Data Communications

- Data Communications

  Data Communication is the exchange of data (in the form of 0's and 1's) between two devices via some form of transmission medium (such a cable)
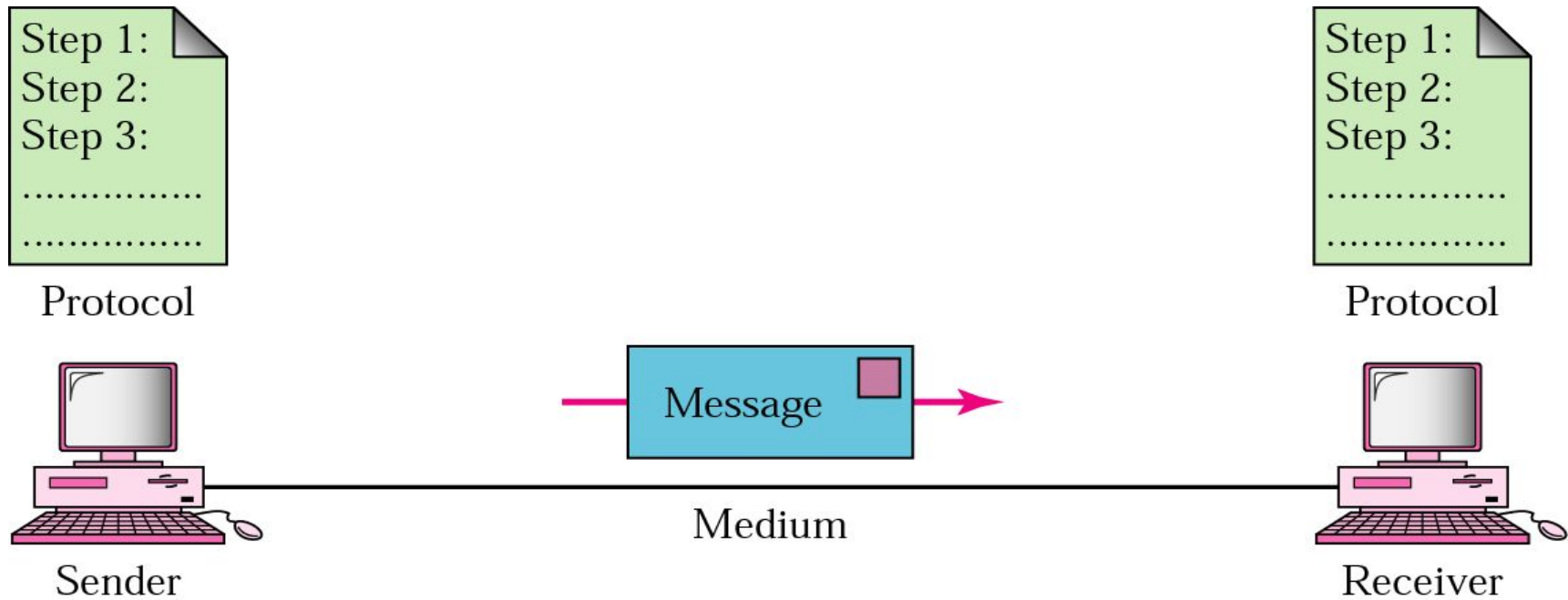
- What is important?

  – Delivery (deliver data to the correct destination)

  – Accuracy (must deliver the data accurately, no altered data in transmission)

  – Timeliness (deliver data in timely manner, data delivered late are useless)

Aspects of Data Communications

- Components
- Data representation
- Direction of data flow

Components

Components (contd.)

