

# **Data Communications and Computer Networks**

*University of Education  
Lahore, Pakistan.*

## **Lecture 02 –Computer Networks**



# Lecture 02 - Roadmap

- **Computer Networks**
- Categories of Networks
  - LAN
  - MAN
  - WAN
    - Circuit and Packet Switch
    - Frame Relay
    - ATM
- Protocols and Standards
  - Syntax, Semantics, Timing
  - De facto and De jure
- Standard Organizations

# Network

- A network is a set of devices (often referred to as nodes) connected by communication links.
- **Distributed Processing**  
Most Networks use distributed processing, in which a task is divided among multiple computers

# Network Criteria

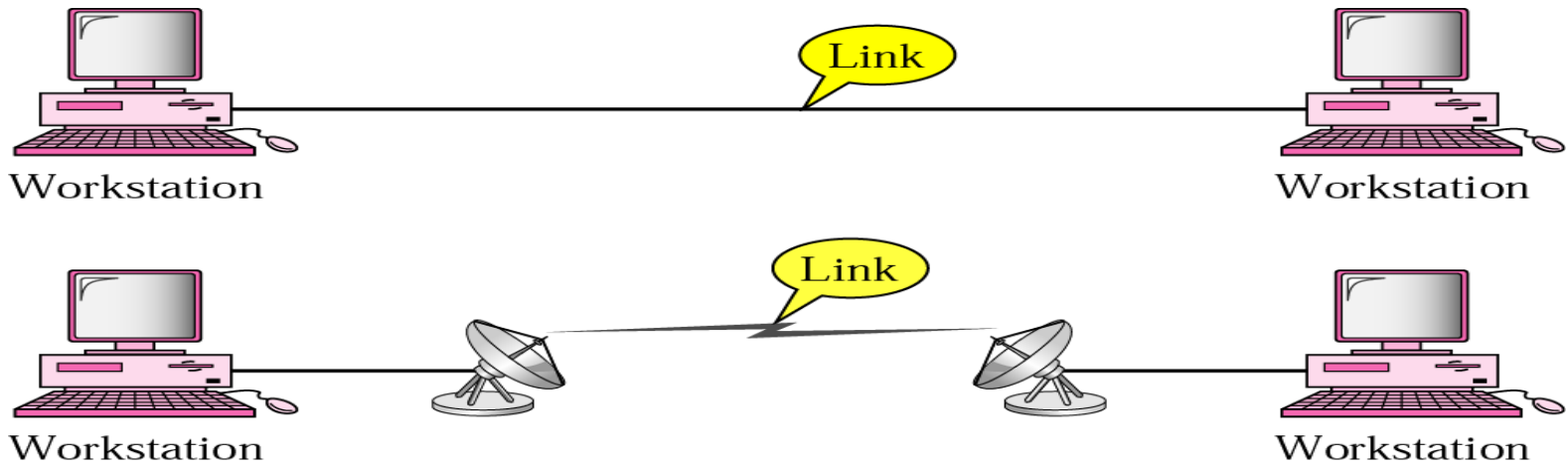
A network must be able to meet a certain number of criteria.  
The most important of these are

- Performance
- Reliability
- Security

# Physical Structures

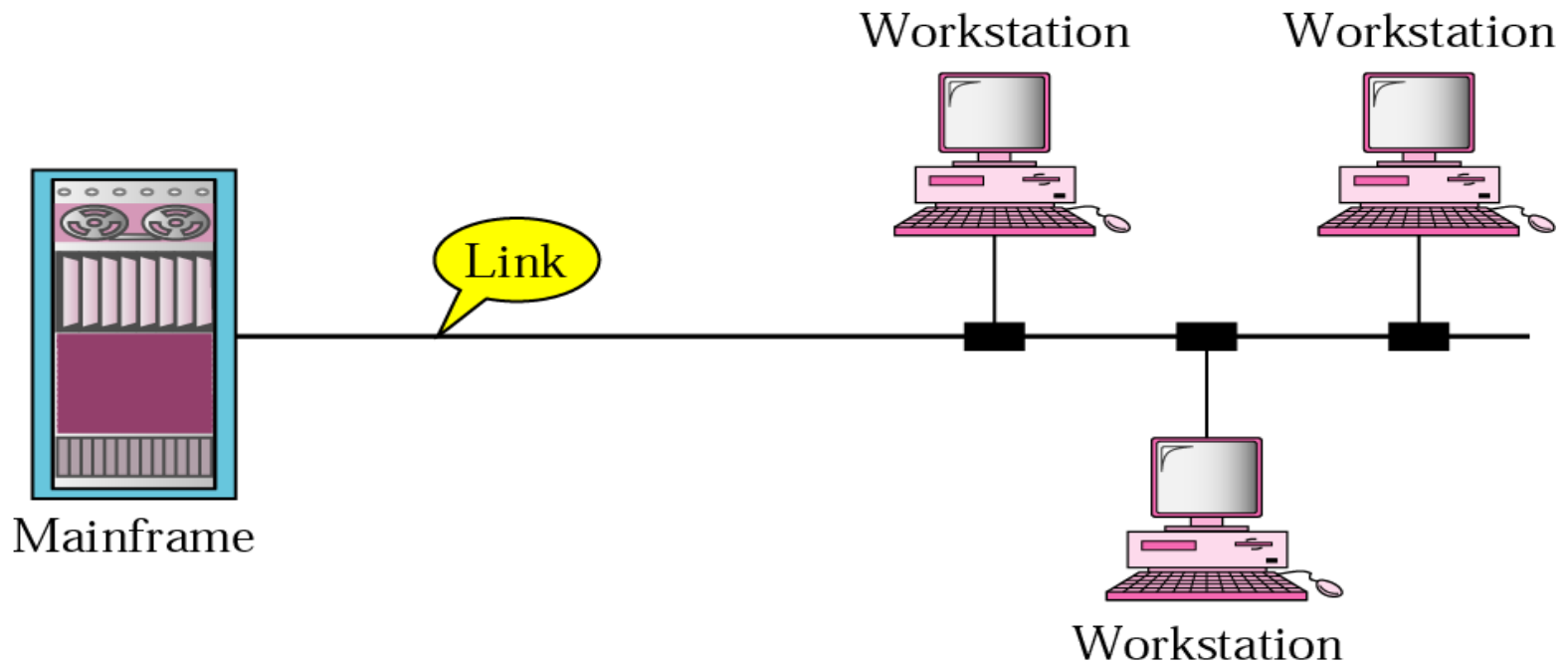
- Type of Connection
- Physical Topology

