

# Computer Network

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# **Chapter 1**

## **Introduction**

# **Data Communication:**

The term 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.

# Data Representation:

## ➤ Numbers

- 8/16/32 bit integers
- floating point

## ➤ Text

- ASCII, Unicode

## ➤ Images

- Bit patterns, Graphics formats JPG/GIF/etc

## ➤ Audio → Samples of continuous signal

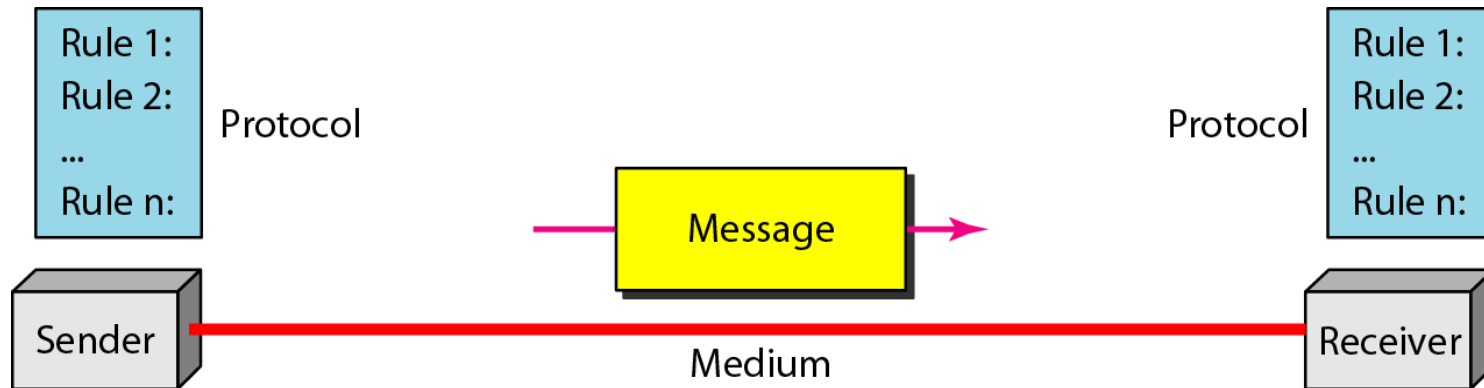
## ➤ Video → Sequence of bitmap images

# Data Communication Characteristic

**Data communications** are the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness, and jitter.

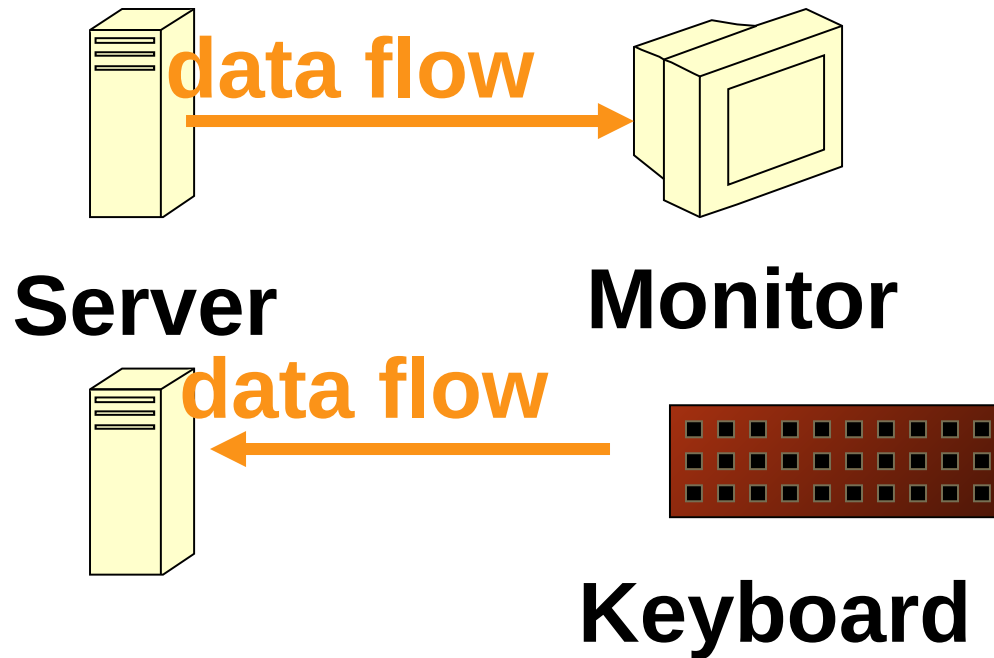
1. **Delivery.** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. **Accuracy.** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3. **Timeliness.** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called *real-time* transmission.
4. **Jitter.** Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video packets are sent every 30 ms. If some of the packets arrive with 30-ms delay and others with 40-ms delay, an uneven quality in the video is the result.

