ES623 Networked Embedded Systems

Introduction to Network models & Data Communication

16th April 2013

Data Communication

- Sharing information

- Sharing can be local or remote

- Exchange of data between two devices via transmission medium

- made up of hardware and software

Characteristics

- **Delivery :** System must deliver data to correct destination. Data must be received by only intended device or user.

- **Accuracy**

- **Timeliness**

- **Jitter**
  - Variation in the packet arrival time.
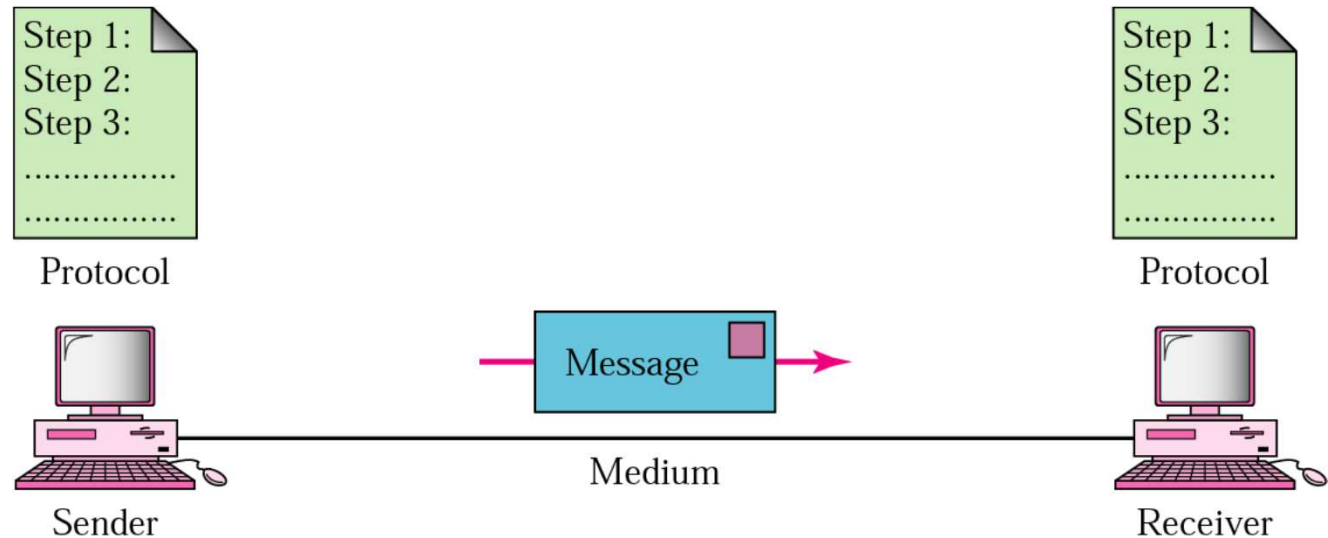
Components

- **Message**

- **Sender**

- **Receiver**

- **Medium**
  - physical path

- **Protocol**
  - set of rules
  - Agreement between commn. devices

Networks

- Set of devices or nodes connected by media links

- Use distributed processing
  - Task is divided among multiple computers

- Advantages
  - Security/encapsulation
  - Distributed databases
  - Faster problem solving
  - Security through redundancy

Network Criteria

- **Performance**
  - Transit time and response time
  - Number of users
  - Type of transmission medium
  - Hardware
  - Software
- **Reliability**
  - Frequency of failure
  - Recovery time of a network after a failure
  - Catastrophe
- **Security**
  - Unauthorized access

Protocols

- What is communicated, how it is communicated, and when it is communicated
- Key elements
  - Syntax
    - Structure or format of data

  - Semantics
    - Meaning of each section of bits

  - Timing
    - When and how fast data can be sent

Direction of Data Flow

- **Simplex**
  - communication is unidirectional
  - Only one of the two devices on a link can transmit; the other can only receive
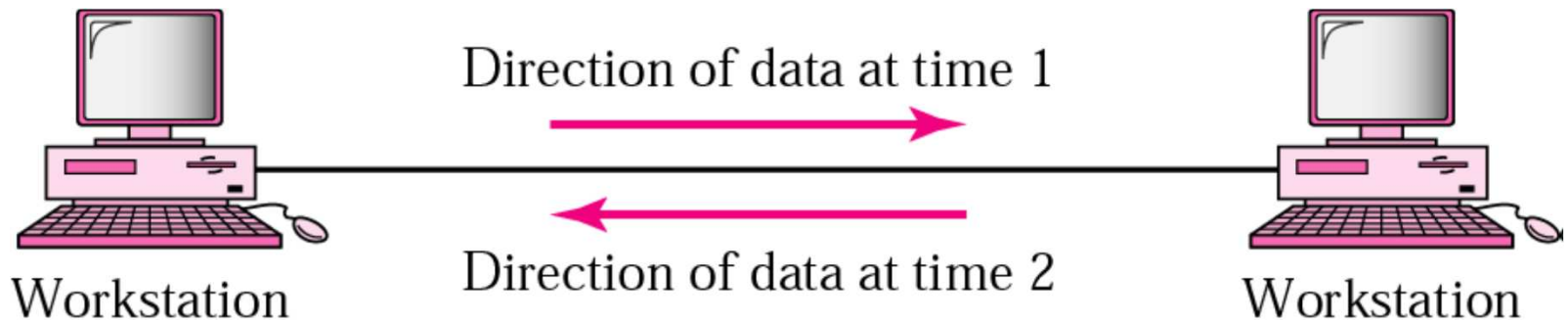