## Point-to-point connection



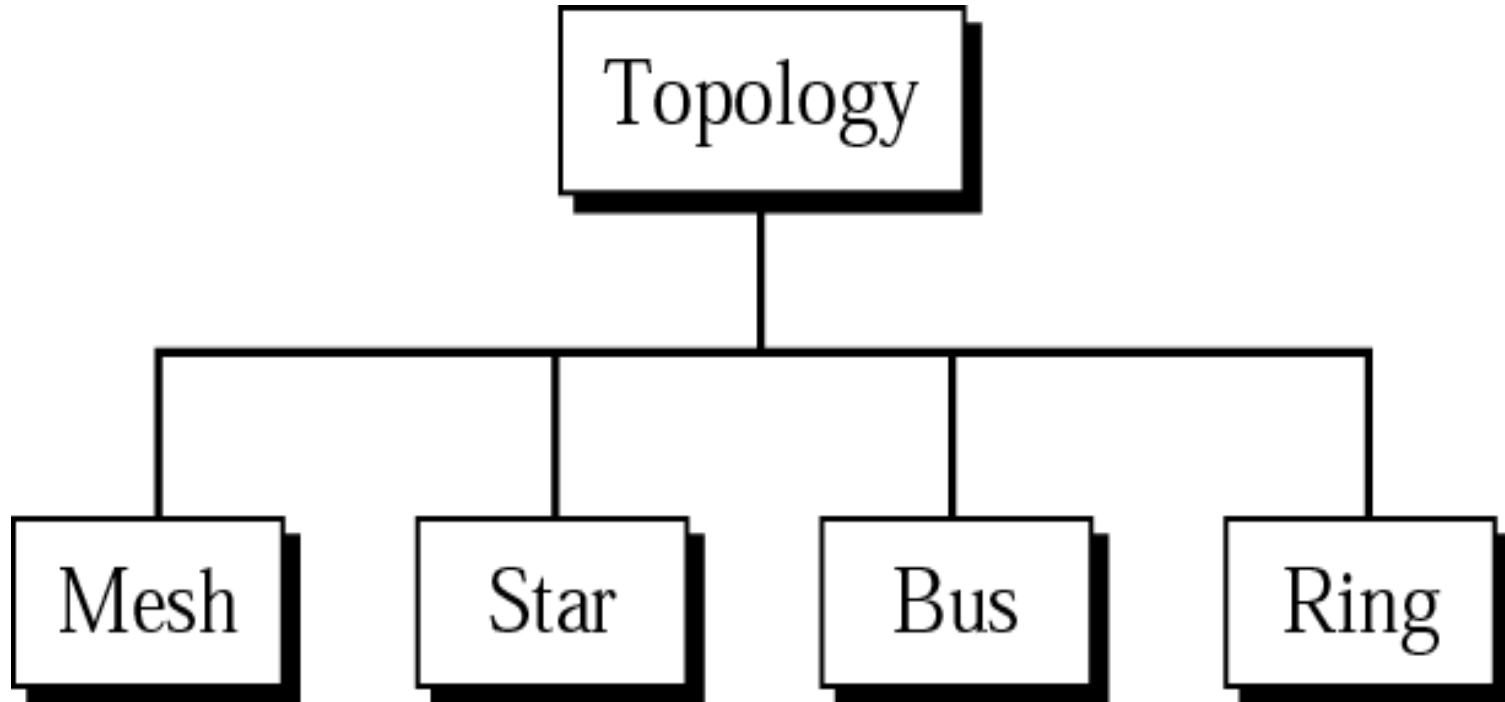
# Physical Structures Cont..

