- Computer Networks
- Al-Mustansiryah University
- Elec. Eng. Department College of Engineering
  Fourth Year Class

Chapter 1

Introduction

1-1 DATA COMMUNICATIONS

Telecommunication means communication at a distance.

Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Figure 1.1 Components of a data communication system

The five components that make up a data communications system are the **Message, sender, receiver, medium, and protocol**.

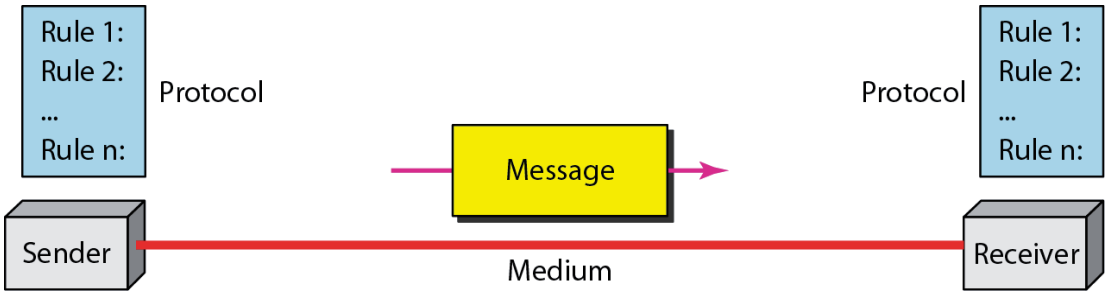
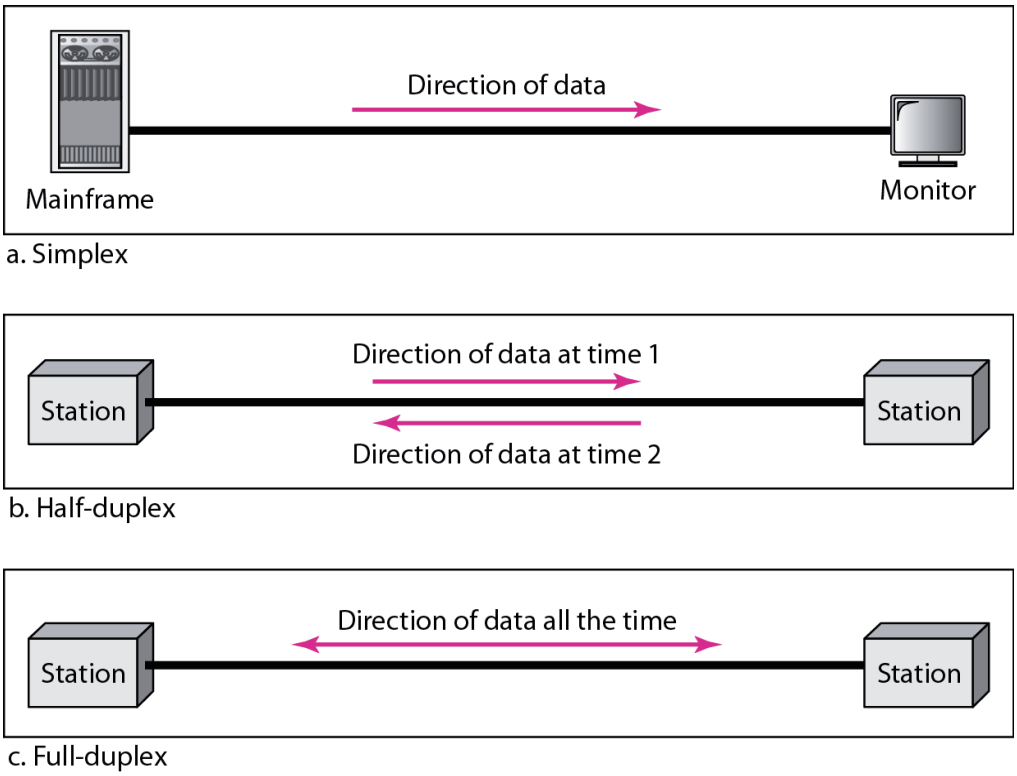


Figure 1.2 Data flow (simplex, half-duplex, and full-duplex)



1-2 NETWORKS

A network is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network. A link can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.