Direction of data

Mainframe

Monitor
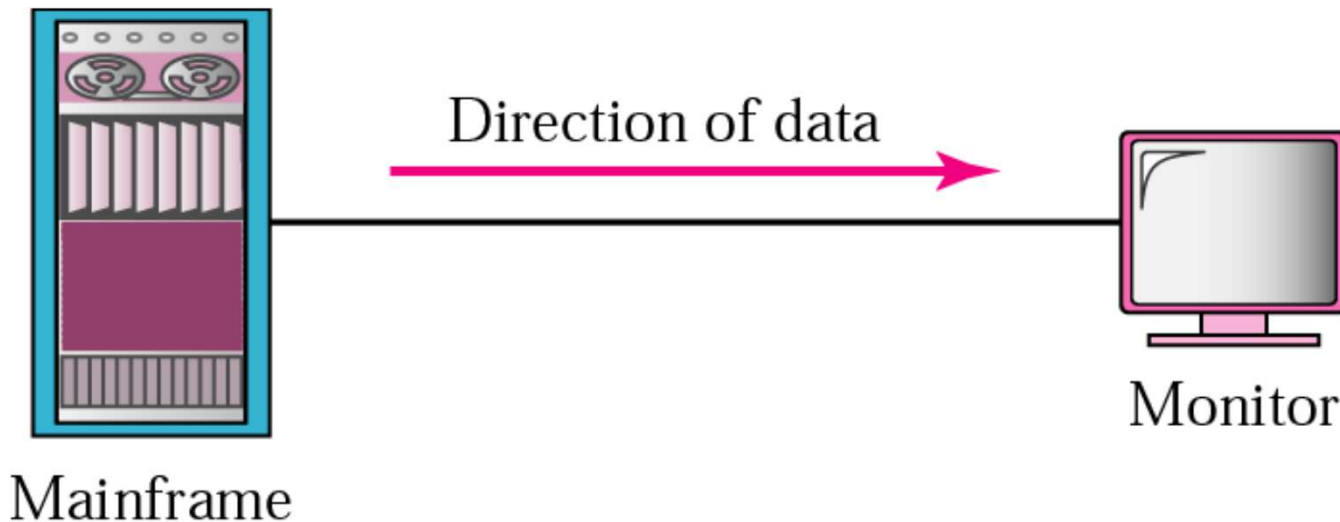
Direction of Data Flow

- ## Half duplex
  - Each station can both transmit and receive , **but not at the same time.**
  - When one device is sending the other can receive and vice versa

Direction of data at time 1

Direction of data at time 2

Workstation

Workstation

Direction of Data Flow

- **Full duplex**
  - Both stations can transmit and receive simultaneously

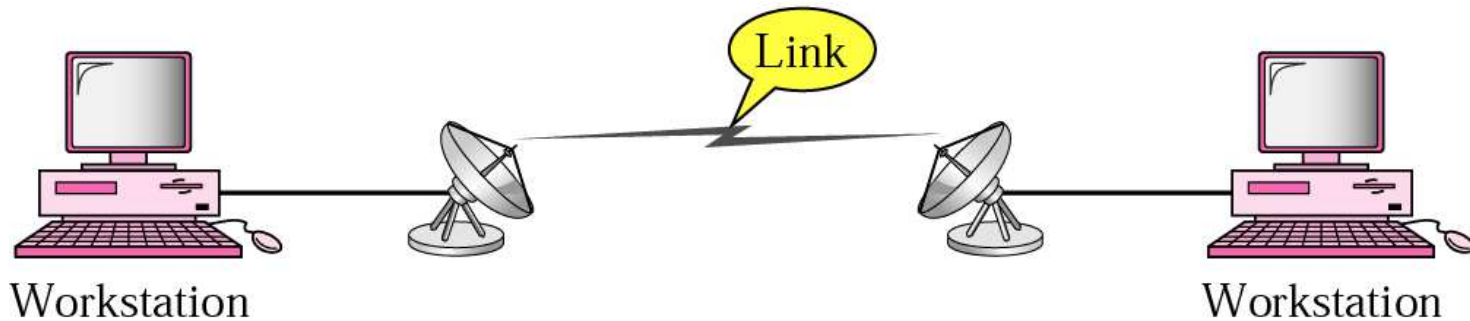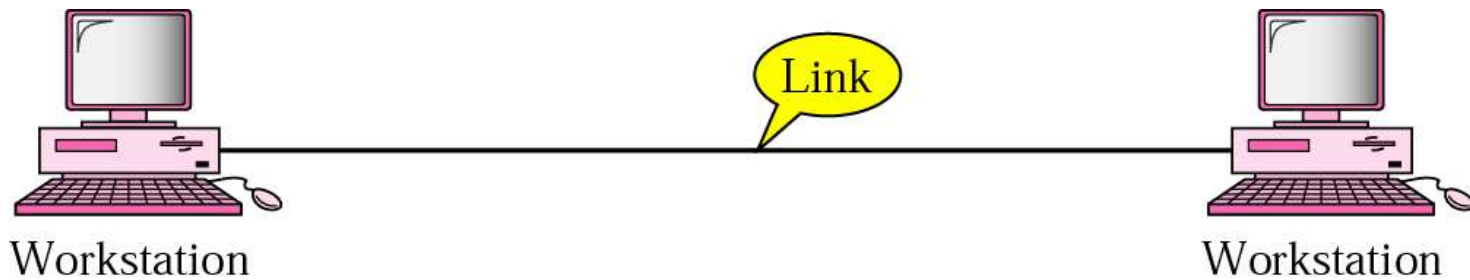Direction of data all the time