- Multipoint Connection



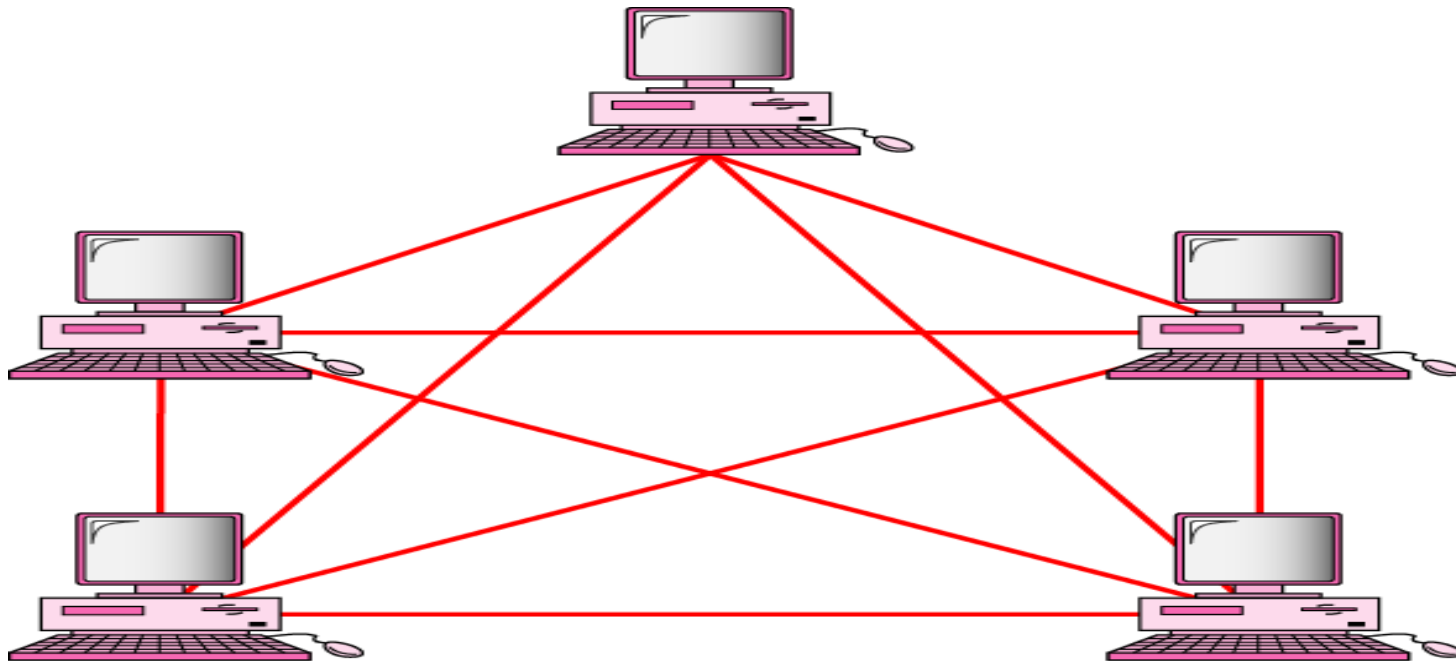
# Physical topology

Topology refers to the physical or logical arrangement of a network.



# Mesh Topology

- In a mesh topology, every device has a dedicated point to point link to every other device.
- To connect  $n$  devices ,we require  $n(n-1)/2$  physical channels .





## Advantages

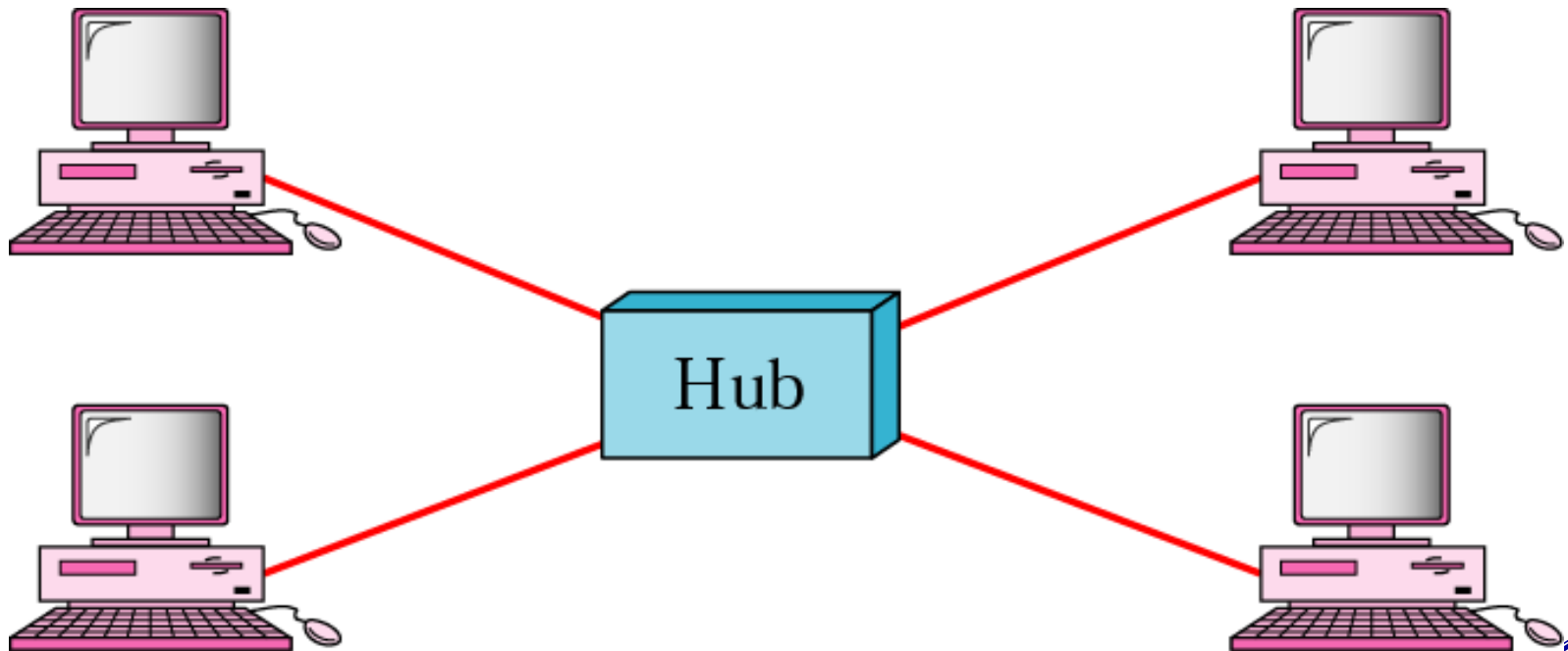
- The use dedicated links guarantees that each connection can carry its own data load.
- It provide privacy and security.
- Fault identification and fault isolation.
- The mesh topology is robust

## Disadvantages

- The main disadvantages are related to the amount of cabling and the number of I/O ports required.

# Star Topology

In a star topology, each device has a dedicated point to point link only to a central controller.



