



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

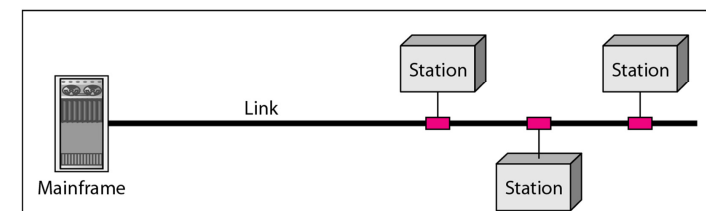
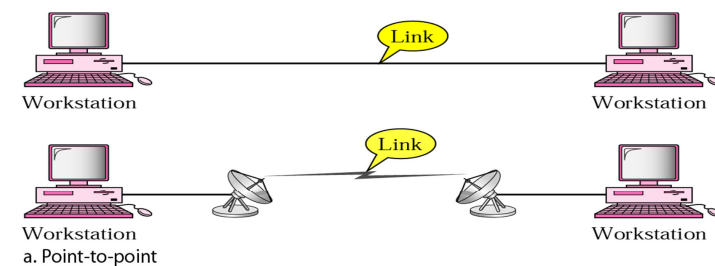
Reliability

- ❖ 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

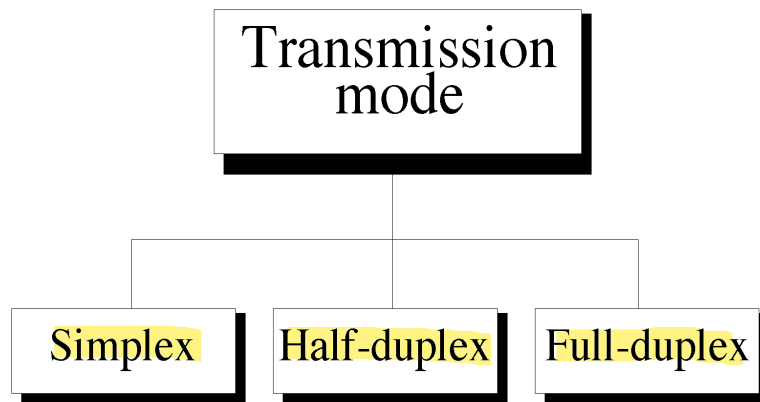
2. Types of Connections

- ❖ 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*

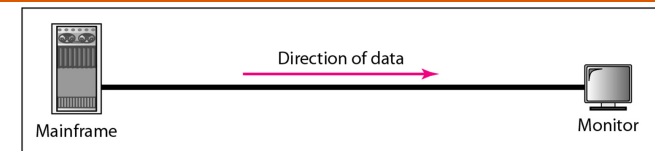


3. Transmission Mode

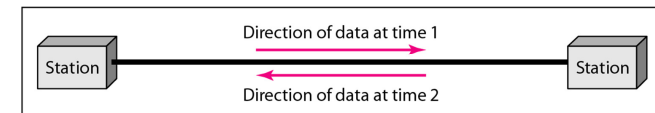


Refers to the direction of information flow

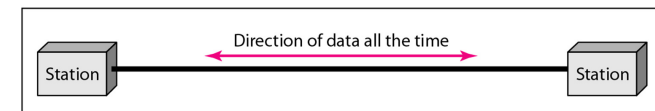
Data flow (simplex, half-duplex, and full-duplex)



a. Simplex - Communication is unidirectional.



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



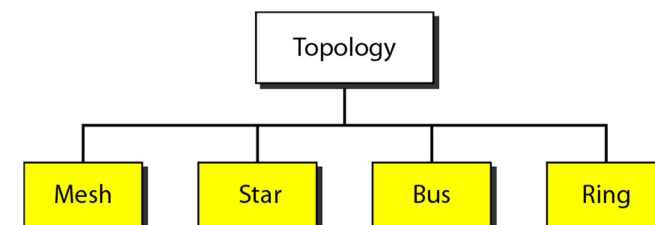
c. Full-duplex - Both stations can transmit and receive simultaneously.