Workstation

Workstation
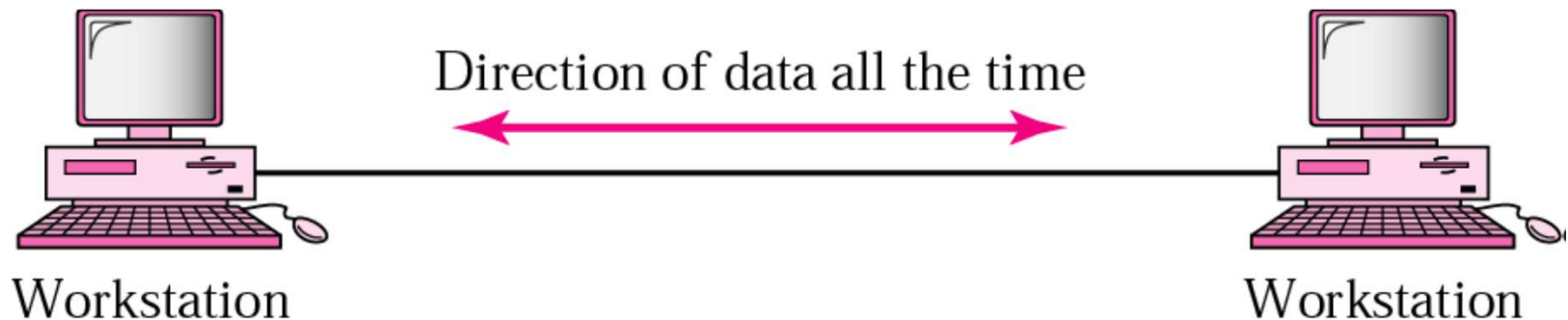
Network Physical Structure

- *Link* physical communication pathway that transfers data from one device to another

- More communication devices attached to a link is line configuration

  - Point-to-point line configuration

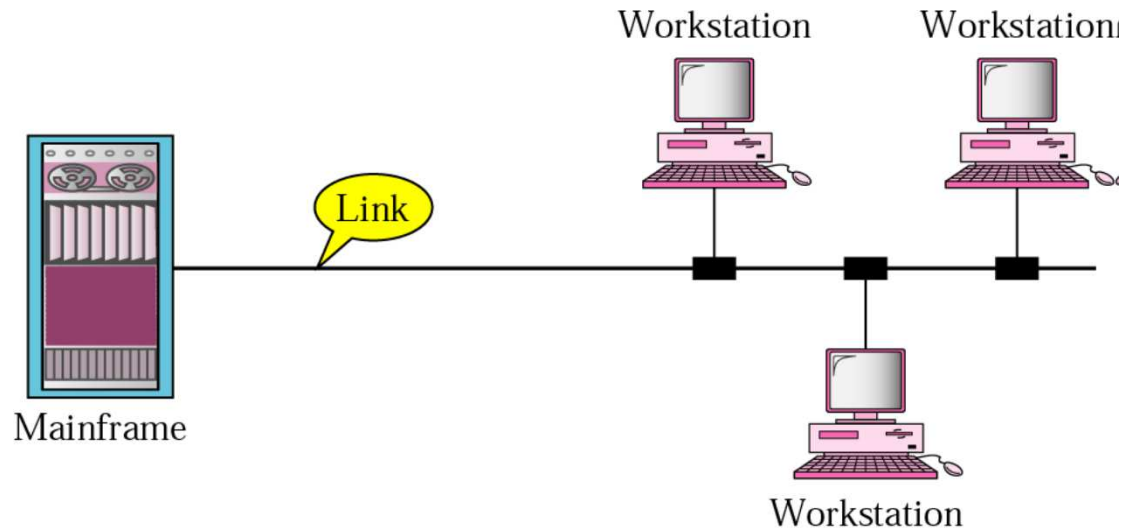 - Multipoint line configuration
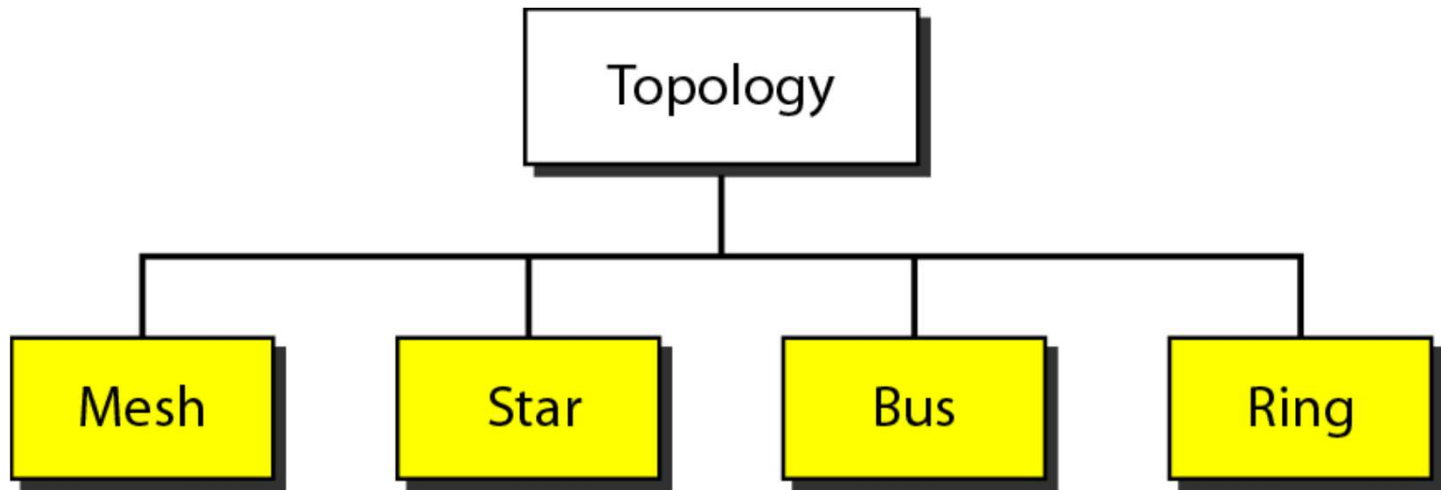
Point-to-point