Components of a Communication System

- **Message**: The message is the information (or data) to be transmitted. For example, text, numbers, pictures, sound, video, or any combination of these.
- **Sender**: The sender is the device that sends the data message . It can be a computer, telephone, video camera, and so on.
- **Receiver**: The receiver is the device that receives the message.
- **Medium (Channel)**: The transmission medium is the physical path by which a message travels from the sender to receiver. For example twisted pair wire, coaxial cable, fiber-optic cable, radio waves (terrestrial or satellite microwaves).
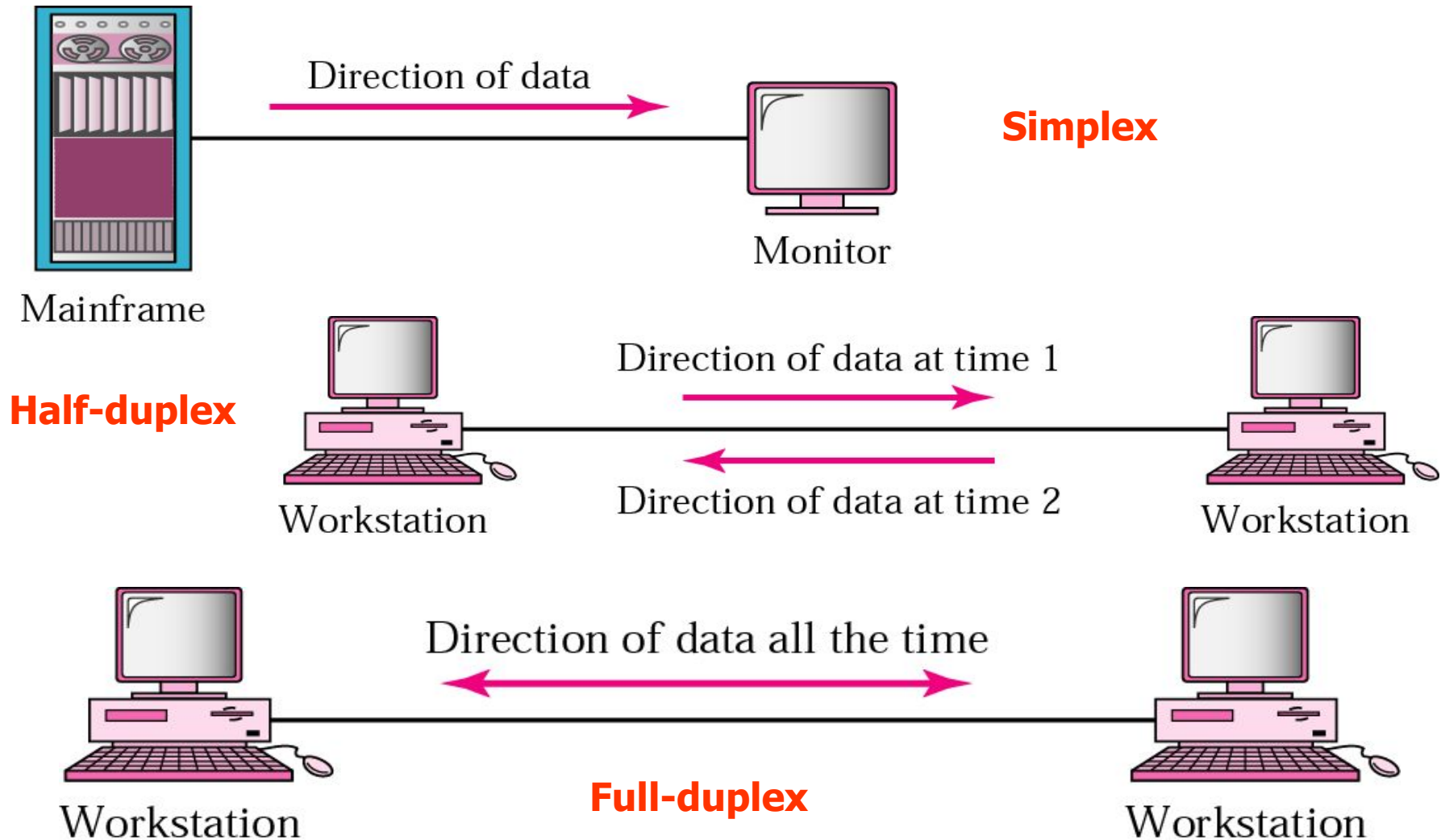
Components (contd.)

- **Protocol:** A protocol is a set of rules that govern data communication. It represents an agreement between the communicating devices.

Data Representation

- Text
  - Represented as a bit pattern
  - Various codes: ASCII (7 bits), Extended ASCII (8 bits), Unicode (16 bits), ISO (32 bits)
- Numbers
  - Directly converted to a binary number
- Images
  - jpeg, gif, etc.
- Audio
  - mp3, wma,
- Video
  - mp4, avi, etc.

Direction of Data Flow

Direction of data →

Simplex

Mainframe

Monitor

Half-duplex

Direction of data at time 1 →

← Direction of data at time 2

Workstation

Workstation

Direction of data all the time ←→

Full-duplex

Workstation

Workstation

IICT, BUET

Networking

- Network

  A network is a set of devices (often referred to as nodes) connected by 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.
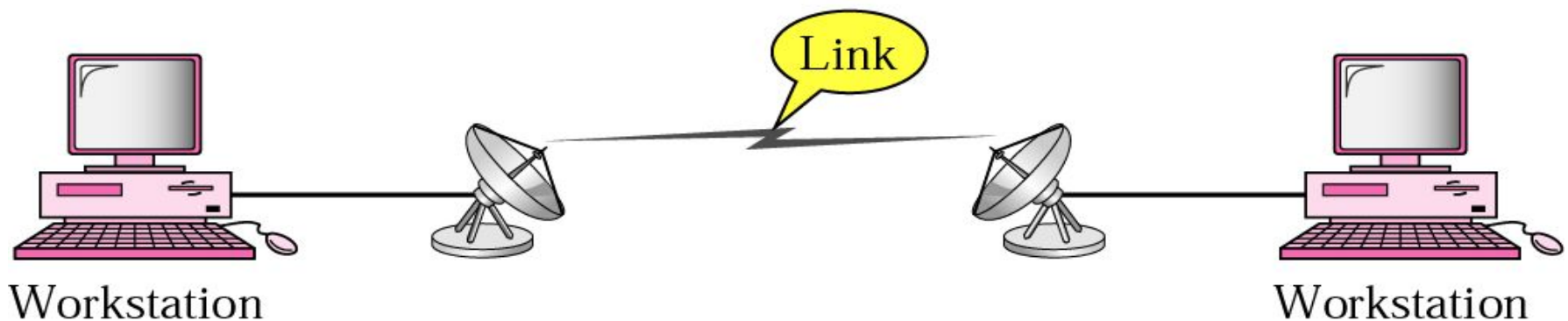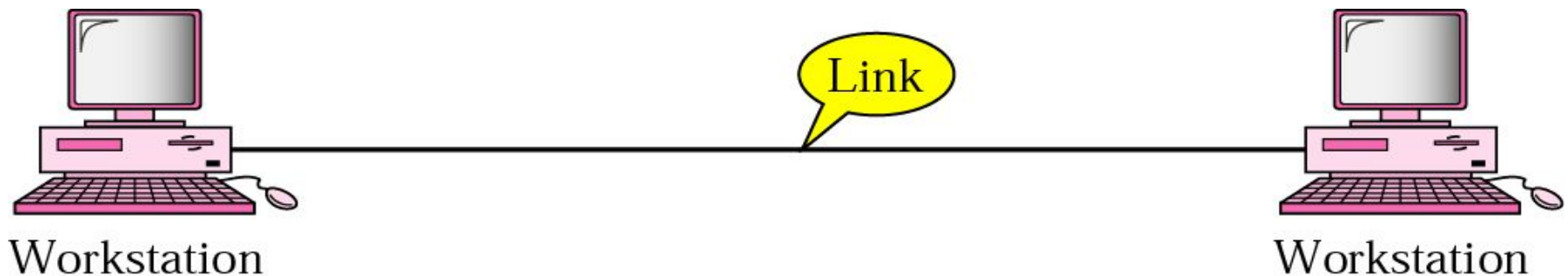
- Network criteria
 - Performance
  - reliability
  - security