# Components of a data communication system



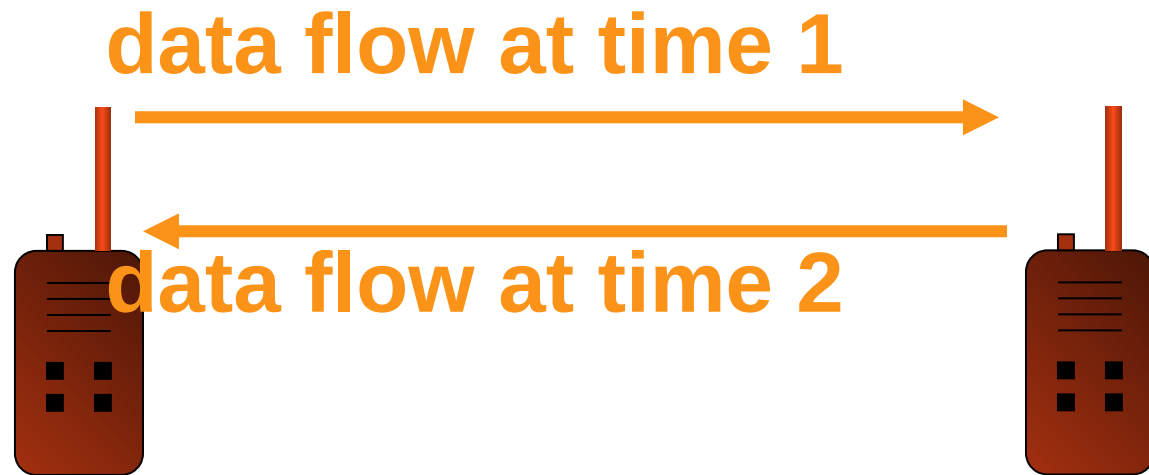
# Direction of Data Flow

**Simplex:** One direction only

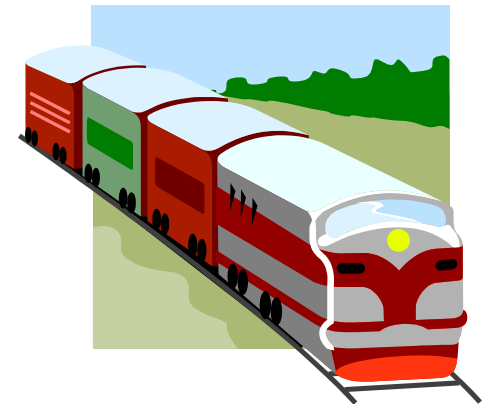


# Direction of Data Flow

**Half Duplex:** Both directions, one at a time



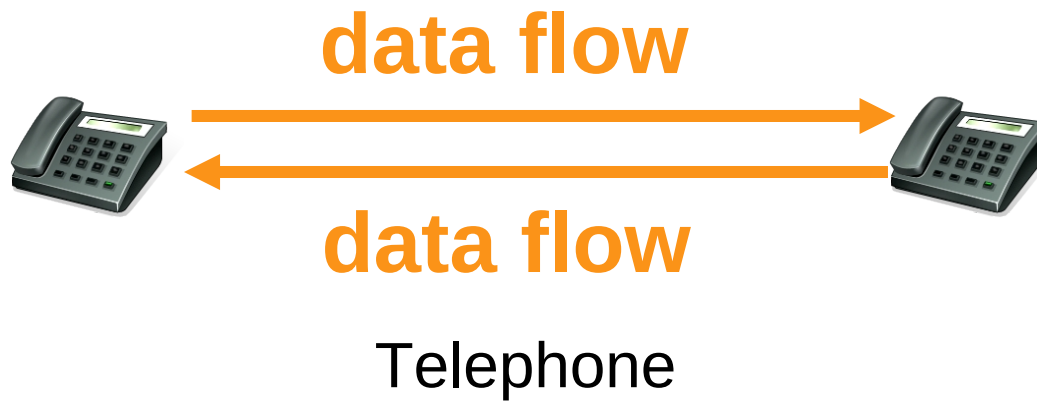
**walkie-talkies**





# Direction of Data Flow

**Full