- Dedicated link between two devices

Multipoint

- More than two devices share a single line.
- Capacity is shared either
- Spatially
  - Several devices can use link simultaneously
- Temporally
 - Users take turns , it is a timeshared

Physical topology

- Way in which a network is laid out physically.

- Geometric representation of relationship of all the links and linking devices (nods) to one another.

Mesh topology

- Every device has a dedicated point-to-point link to every other devices
- Fully connected mesh network has $n(n-1)/2$ physical connection to link n devices.
- Every device on the network must have $n-1$ input/output (I/O) ports
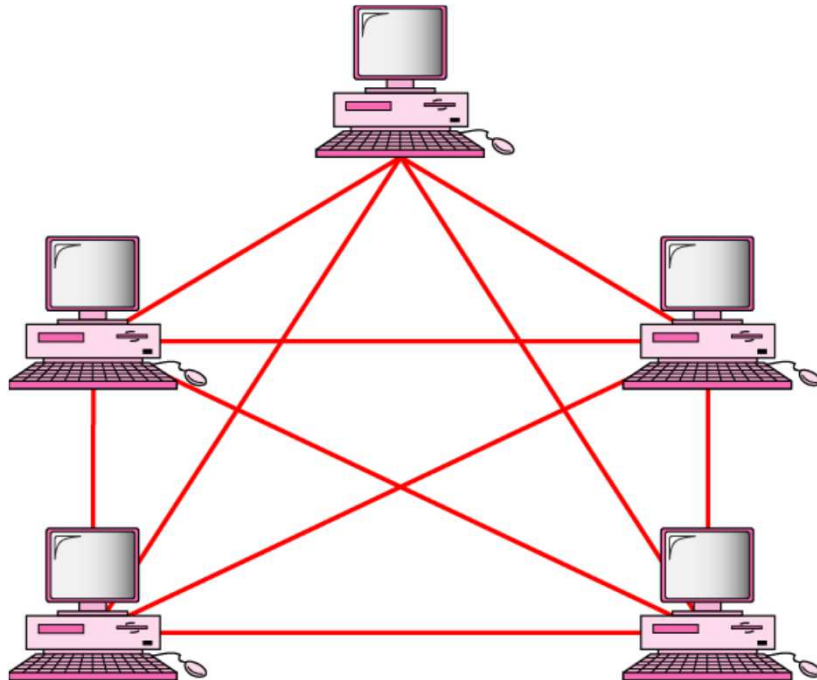
Mesh topology

Advantages

- **Privacy or security** : every message travels along a dedicated line, only the intended recipient sees it.

- **Eliminating the traffic problems**: dedicated links guarantees that each connection can carry its own data load

- **A mesh is robust**. If one link becomes unusable, it does not incapacitate the entire system.

- **Fault identification and fault isolation** easy.

Mesh topology

Disadvantages

- installation and reconnection are difficult

- Hardware required to connect each link (I/O ports and cable) expensive

Star topology

- Every device has a dedicated point-to-point link only to a central controller (hub)

- Does not allow direct traffic between devices, if one device want to send data to another, it send it to the hub, which send it to other device
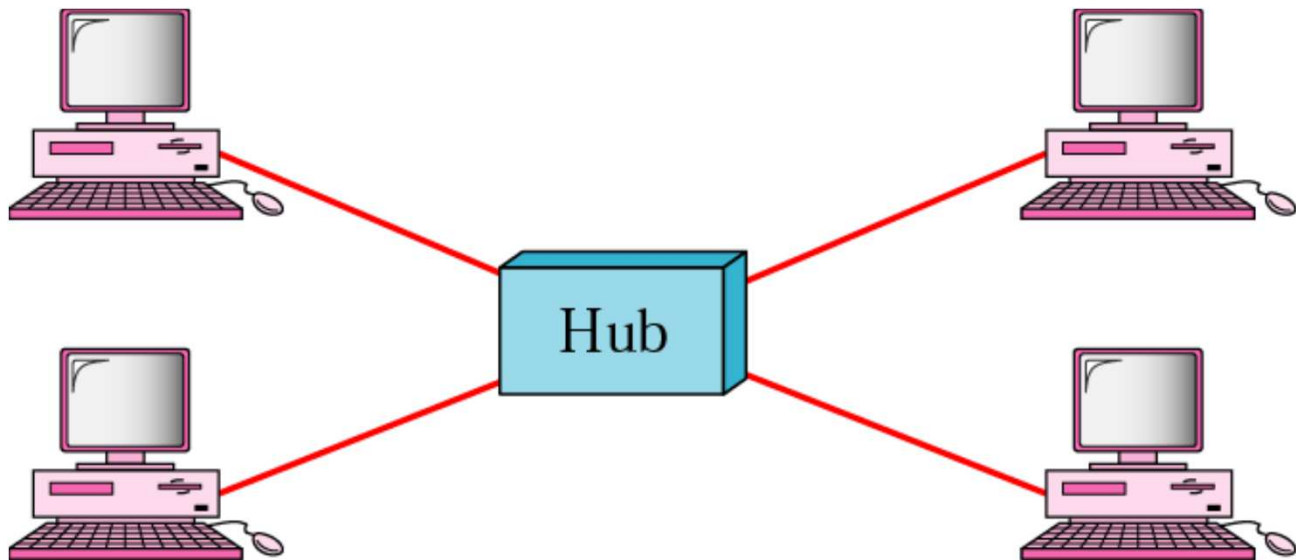
Star topology