Network Criteria

- Performance
  - Depends on Network Elements
  - Measured in terms of Delay and Throughput
- Reliability
  - Failure rate of network components
  - Measured in terms of availability/robustness
- Security
  - Data protection against corruption/loss of data due to:
    - Errors
    - Malicious users

Physical Structures

- **Type of Connection**
  - **Point to Point - single transmitter and receiver**
  - **Multipoint - multiple recipients of single transmission**
- **Physical Topology**
  - **Connection of devices**
  - **Type of transmission - unicast, mulitcast, broadcast**

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

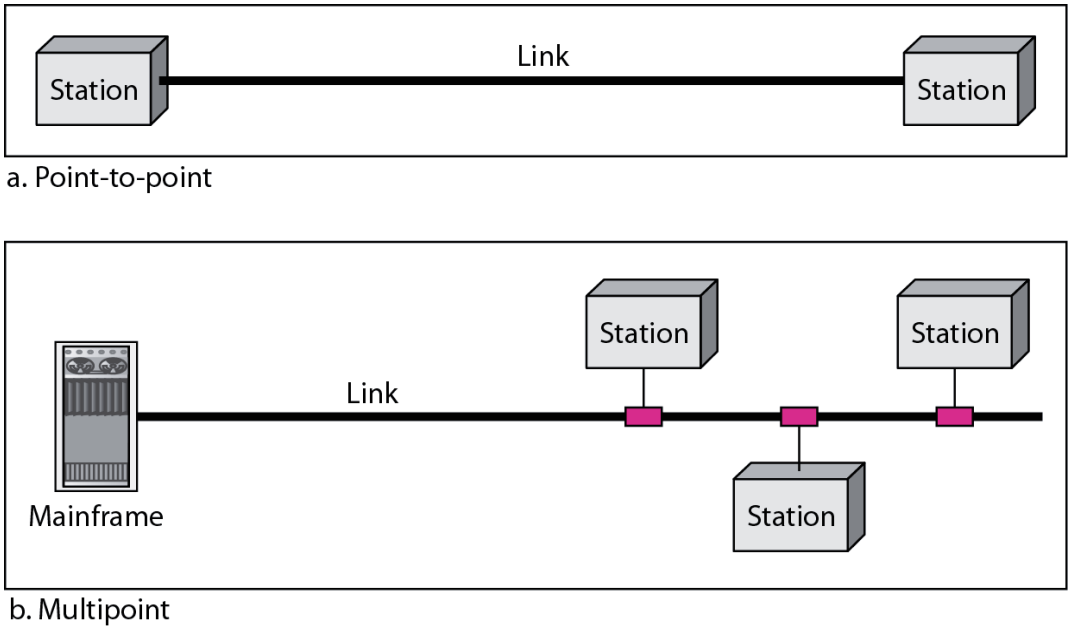


Figure 1.4 *Categories of topology*

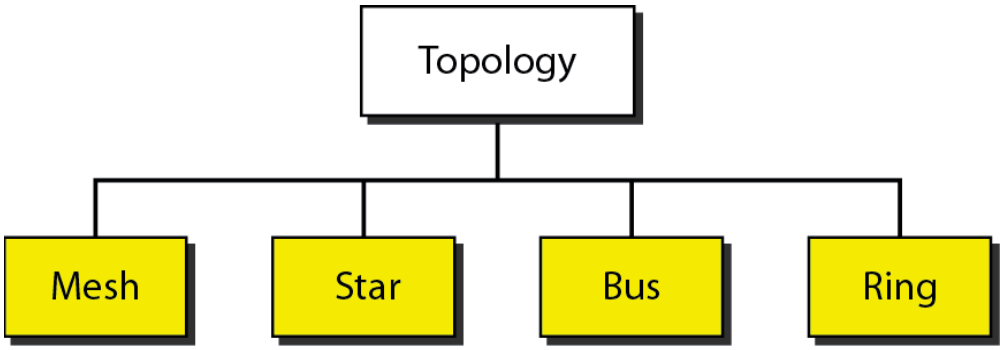
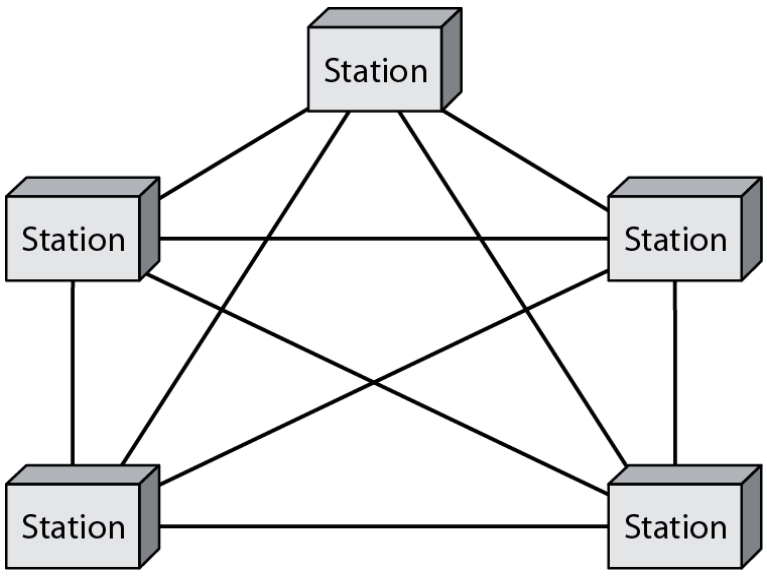