## Advantages

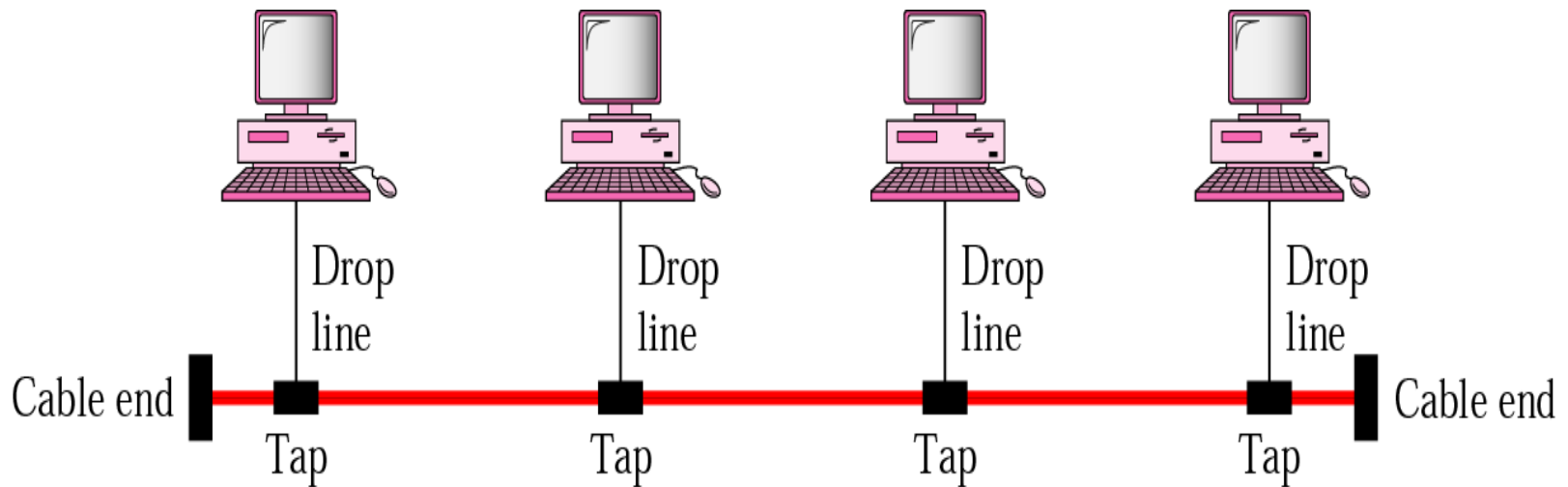
- A star topology is less expensive than mesh topology.
- Each device needs only one link and one I/O port to connect with other device.
- Fault identification and fault isolation.
- Easy to add new stations
- Easy to monitor and troubleshoot

# Disadvantages

- Failure of hub cripples attached stations .
- More cable required .

# Bus Topology

A bus topology is a multipoint topology in which one long cable acts as a backbone to link all the devices in the network.



## Advantages

- Ease of installation.
- Uses less cabling than mesh or a star.
- Easy to implement and extend
- Typically the least cheapest topology to implement
- Failure of one station does not affect others

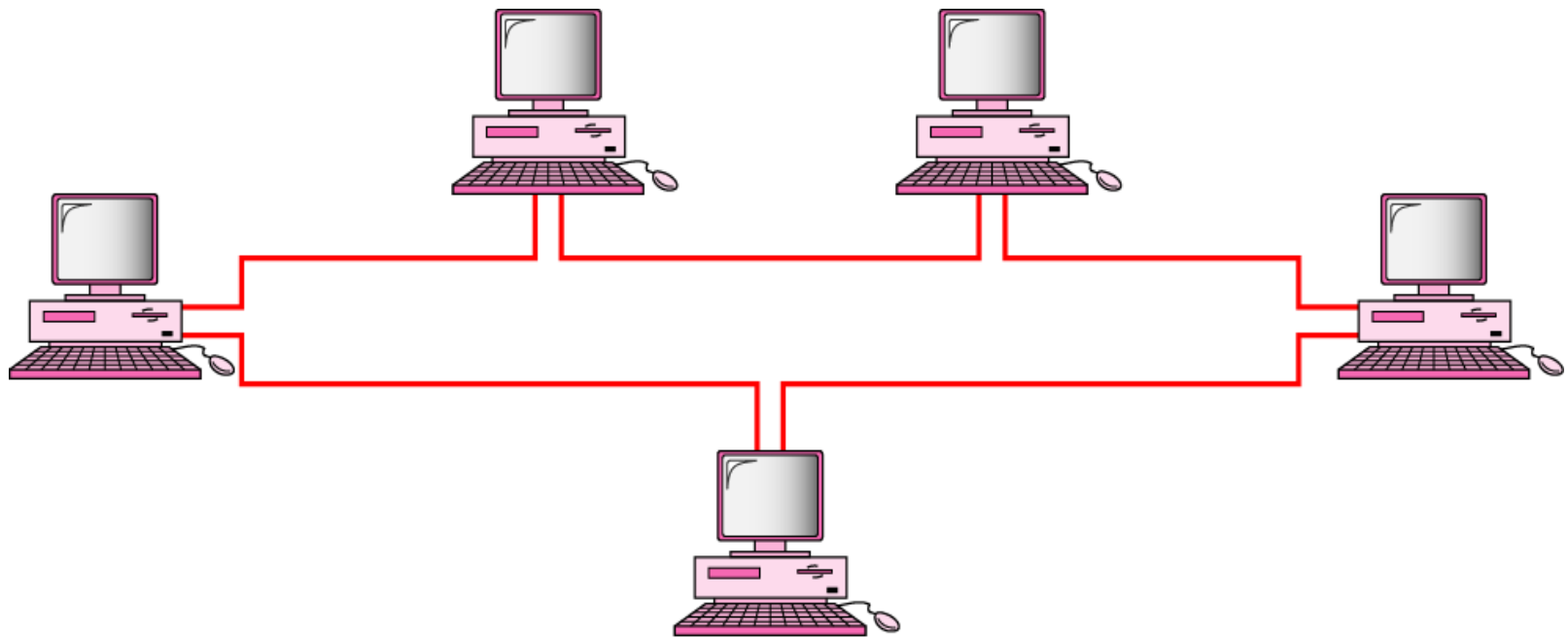
# Disadvantages

- Difficult to administer/troubleshoot
- A cable break can disable the entire network.
- Performance degrades as additional computers are added.
- A fault or break stops all transmission