Advantages

- Easy to install and reconfigure and less expensive
  - Need only one link and I/O port to connect it to any other devices
- Robustness
  - if one link fails, only that link affected and other links remain active.
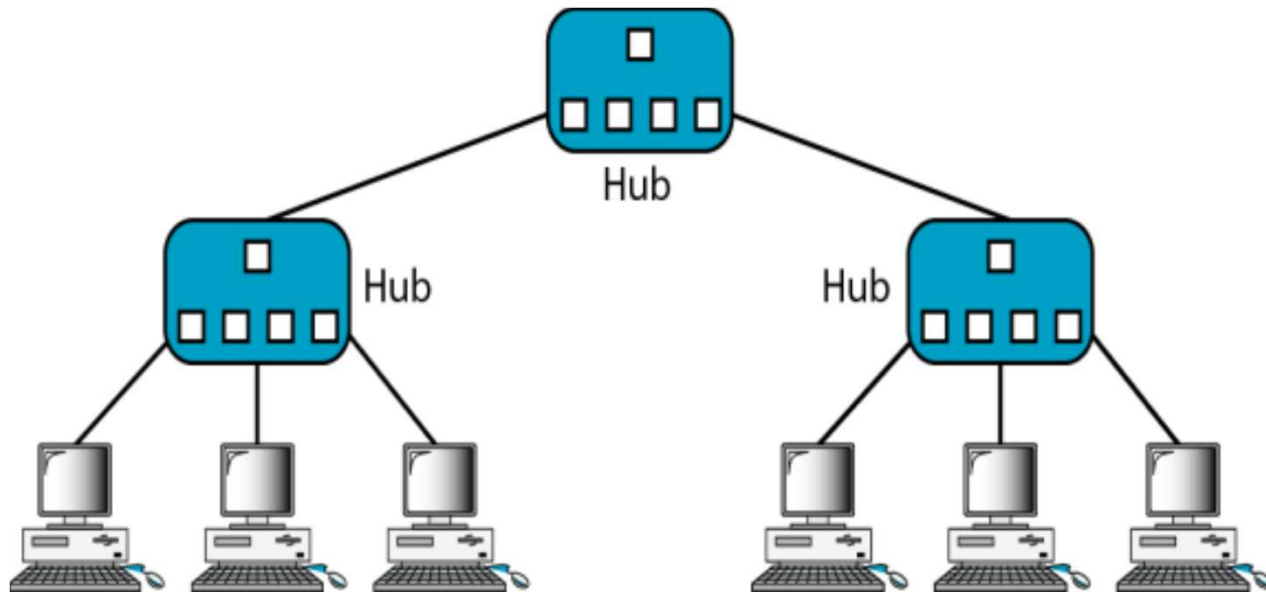- Identification and fault isolation

Disadvantages

- dependency of the whole topology on one single point, the hub.