Point-to-Point Connection

A point-to-point line configuration provides a dedicated link between two devices. The entire capacity of the channel is reserved for transmission between those two devices.
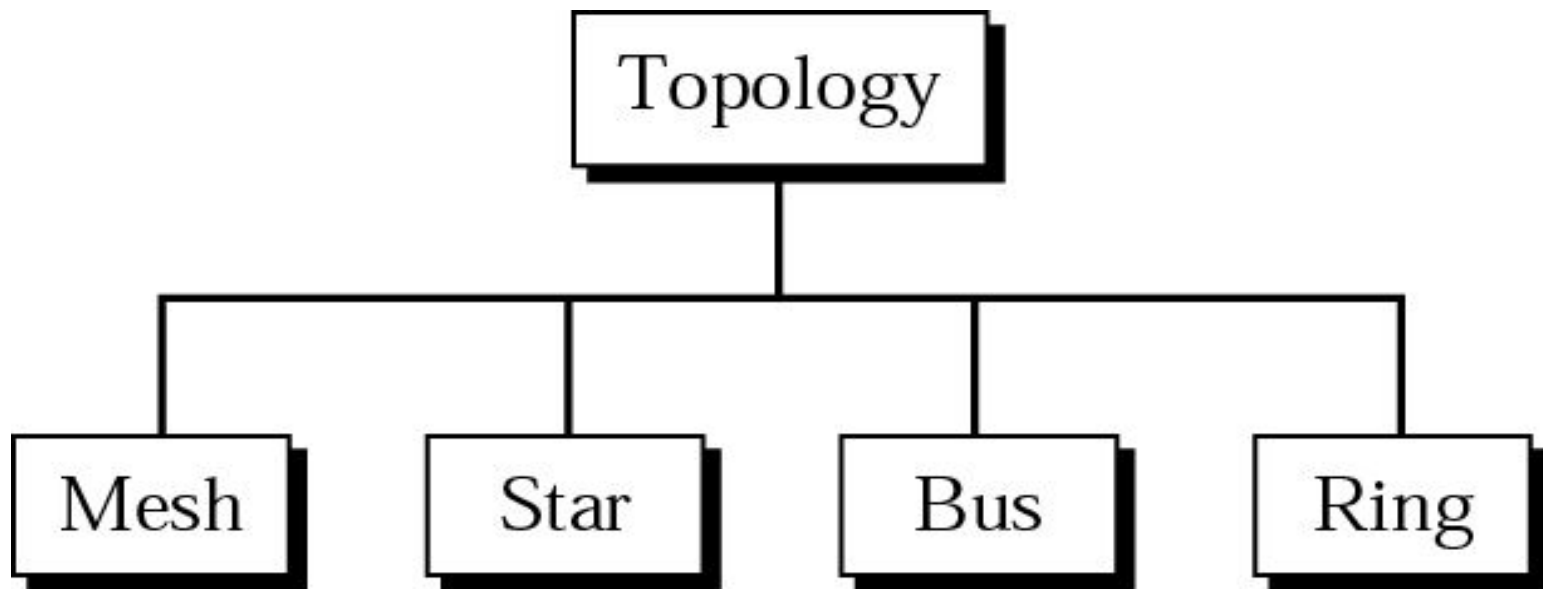
Multi-point Connection