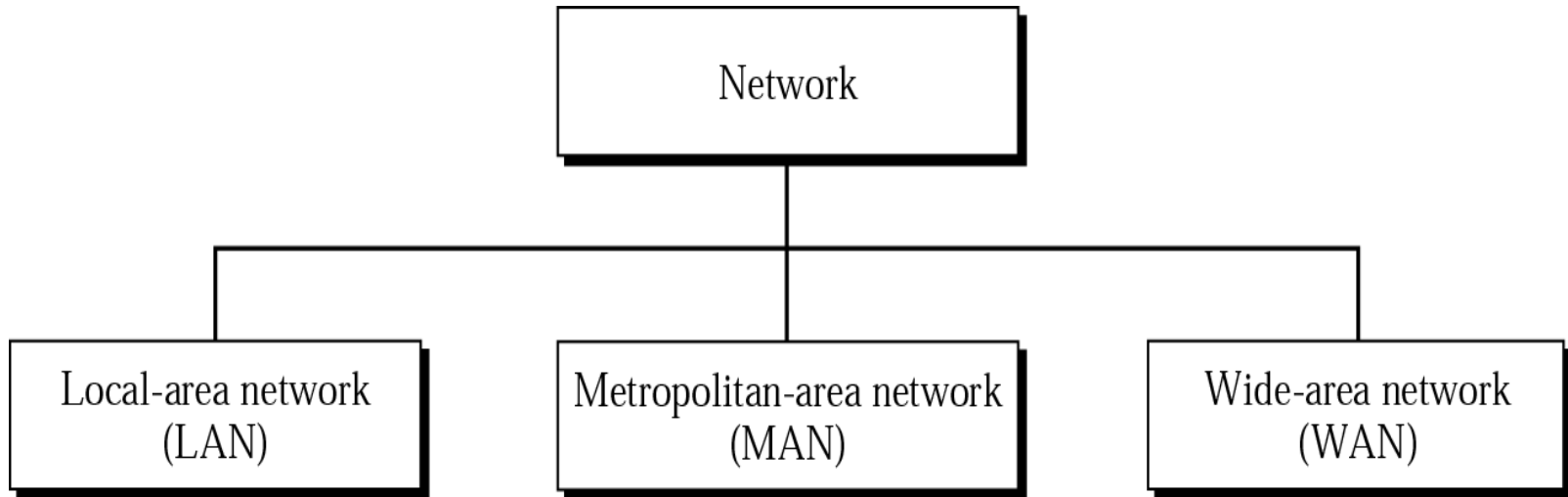


# Ring topology

In a ring topology, each device has a dedicated point to point connection only with two devices on either side of it.

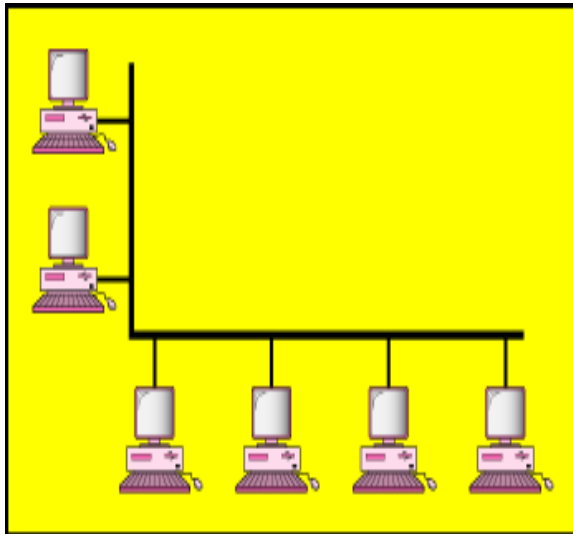


# Categories of Networks

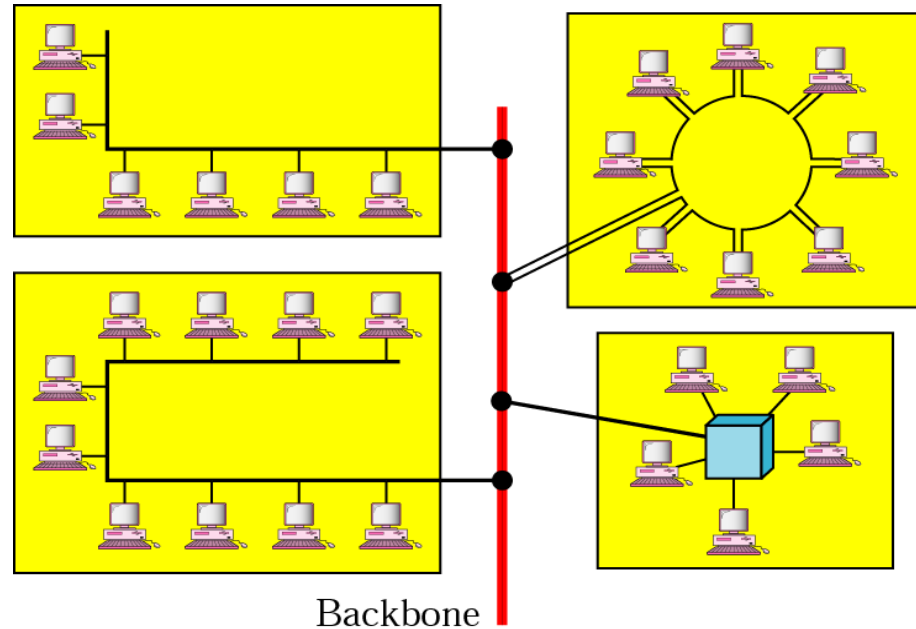


# Local Area Network

A local area network is usually privately owned and links the devices in a single office, building, or campus.