Tree topology

- Allow more devices to be attached to a single central hub, therefore increase the distance a signal can travel between devices.
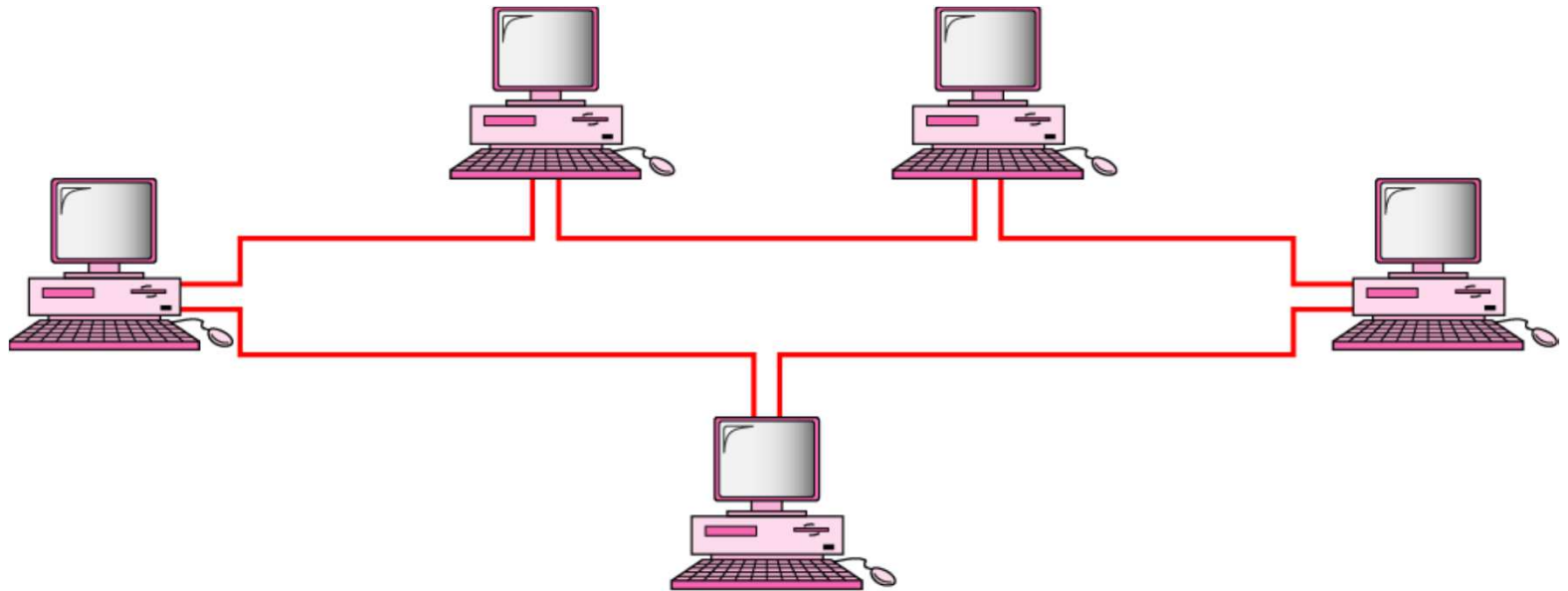
- Example : Cable TV technology

Bus topology

- Multipoint connection

- link all the devices in a network

- There is a limit on the number of taps a bus can support and on the distance between those taps
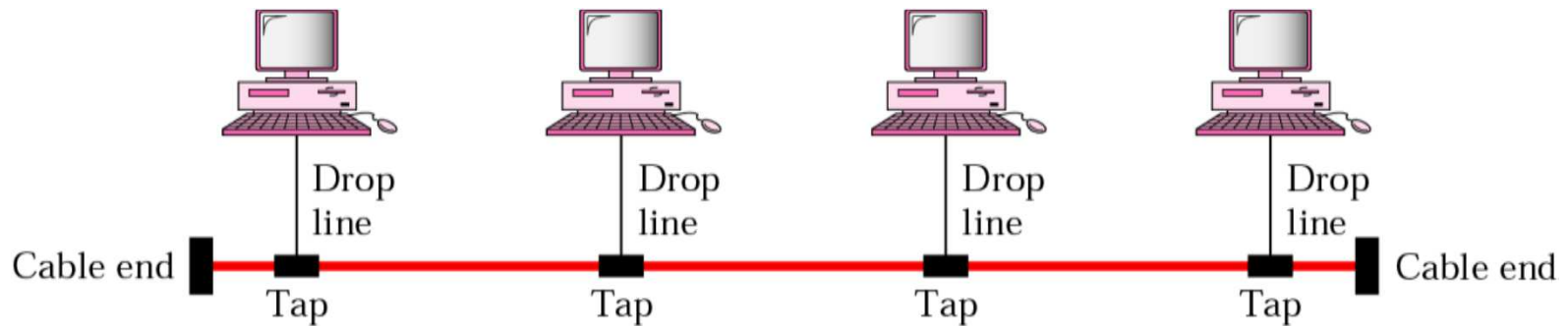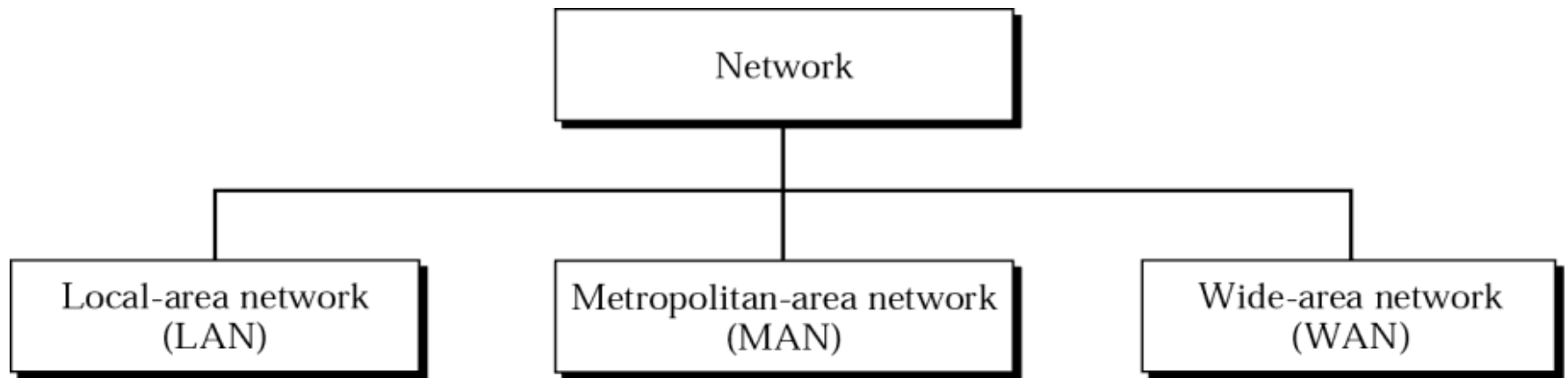
Ring topology