A multipoint line configuration is one in which more than two specific devices share a single link. In a multipoint environment, the capacity of the channel is shared, either spatially or temporally.
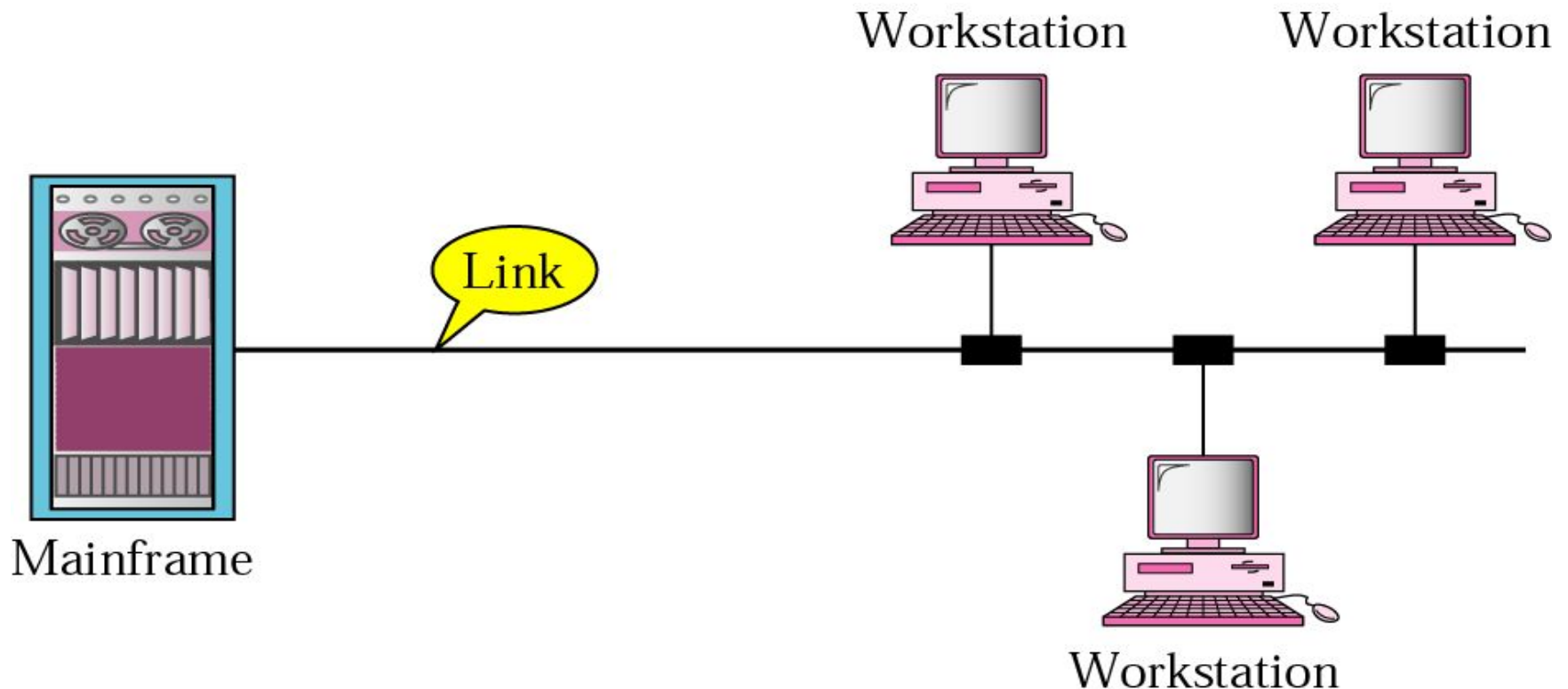
Physical Topologies

The topology of a network is the geometric representation of the relationship of all links and linking devices to one other. Two or more devices connect to a link; two or more links form a topology.

```
                    ┌──────────┐
                    │ Topology │
                    └────┬─────┘
        ┌────────────────┼────────────────┐
   ┌────┴───┐      ┌─────┴──┐       ┌─────┴──┐      ┌──────┐
   │  Mesh  │      │  Star  │       │  Bus   │      │ Ring │
   └────────┘      └────────┘       └────────┘      └──────┘
```