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

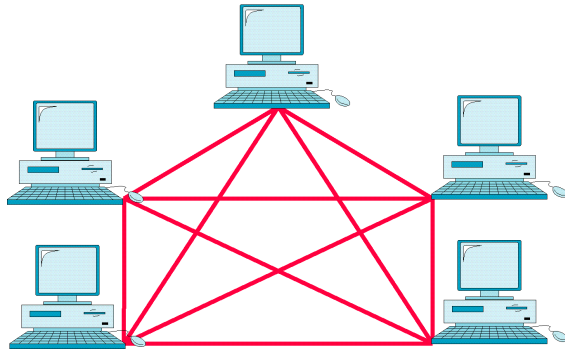
4. Topology

- ❖ 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?*

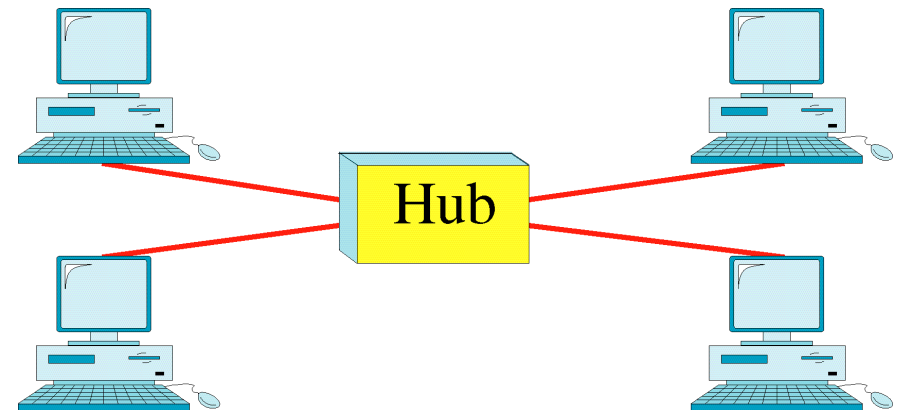
Mesh Topology

- ❖ 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

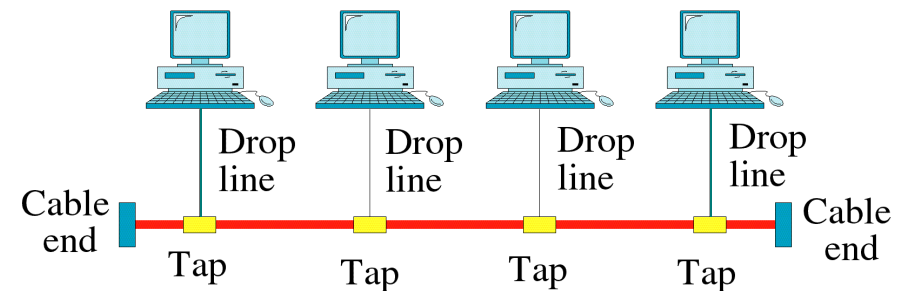
Star Topology



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?)