Figure 1.5 *A fully connected mesh topology (five devices)*



In mesh topology, we need *n(n -1) /2* duplex-mode links

Advantage of mesh topology

1- Use of dedicated links guarantees that each connection can carry its own data load.

2- Robust. If one link becomes unusable, it does not incapacitate the entire system.

3- Security. When every message travels along a dedicated line, only the intended recipient sees it.

4- Point-to-point links make fault identification and fault isolation easy.

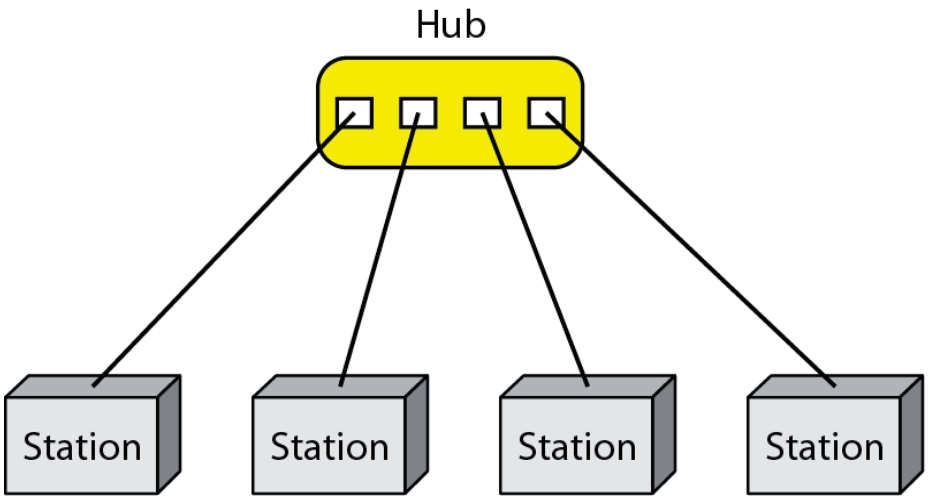
Disadvantage of mesh topology

1- The amount of cabling because every device must be connected to every other device.

2- The number of I/O ports required.

3- The hardware required to connect each link can be prohibitively expensive.

Figure 1.6 *A star topology connecting four stations*



Advantage of Star topology

1- Less expensive than a mesh topology.

2- Easy to install and reconfigure. Far less cabling needs to be housed.

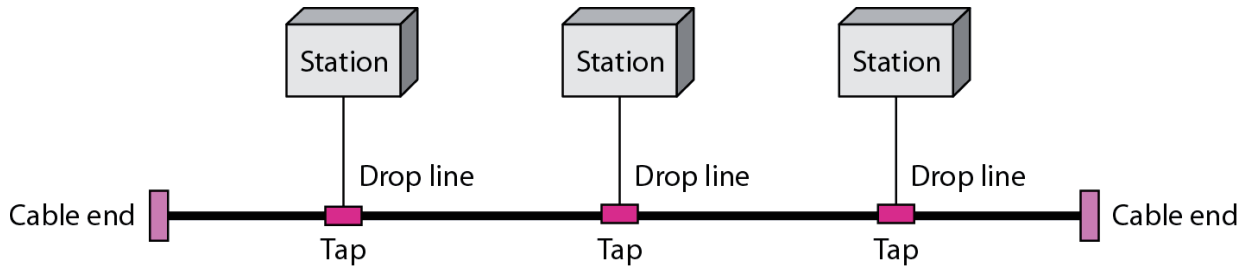
3- Include robustness.