- Dedicated point-to-point connection
- A signal is passed along the ring in one direction from device until it reaches its destination
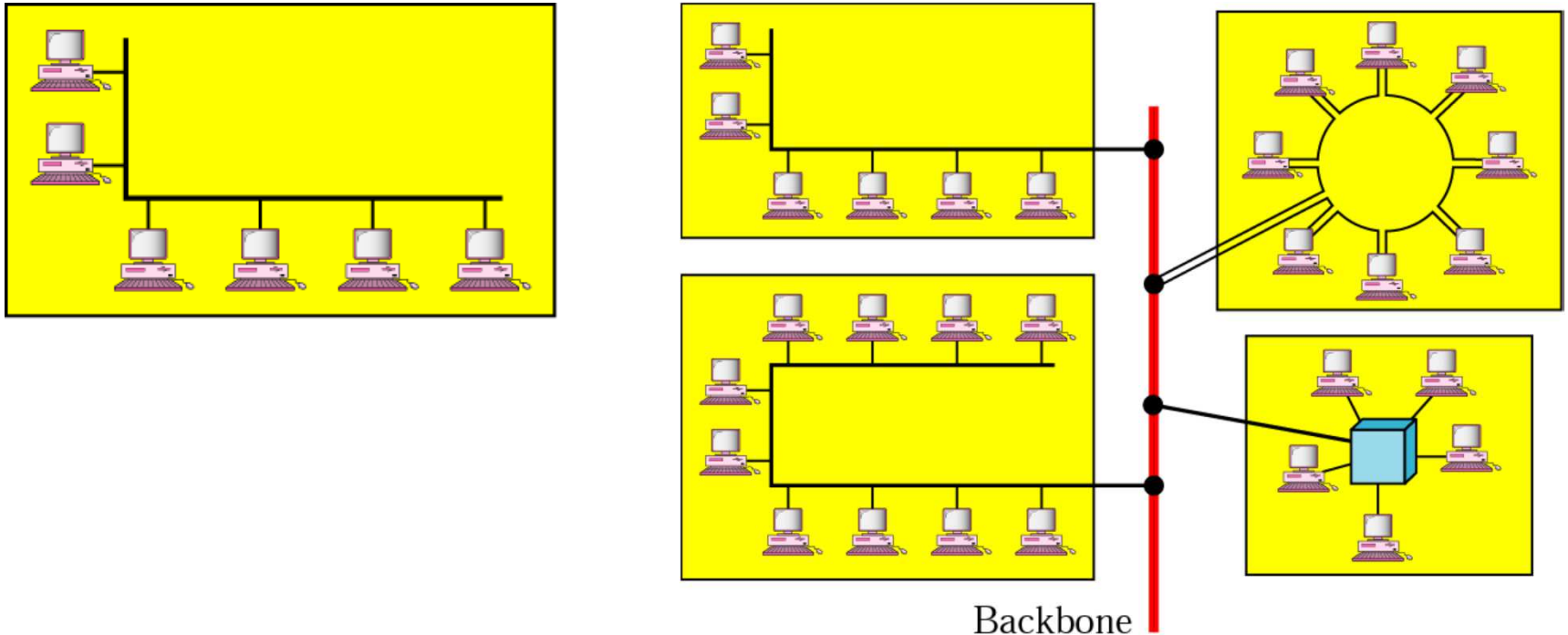
Network Categories

- Network category is determined by its size, ownership, the distance it cover and its physical architecture.
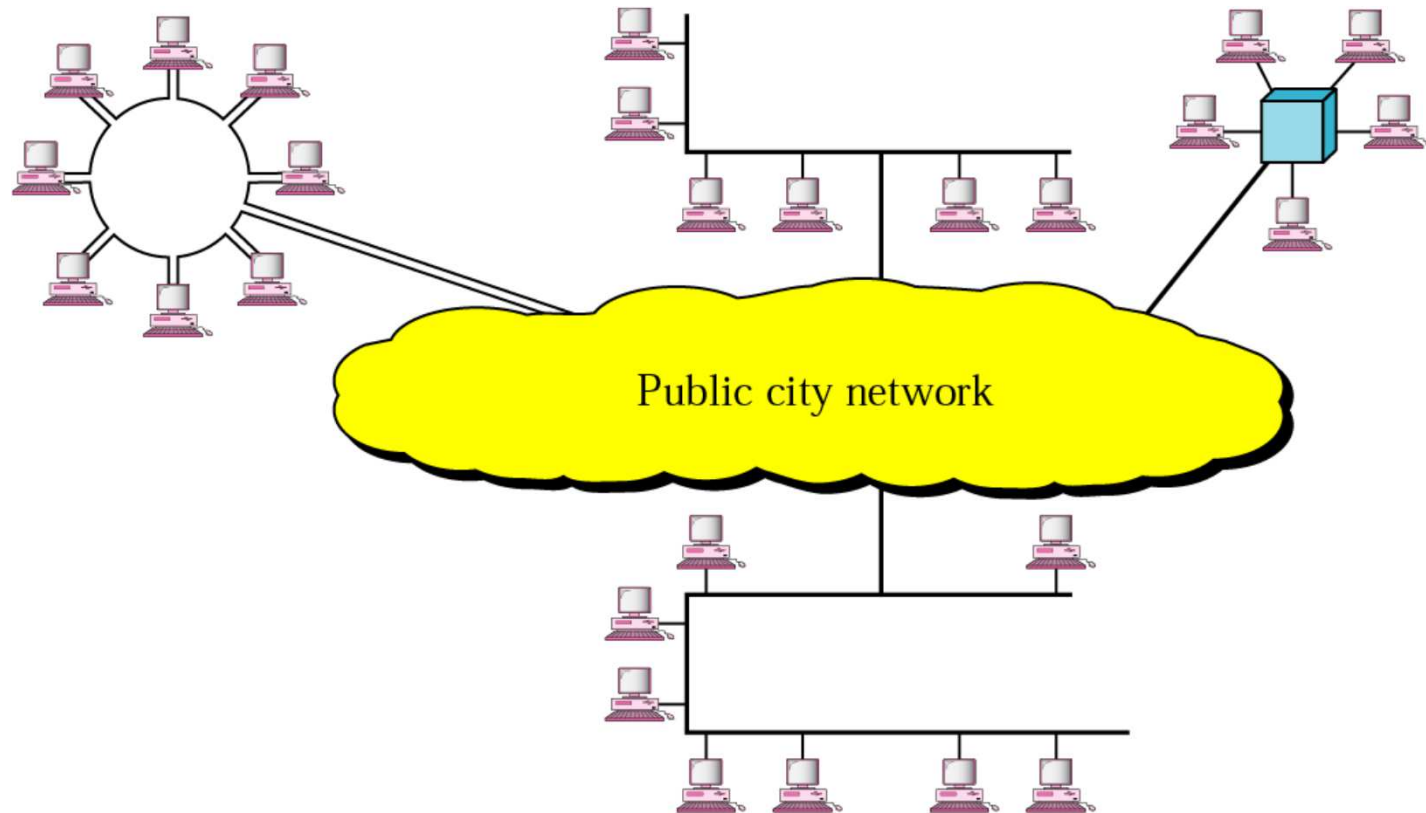
LAN