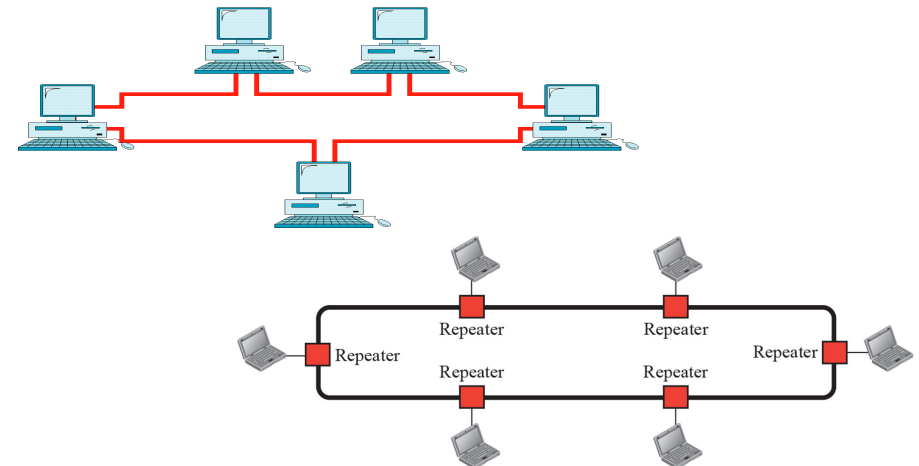
Bus Topology



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

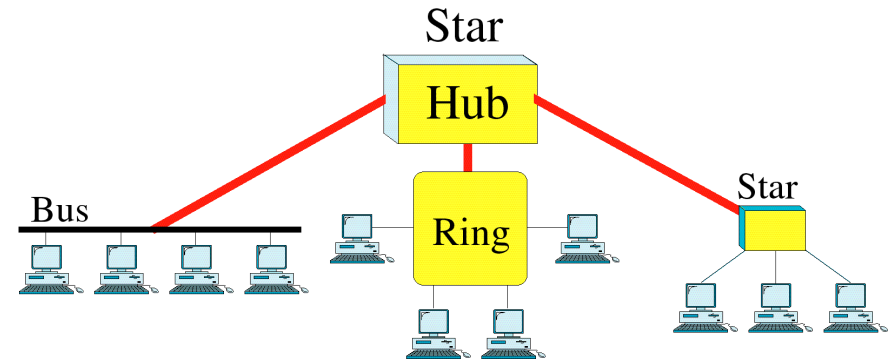
Ring Topology



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

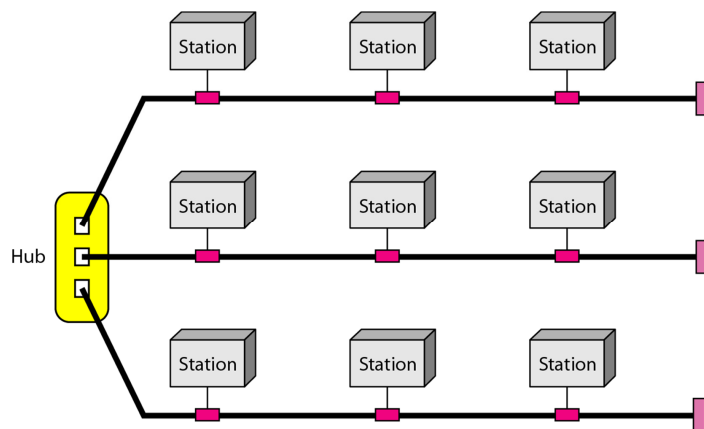
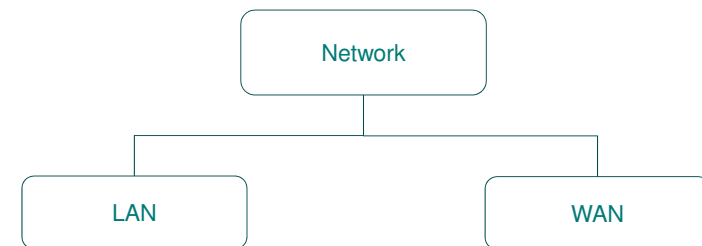


Figure 1.9 A hybrid topology: a star backbone with three bus networks

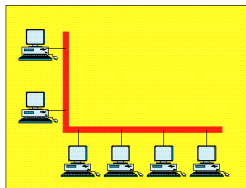
5. Categories of Networks

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

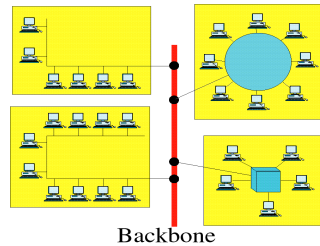


Local Area Network

- ❖ 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.