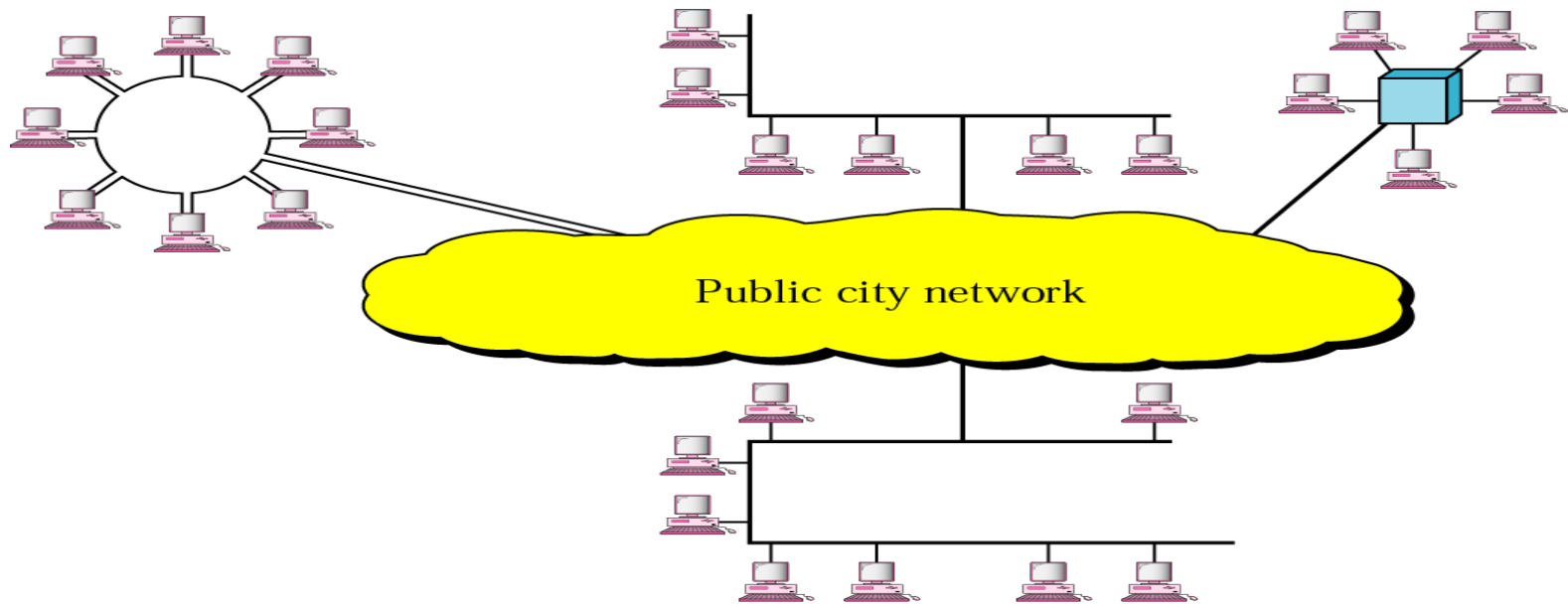
a. Single-building LAN



b. Multiple-building LAN

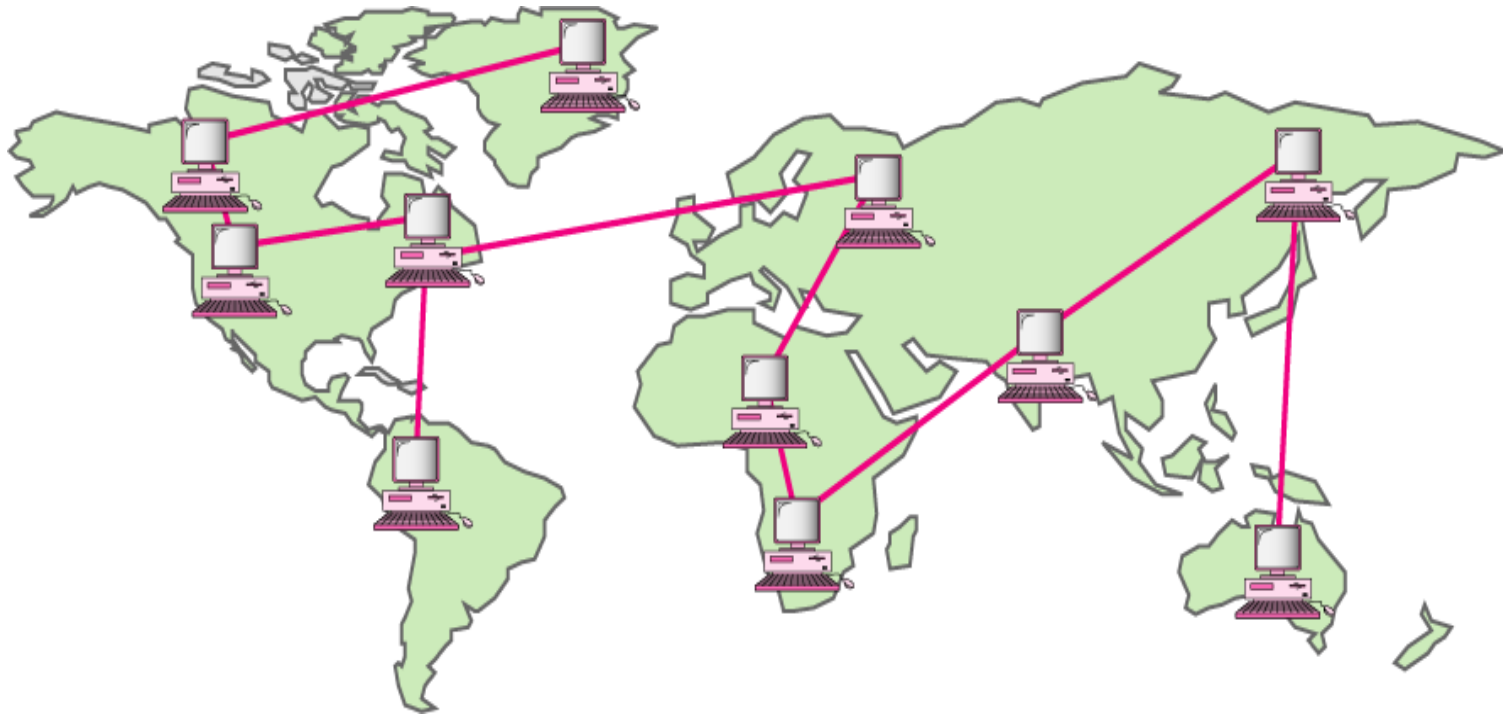
# Metropolitan Area Network

A MAN is a data communication system covering an area the size of a town or city.