Duplex:** Both directions simultaneously

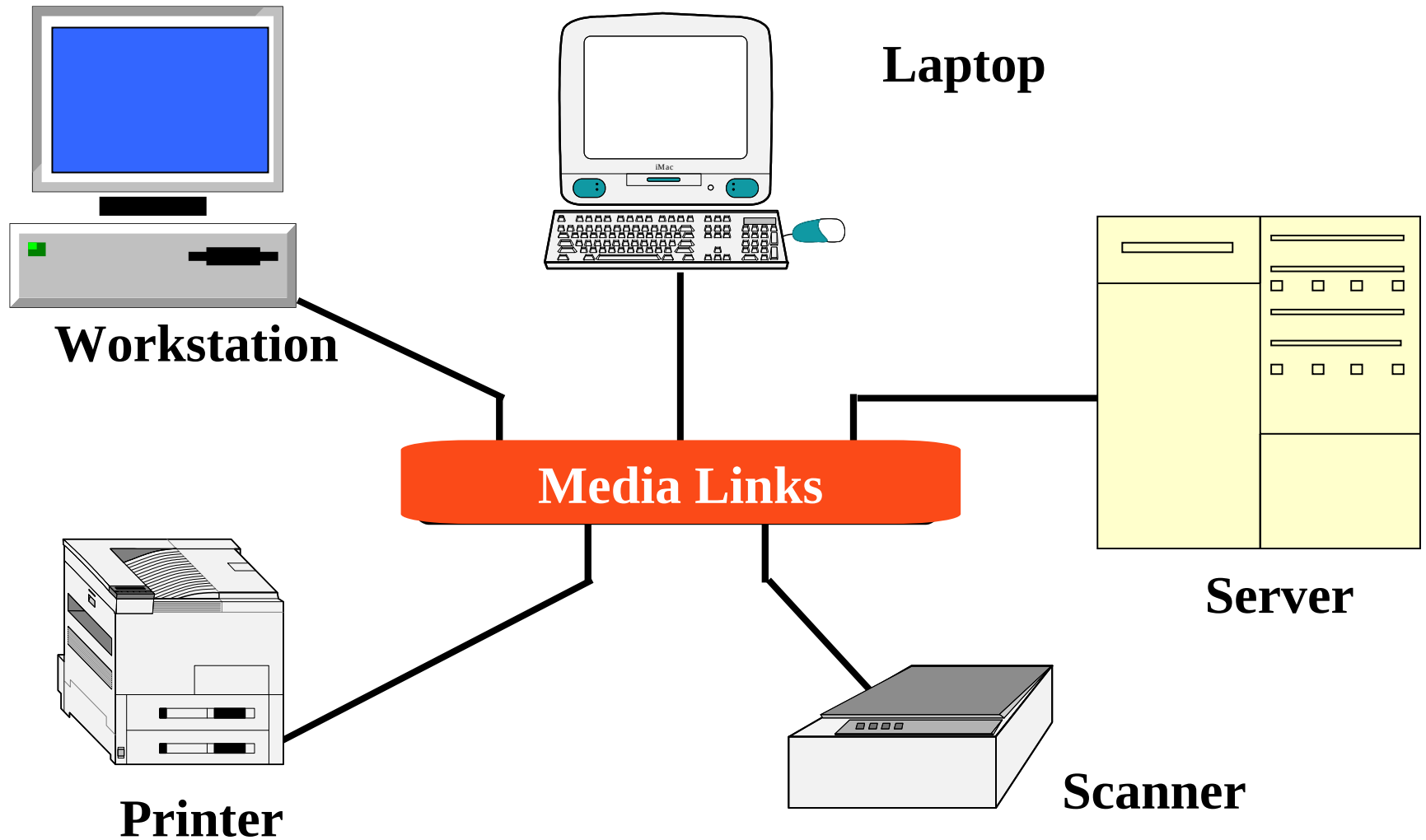


Can be emulated on a single communication link using various methods

# 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.

# Networks:



# Physical Structures

## Type of Connection:

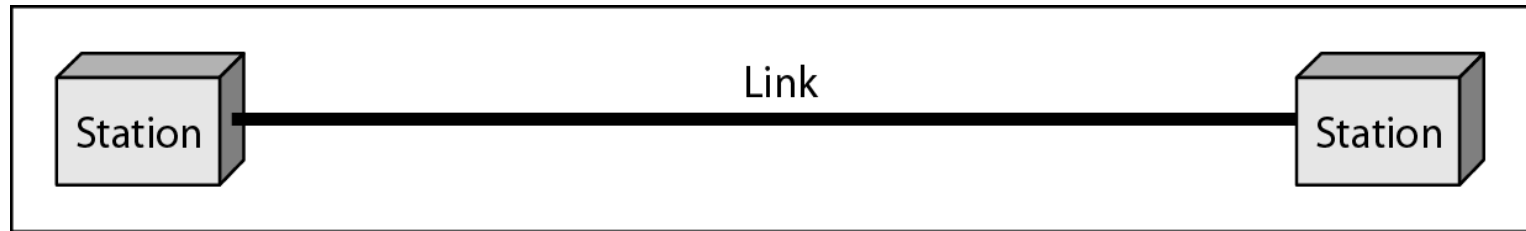
Point to Point - single transmitter and receiver