Mesh Topology

In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.
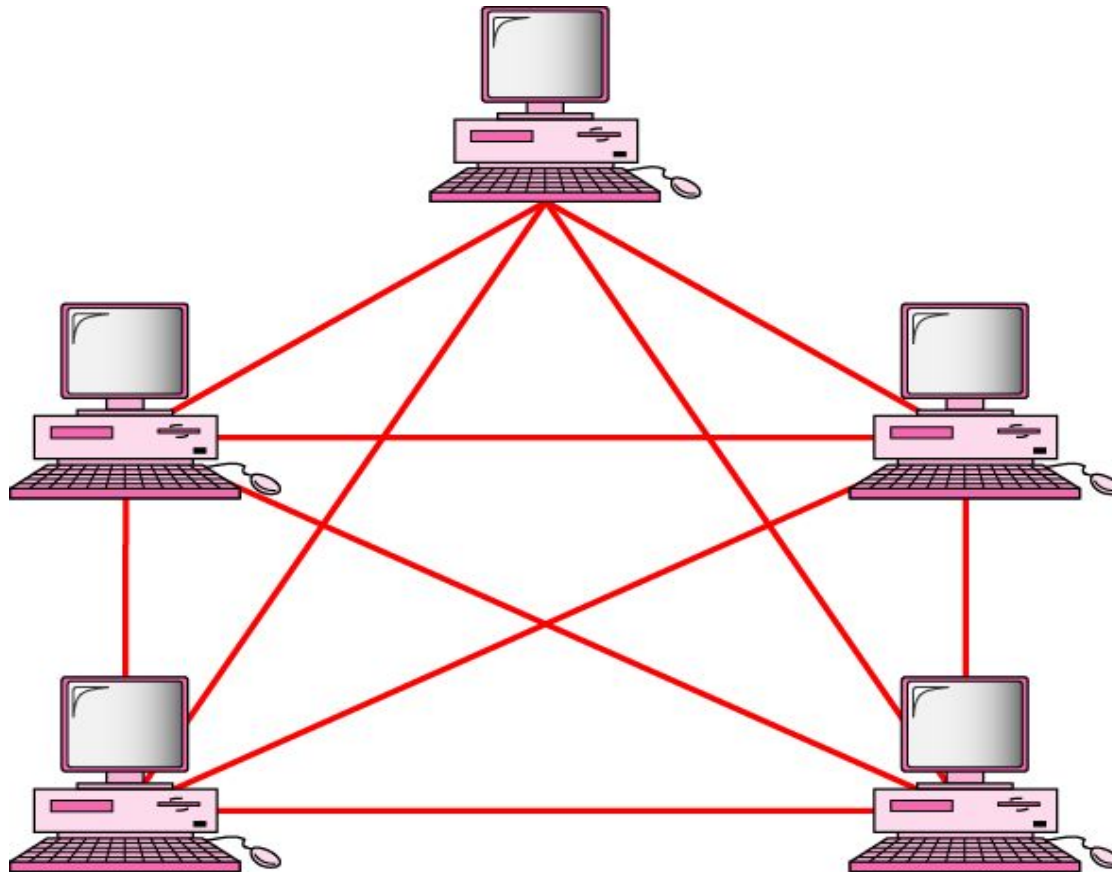
Mesh Topology (contd.)

Advantages

- The use of a dedicated links guarantees that each connection can carry its own load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.

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

- Privacy. When every message sent travels along a dedicated link, only the intended recipient sees it. Physical boundaries prevent other users from gaining access to messages.

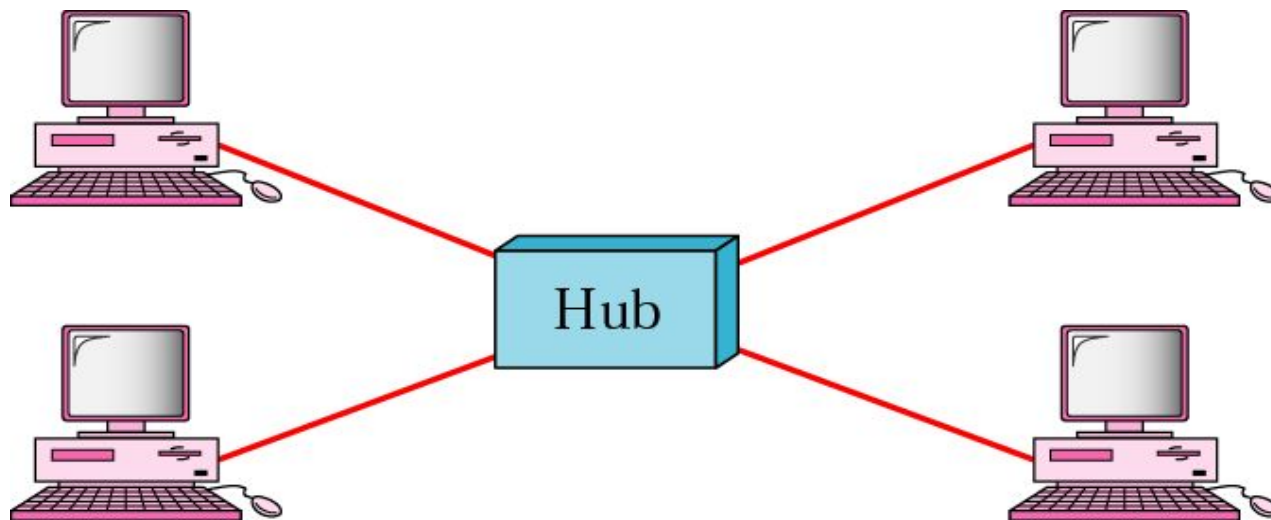- Point-to Point links make fault identification and fault isolation easy.

Mesh Topology (contd.)

Disadvantages

- A big amount of cabling and a big number of I/O ports required, i.e, the hardware required can be very expensive.

- Because every device must be connected to every other device, installation and reconfiguration are difficult.

- For these reasons a mesh topology is usually implemented in a limited fashion.

- For example, as a backbone connecting the main computers to a hybrid network that can include several other topologies.

Star Topology

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub. A star topology does not allow direct traffic between devices. If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.

Star Topology (contd.)