# Wide Area Network

A WAN is a data communication system spanning states, countries, or the whole world.



## WANs

vs.

## LANs

- Wide Scope
  - Low data rates
  - Usually use Public Resources
  - Commonly implemented using circuit switching, packet switching etc.
- Limited Scope
  - High data rates
  - Usually under Private Ownership
  - Common technologies include Bus, star, Ring, mesh etc

# WAN Implementation

Traditionally, WANs have been implemented using one of two technologies:

- Circuit Switching
- Packet Switching

- **Circuit Switching**

In a circuit switching network, a dedicated communication path is established between two stations through the nodes of the network. Telephone network is an example of Circuit switching.

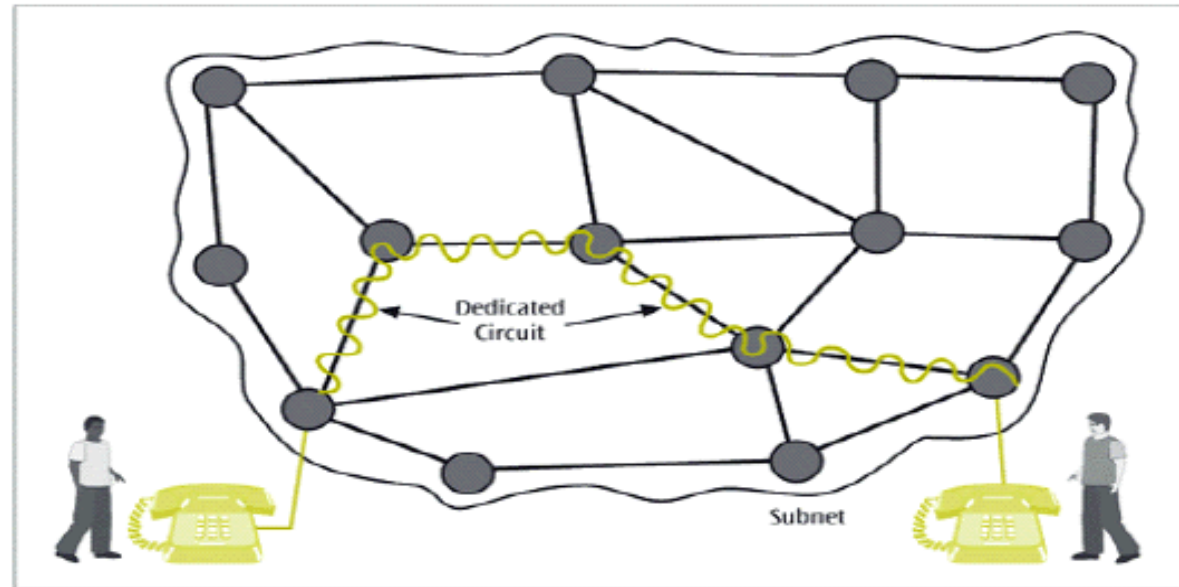
- **Packet Switching**

In packet Switching it is not necessary to dedicate communication path between two stations. Data are sent out in a sequence of small chunks, called packets.

# Circuit Switching

**Figure 10-6**

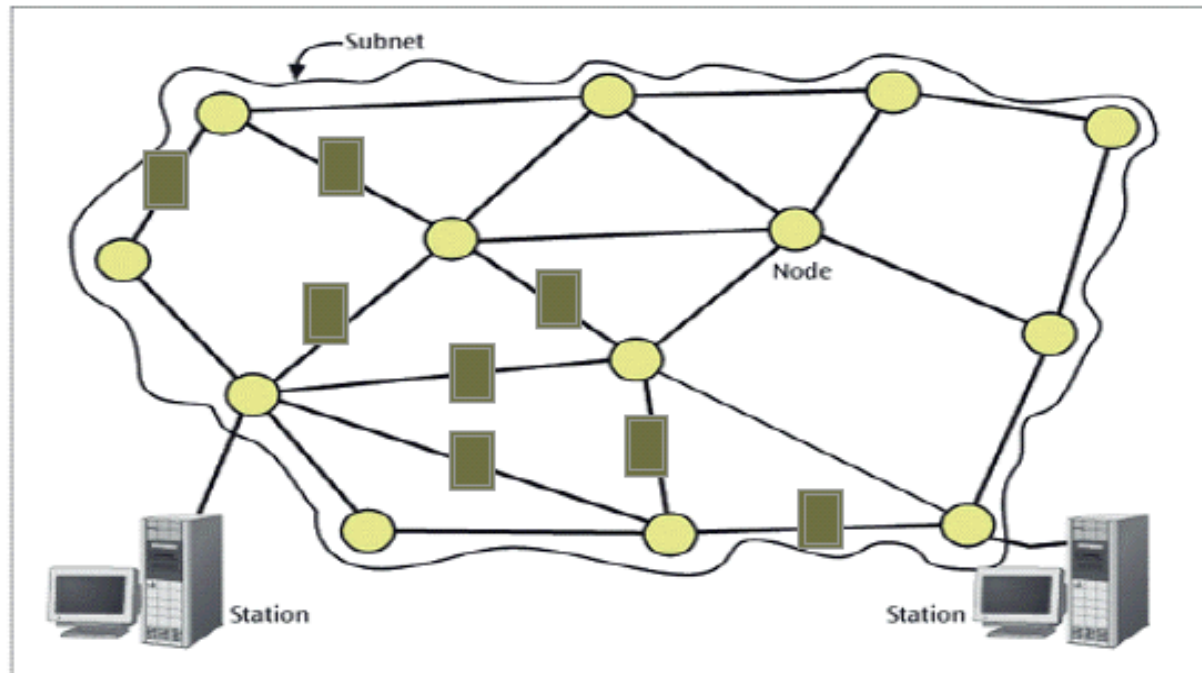
*Two people carrying on a telephone conversation using a circuit-switched network*





# Packet Switching

**Figure 10-5**  
*Network subnet, nodes,  
and two end stations*



# WAN Implementation cont...

- Frame Relay

Frame Relay is also a packet switching technique with variable length packets develop to take the advantages of high data rates and low error rates of current Transmission Systems.