Disadvantage of Star topology

1- the dependency of the whole topology on one single point.

2- more cabling is required in a star than in some other topologies (such as ring or bus).

Figure 1.7 *A bus topology connecting three stations*



Advantage of Bus topology

1- Ease of installation.

2- Less cabling than mesh or star topologies.

3- Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths.

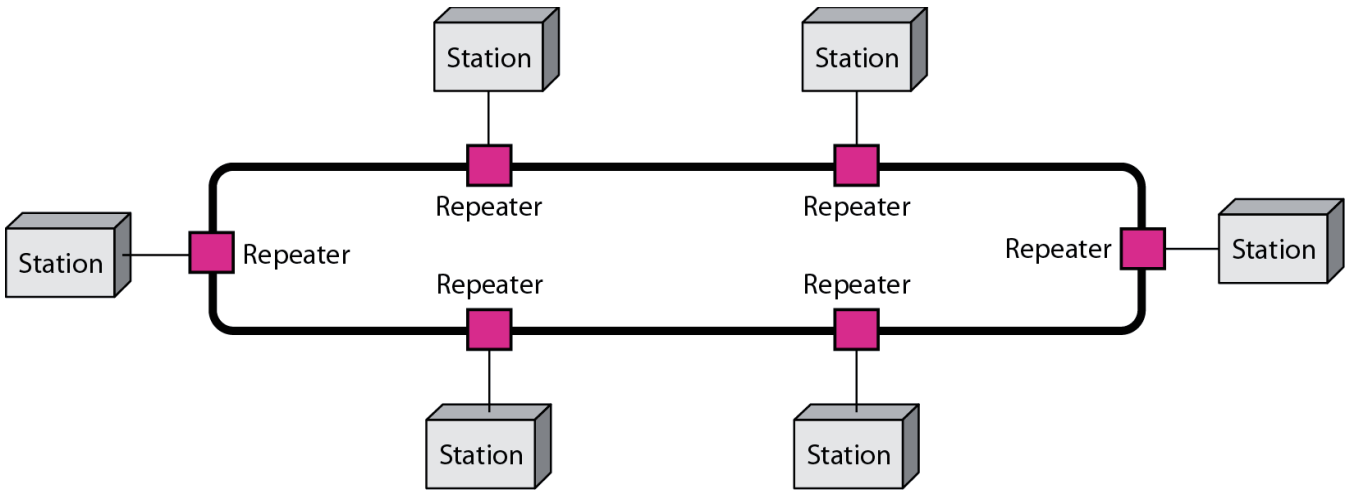
Disadvantage of Bus topology

1- Difficult reconnection and fault isolation.

2- Signal reflection at the taps can cause degradation in quality.

3- Fault or break in the bus cable stops all transmission.

Figure 1.8 *A ring topology connecting six stations*



Advantage of Ring topology

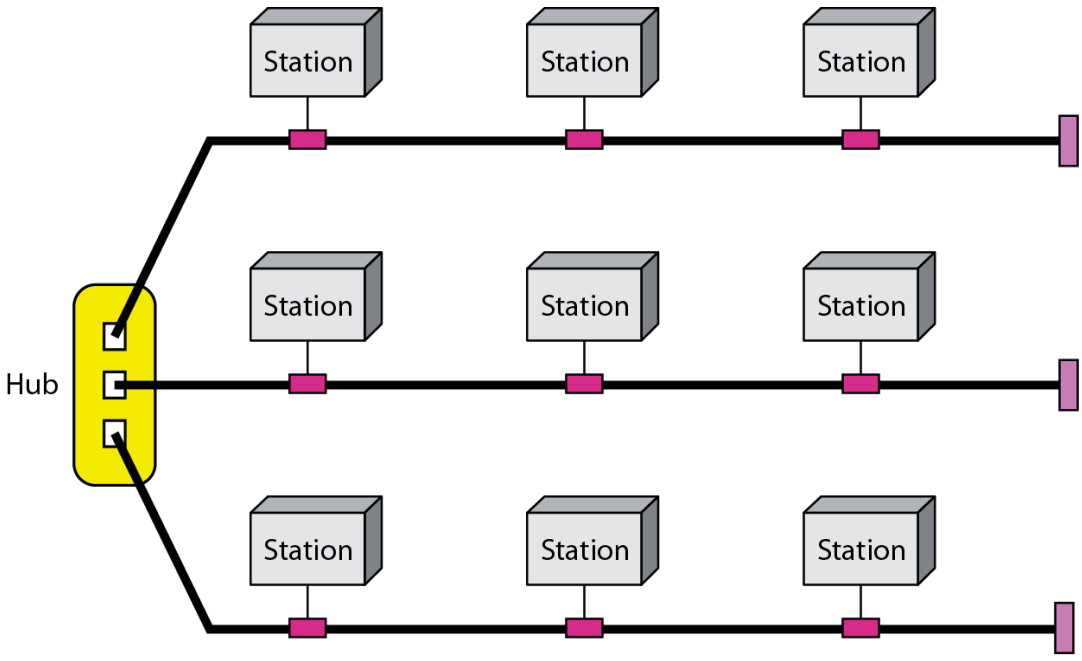
1- Easy to install and reconfigure.