Advantages

- It is easy to install and reconfigure
- The star topology is robust. If one link fails, only that link is affected. This factor also lends itself to easy fault identification and fault isolation.
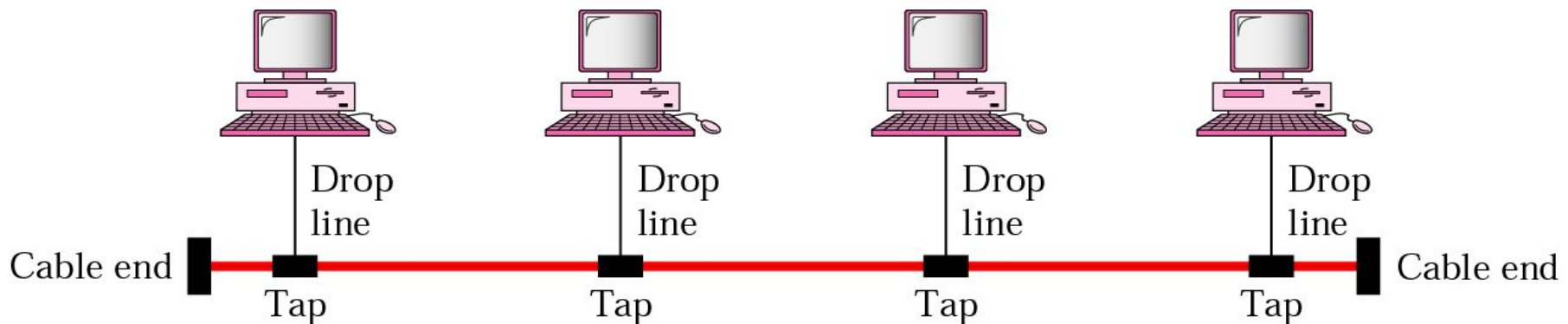
Disadvantages

- A big amount of cabling and a big number of I/O ports required, i.e, the hardware required can be very expensive.

  Note: Star topology requires far less cable than Mesh topology.

Bus Topology

In a bus topology one long cable acts as a backbone to link all the devices in the network. Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable. A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core.


IICT, BUET

Bus Topology (contd.)

Advantages

- Easy to install

- Bus topology uses less cabling than mesh, star, or tree topologies.

Disadvantages

- Difficult reconfiguration and fault isolation. A bus is usually designed to be optimally efficient at installation. It can therefore be difficult to add a new devices.

- A fault or break in the bus cable stops all transmission, even between devices on the same side of the problem. The damaged area reflects signals back in the direction of origin, creating noise in both directions.

Ring Topology

In a ring topology, each device has a dedicated point-to-point line configuration only with the two devices on either side of it.
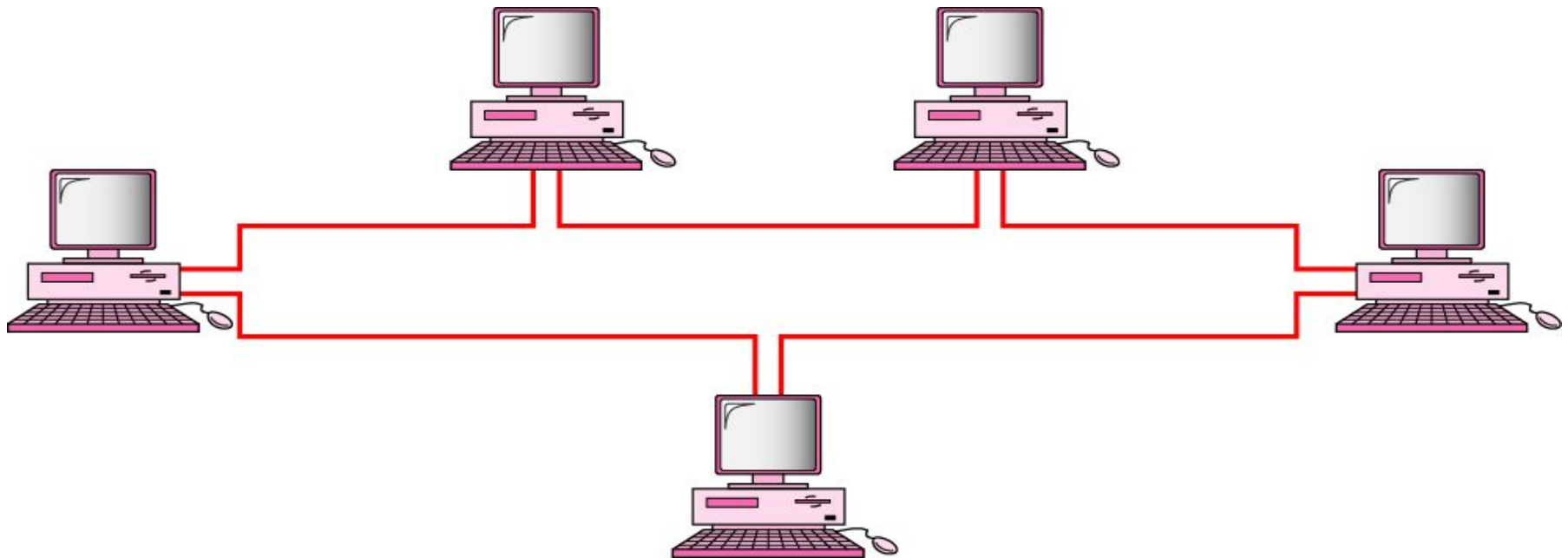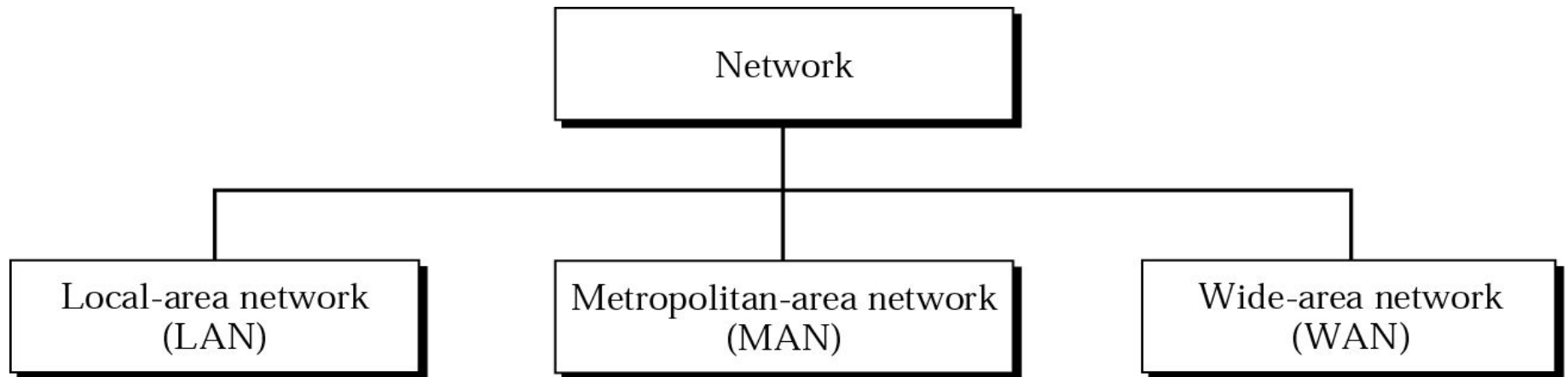
Ring Topology (contd.)