- Privately owned and links the devices in single office, building or campus
- Designed to allow resources to be shared between personal computers or workstations

Backbone

MAN

- Designed to extend over an entire city
- Connecting number of LANs into a larger network
- Example: Telephone line network

Public city network

WAN

- Provides long distance transmission of data, voice , image and video information over large areas (country or whole world)
- In contrast to LAN, WAN may utilize public or private communication equipments or combination
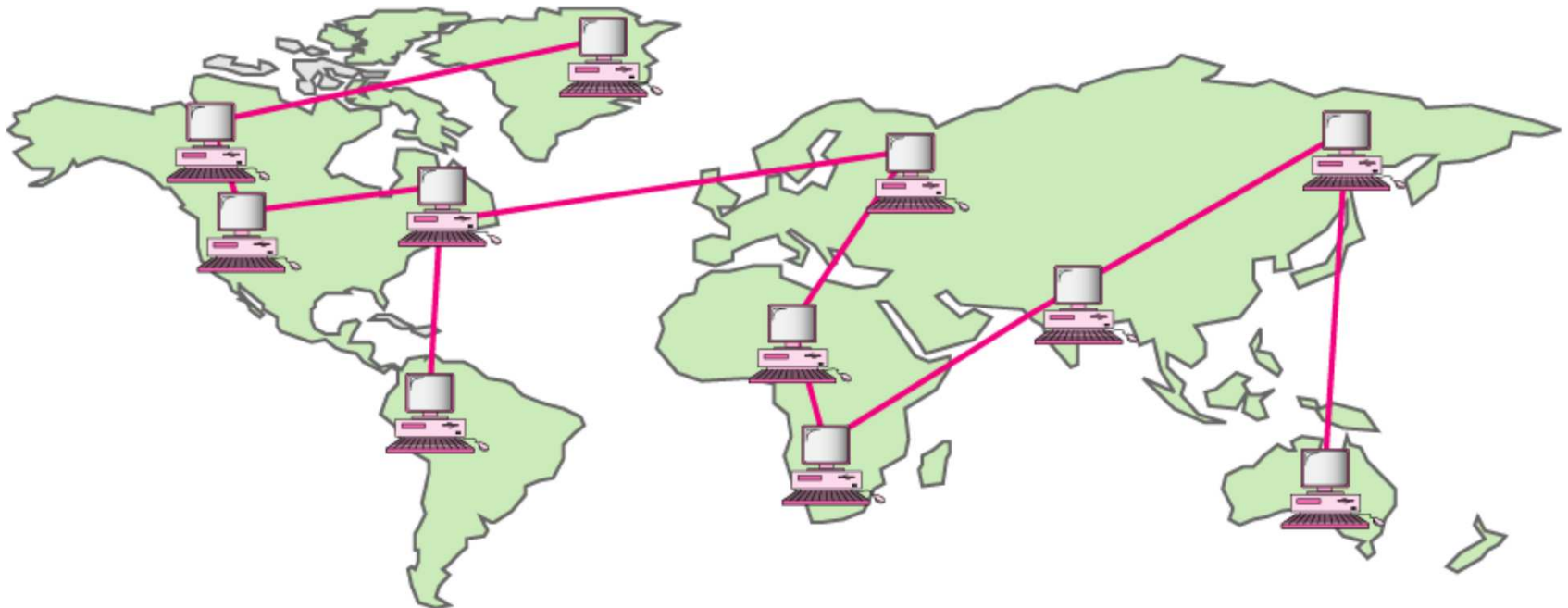
Internetworks

- Interconnection of networks