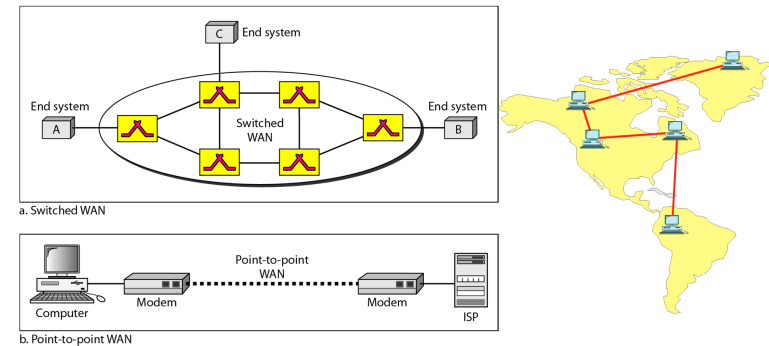
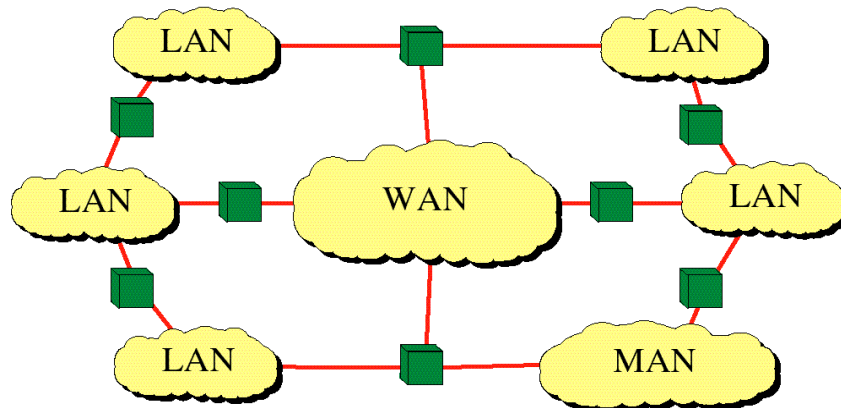


Figure 1.11 WANs: a switched WAN and a point-to-point WAN

Internetwork (Internet) is a network of networks



Example of LAN and WAN

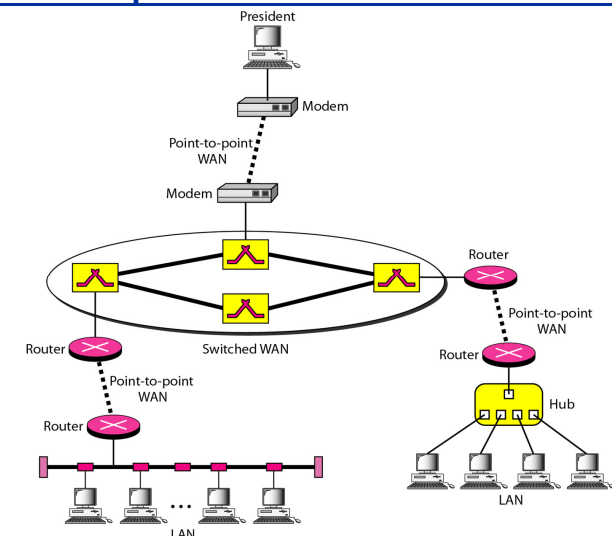


Figure 1.12 A heterogeneous network made of four WANs and two LANs

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

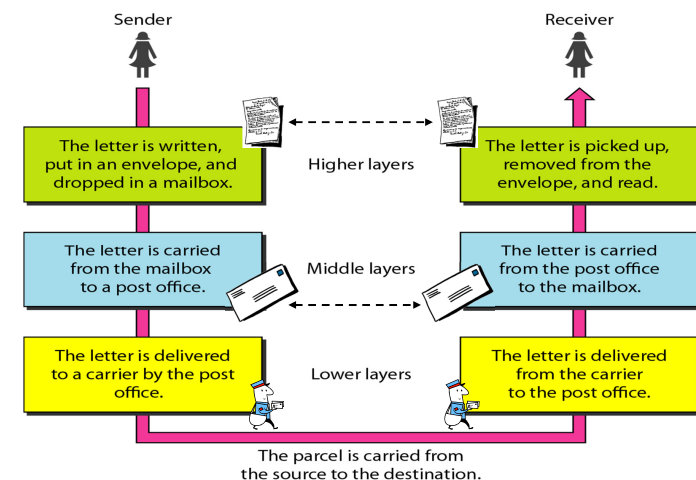
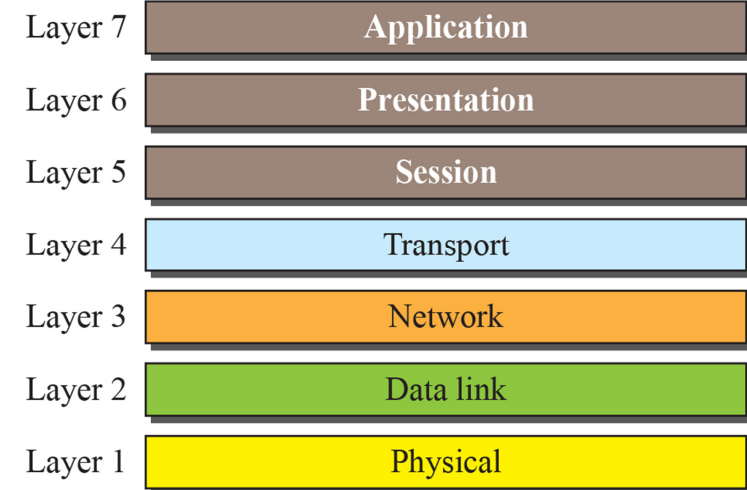