Advantages

- Easy to install and reconfigure. To add or delete a device require only two connections.
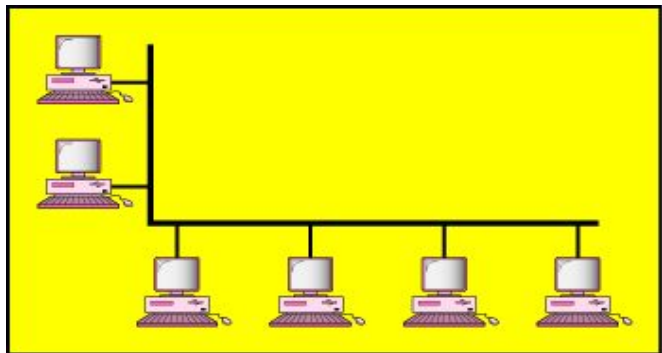
- Easy fault isolation

Disadvantages

- A break in the ring (such as a disabled station) can disable the entire network.
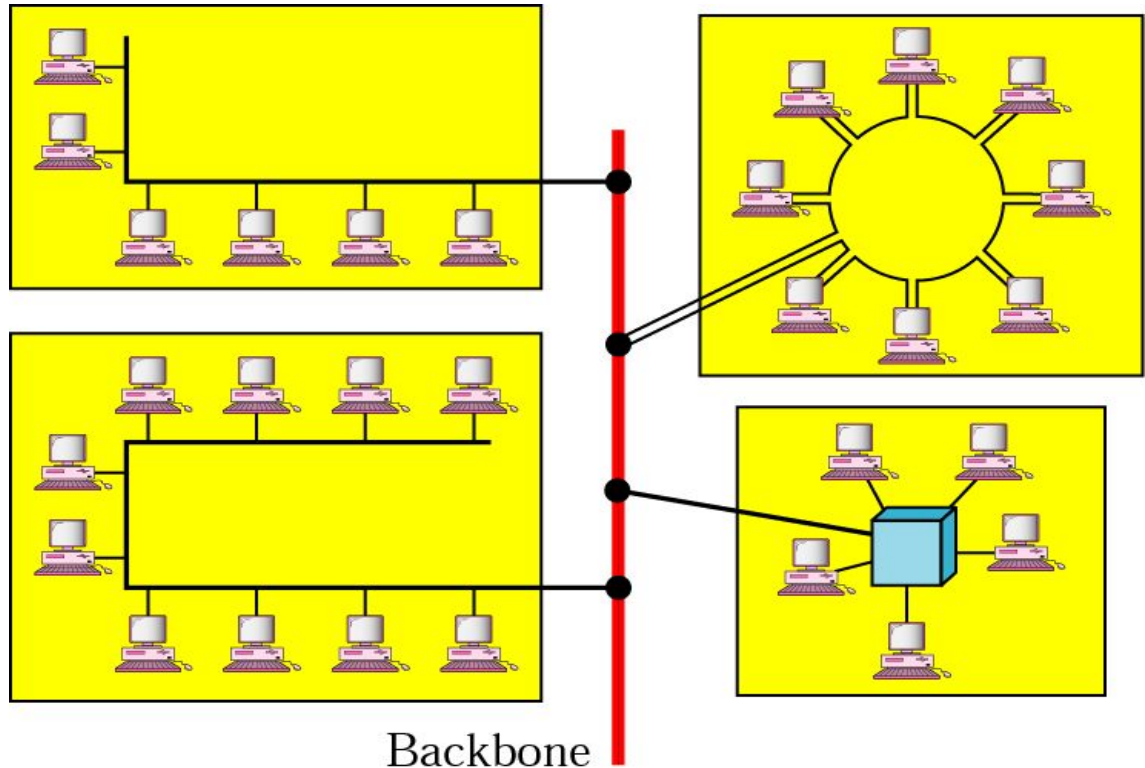
Categories of Networks

```
                        ┌──────────────────┐
                        │     Network      │
                        └──────────────────┘
                                 │
        ┌────────────────────────┼────────────────────────┐
┌──────────────────┐   ┌──────────────────────┐   ┌──────────────────┐
│ Local-area network│   │ Metropolitan-area    │   │ Wide-area network│
│      (LAN)        │   │    network (MAN)     │   │      (WAN)       │
└──────────────────┘   └──────────────────────┘   └──────────────────┘
```

