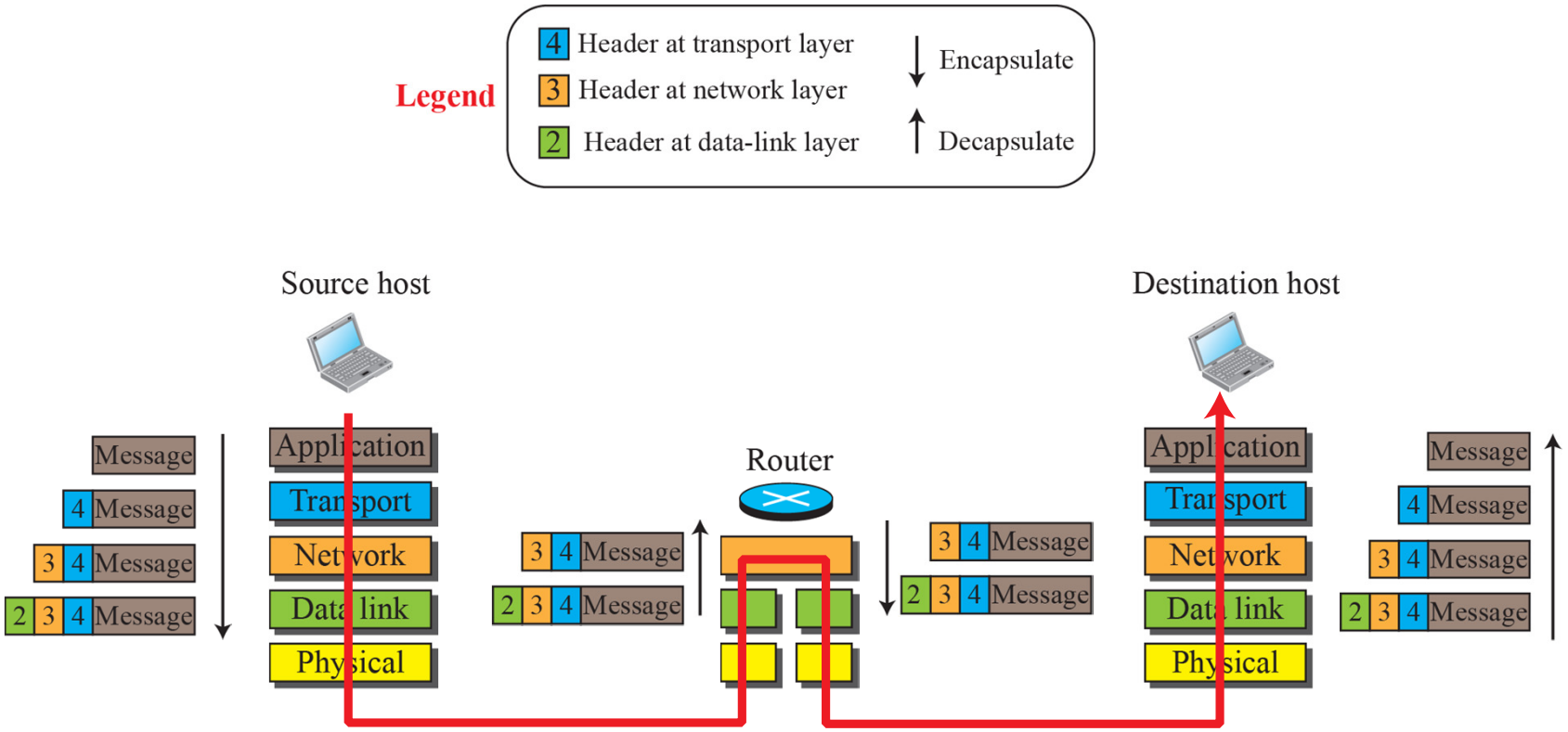


Figure 2.8: Encapsulation / Decapsulation

Examples of Protocols

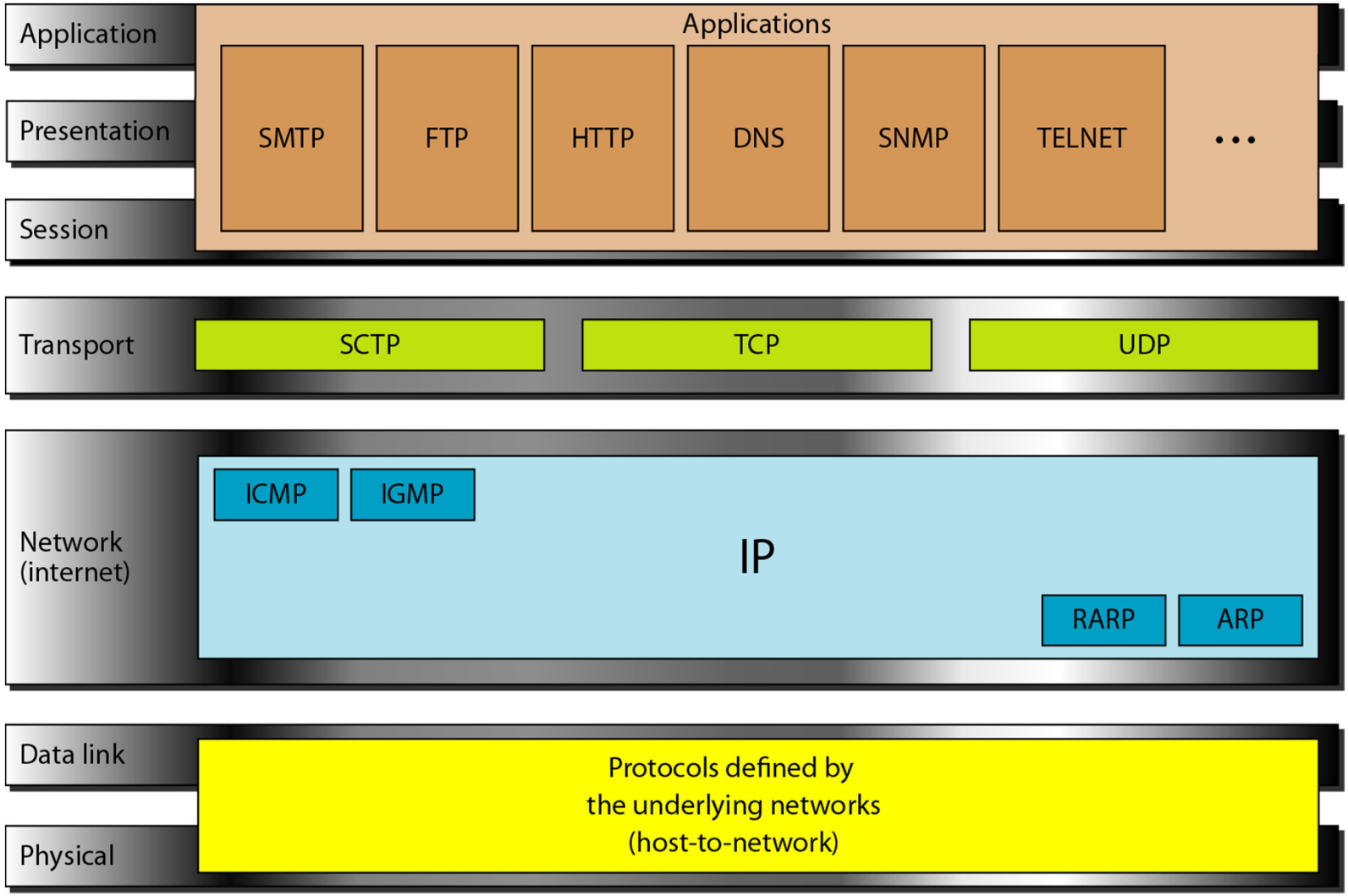


Figure 2.16

Summary

1. **Types of connection: Point-to-point and Multipoint**
2. **Transmission Mode: Simplex, …**
3. **Topology: Mesh, bus, ring, star, hybrid**
4. **OSI Model, TCP/IP protocol suite**

Revision Quiz:

- **Chapter 1**
  - http://highered.mheducation.com/sites/0073376221/student_view0/chapter1/quizzes.html
- **Chapter 2**
  - http://highered.mheducation.com/sites/0073376221/student_view0/chapter2/quizzes.html