Figure 2.1 Tasks involved in sending a letter

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

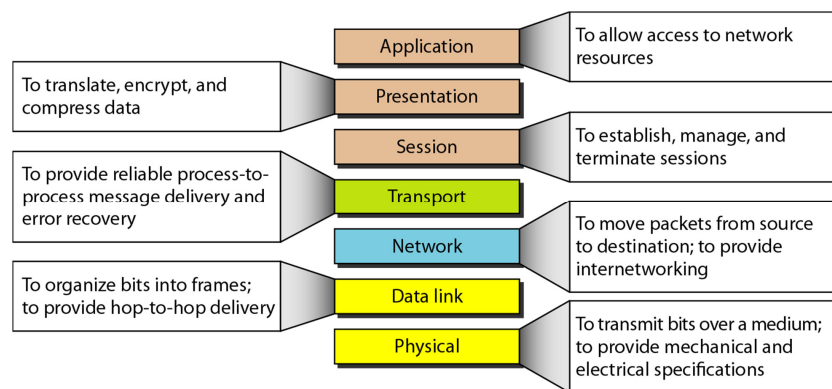
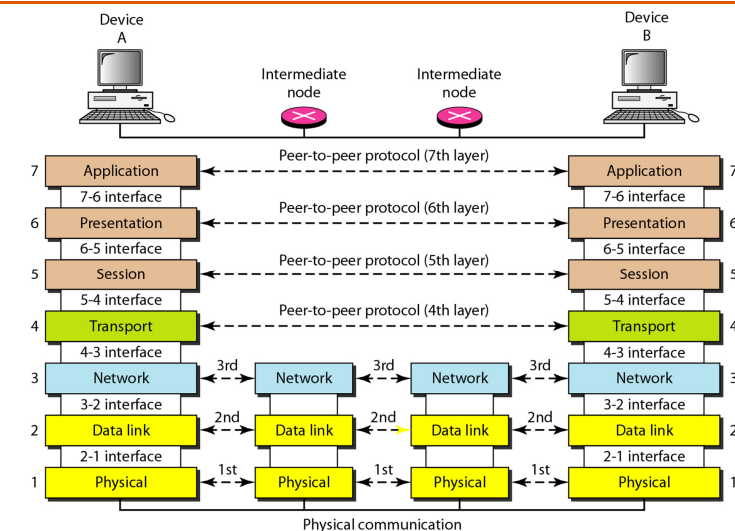


Figure 2.15

Figure 2.3 The interaction between layers in the OSI model



TCP/IP Protocol Suite

- ❖ 5-layered architecture
- ❖ Being used by current Internet

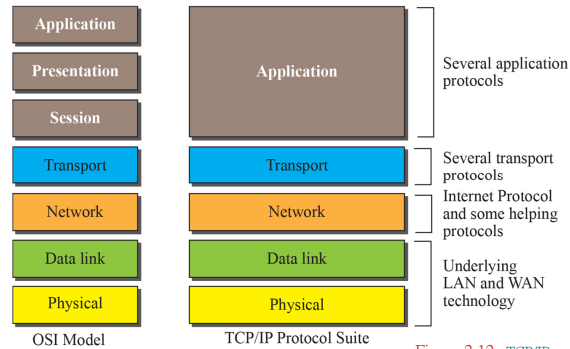


Figure 2.12: TCP/IP and OSI model

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Communication through the Internet