Local Area Networks

Typically, one type
of transmission
medium

a. Single-building LAN

Backbone
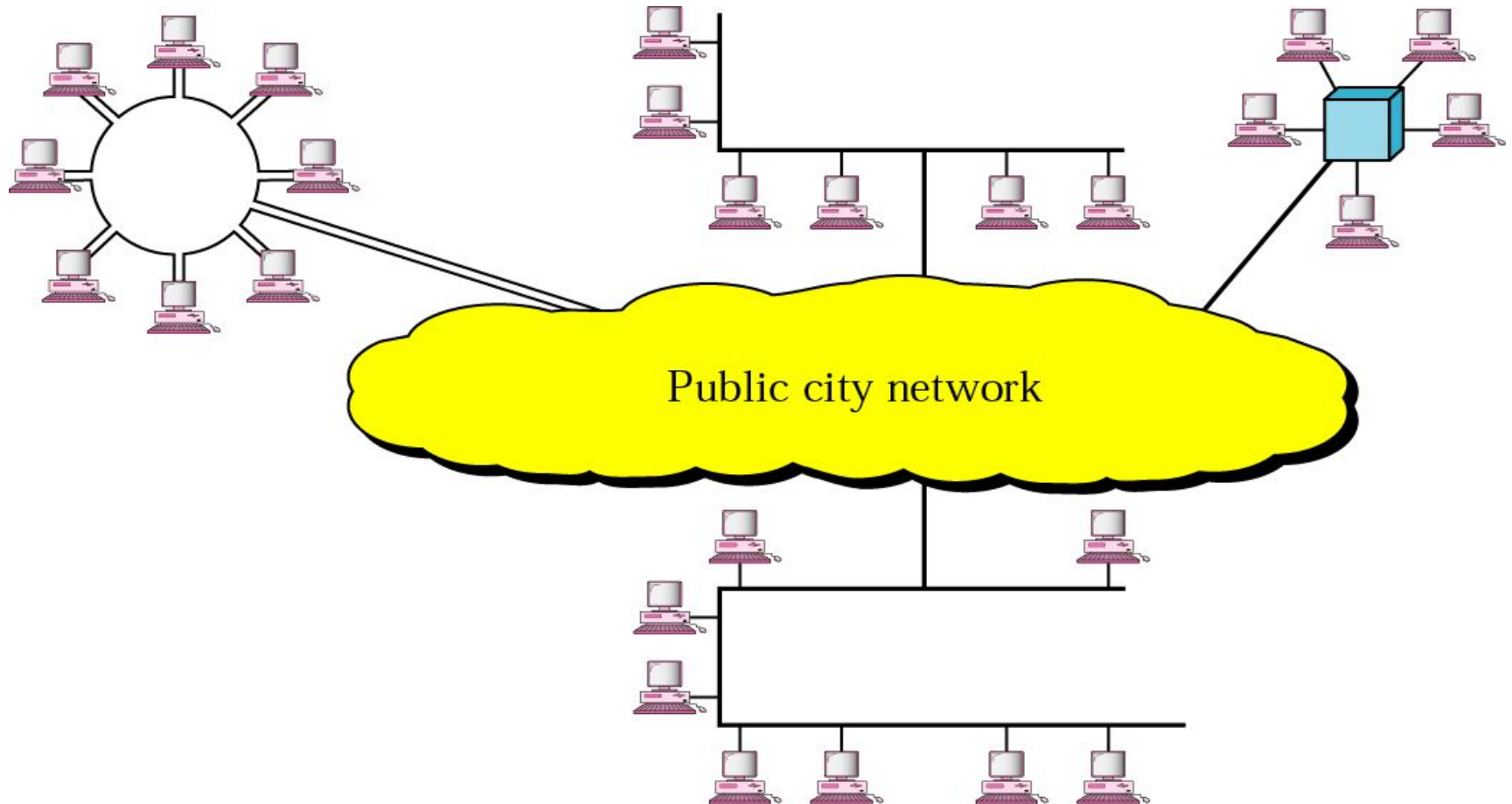
b. Multiple-building LAN

Metropolitan Area Networks

Public city network

Wide Area Networks