2- Fault isolation is simplified.

Disadvantage of Ring topology

- Unidirectional traffic.

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



Categories of Networks

- Local Area Networks (LANs)
  - Short distances
  - Designed to provide local interconnectivity
- Wide Area Networks (WANs)
  - Long distances
  - Provide connectivity over large areas
- Metropolitan Area Networks (MANs)
  - Provide connectivity over areas such as a city, a campus

Figure 1.10 *An isolated LAN connecting 12 computers to a hub in a closet*

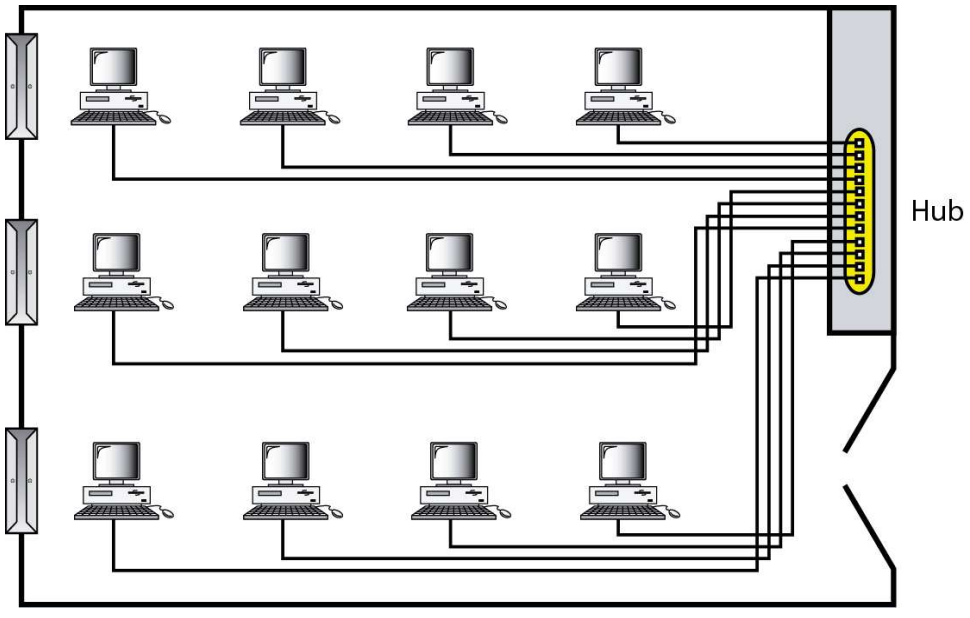
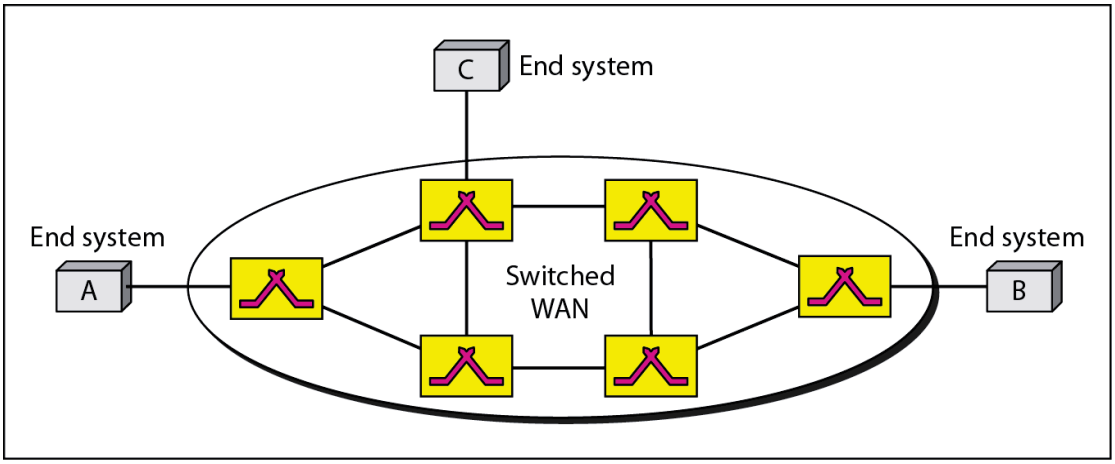
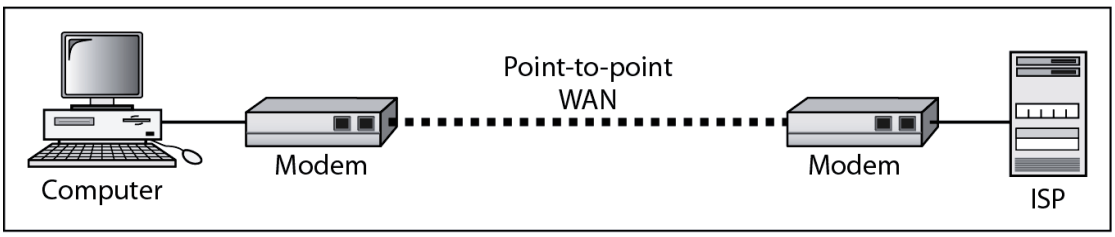