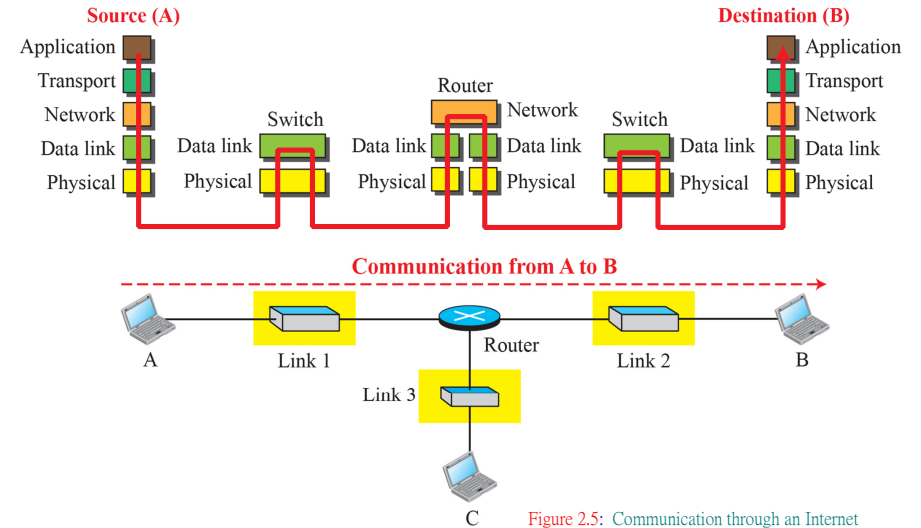


Figure 2.5: Communication through an Internet

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How data is transmitted

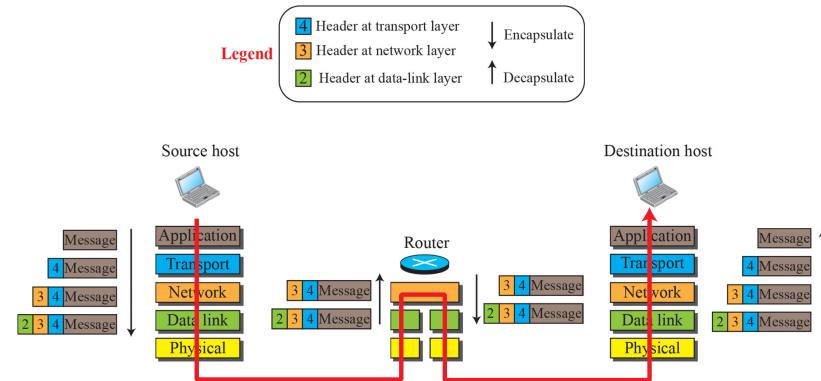


Figure 2.8: Encapsulation / Decapsulation

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Examples of Protocols

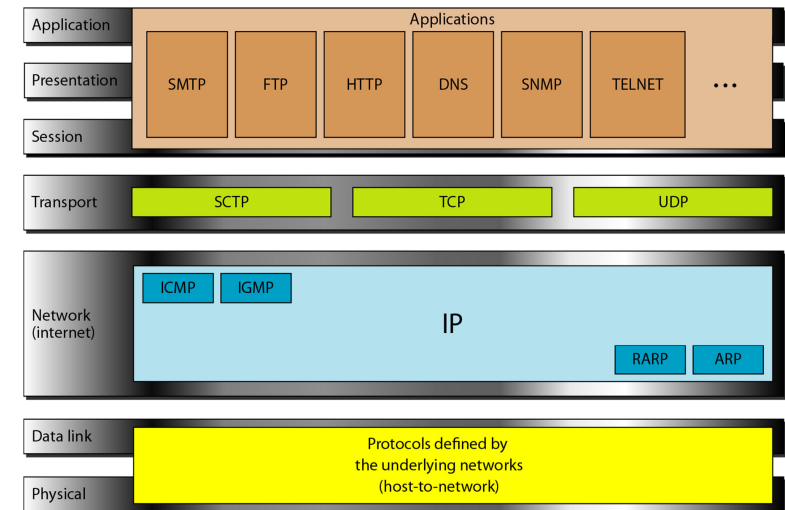


Figure 2.16

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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