- Frame Relay provide high speed data connection
- Uses the variable size packets called “Frames” to send the data
- Data rate from 2 Mbps to 10 Mbps

## ATM

Asynchronous transfer mode, sometimes referred to as cell relay. ATM technology uses a fixed size packet called a cell. The data rate from 10 Mbps to Gbps

# Protocols and Standards

- Protocol

A protocol is a set of rules that governs data communication;

A protocols defines

- What is communicated
- How it is communicated
- When it is communicated

The key elements of a protocol are Syntax, Semantics and Timing.

- Standards

Standards are necessary to ensure that products from different manufactures can work together as expected.

# Protocols and Standards

- **Syntax**

Syntax refers to the structure or format of the data. For example, a simple protocol might expect the first 8 bits of data to be the address of the sender, the second 8 bits to be the address of the receiver, and the rest of the stream to be the message itself.

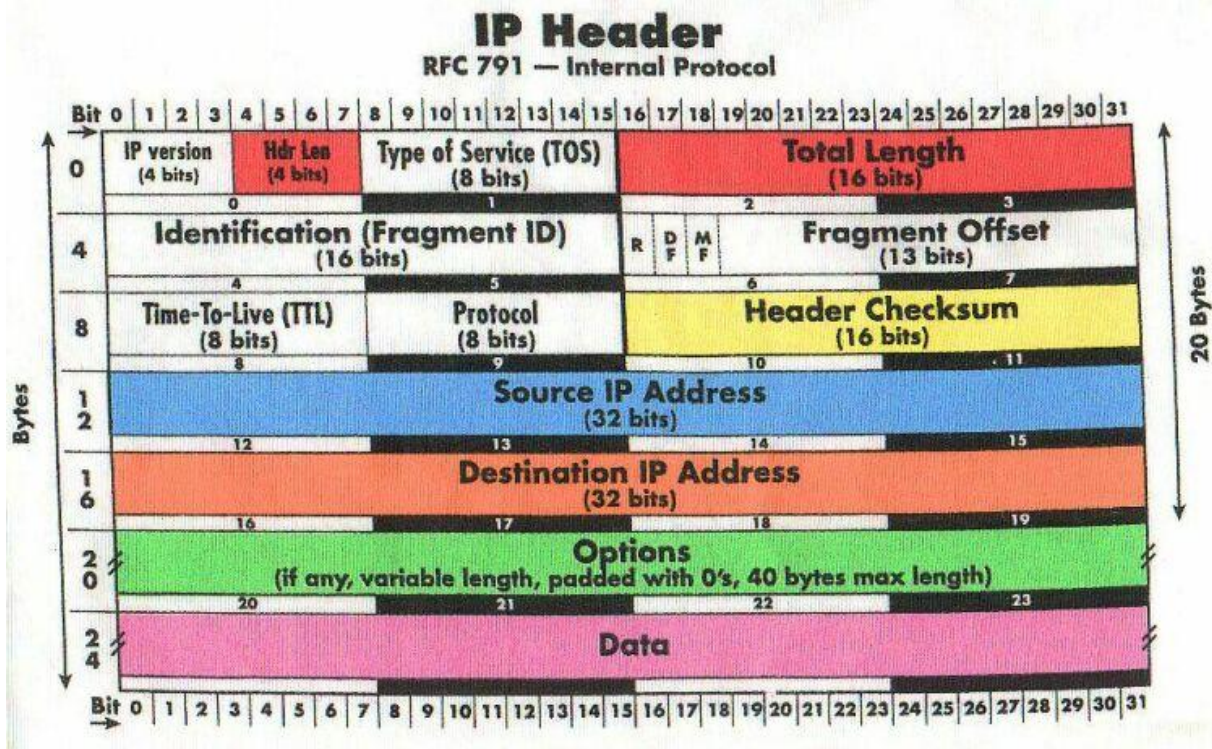
- **Semantics**

Semantics refers to the meaning of each section of bits. For example, does an address identify the route to be taken or the final destination of the message?

- **Timing**

Timing refers to two characteristics: when data should be sent and how fast they can be sent.

# Protocols and Standards



# Protocols and Standards

- Standards

Standards are necessary to ensure that products from different manufactures can work together as expected.

Data communication Standards fall in to two categories: de facto and de jure

- De facto

Meaning by fact, standards that have not been approved by an organized body but have been adopted as standards through widespread, Often established originally by manufactures that seek to define the functionality of a new product or technology.

- De jure

Those that have been legislated by an officially recognized body.

# Standards Organizations

- **International Organization for Standardization (ISO)**
  - Stands for “International Standards Organization” is a multi national body created in 1947.
  - Dedicated to world wide agreement on international standards in a variety of fields .
- **American National Standards Institute (ANSI)**
  - Completely private, nonprofit corporation not affiliated with the U.S federal government
- **Institute of Electrical and Electronics Engineers (IEEE)**
  - The largest professionals engineering society in the world.
  - It aims to advance theory, creativity and product quality in the filed of electrical engineering and electronics.
  - LAN (project 802)
- **Electronic Industries Association (EIA)**
  - Association of electronics manufacture in united States.
- **International Telecommunication Union-Telecommunication Standards (ITU-T)**