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*



a. Switched WAN



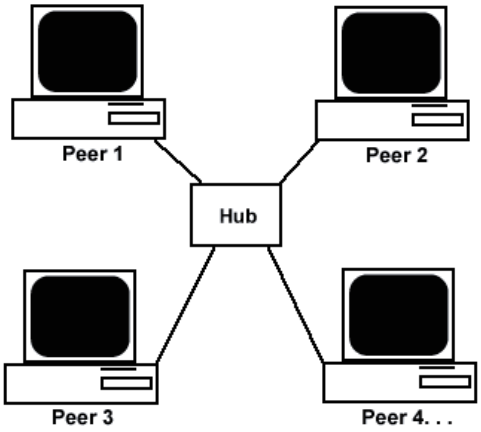
b. Point-to-point WAN

1-4 PROTOCOLS

A protocol is synonymous with rule. **It consists of a set of rules that govern data communications. It determines what is communicated, how it is communicated and when it is communicated.** The key elements of a protocol are syntax, semantics and timing

Peer-to-Peer Networks

- Peer-to-peer network is also called workgroup
- No hierarchy among computers ⇒ all are equal
- No administrator responsible for the network



Peer-to-peer

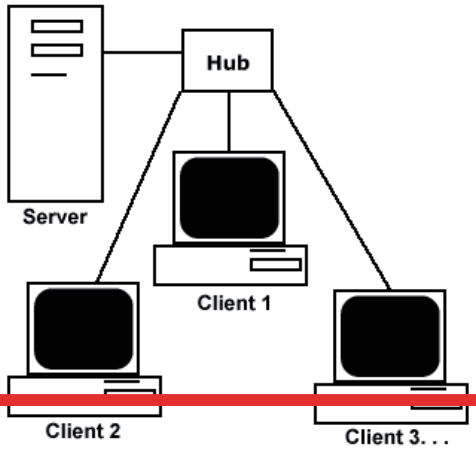
- Advantages of peer-to-peer networks:
  - Low cost
  - Simple to configure
  - User has full accessibility of the computer

- Disadvantages of peer-to-peer networks:
  - May have duplication in resources
  - Difficult to uphold security policy

- Where peer-to-peer network is appropriate:
  - 10 or less users
  - No specialized services required
  - Security is not an issue

Clients and Servers

- Network Clients (Workstation)
  - Computers that request network resources or services
- Network Servers
  - Computers that manage and provide network resources and services to clients
    - Usually have more processing power, memory and hard disk space than clients
    - Run Network Operating System that can manage not only data, but also users, groups, security, and applications on the network.



- Advantages of client/server networks
  - Facilitate resource sharing – centrally administrate and control
  - Facilitate system backup and improve fault tolerance
  - Enhance security – only administrator can have access to Server
  - Support more users – difficult to achieve with peer-to-peer networks

- Disadvantages of client/server networks
  - High cost for Servers
  - Need expert to configure the network
  - Introduce a single point of failure to the system