Multipoint - multiple recipients of single transmission

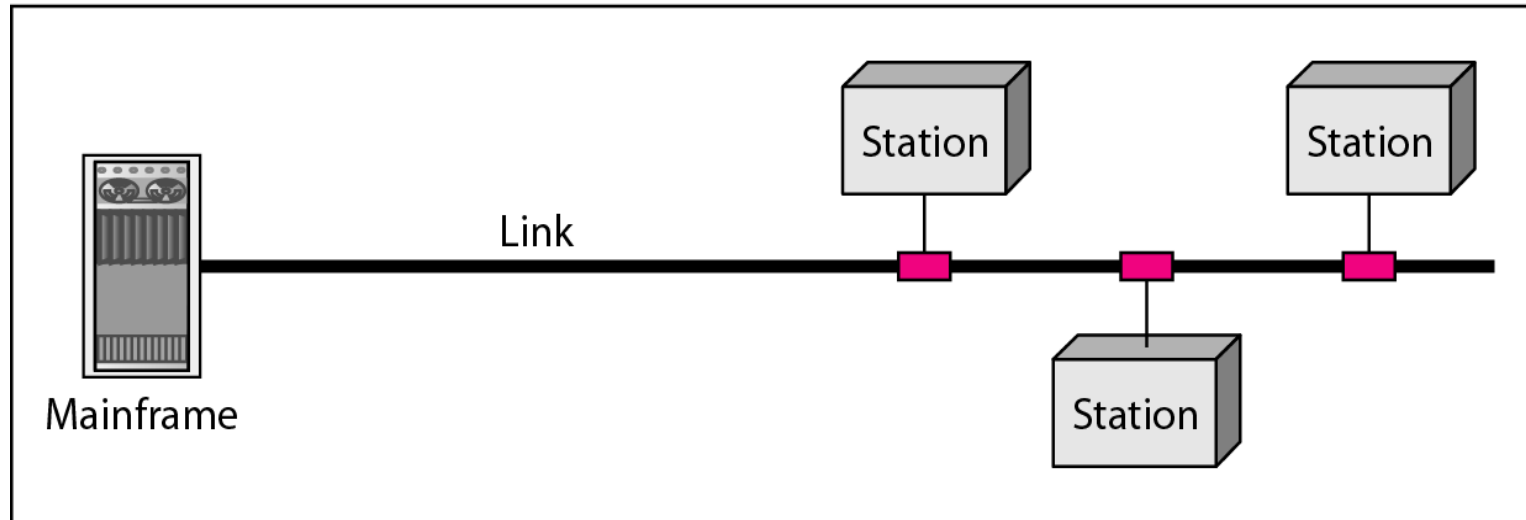
Physical Topology-Connection of devices

Type of transmission - unicast, multicast, broadcast

# Types of connections: point-to-point and multipoint

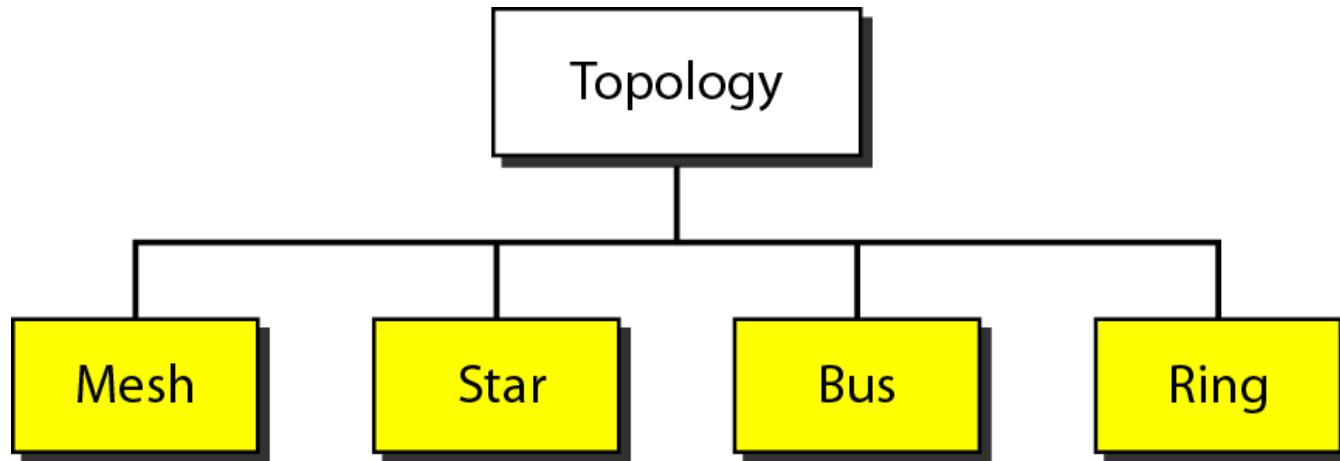


a. Point-to-point

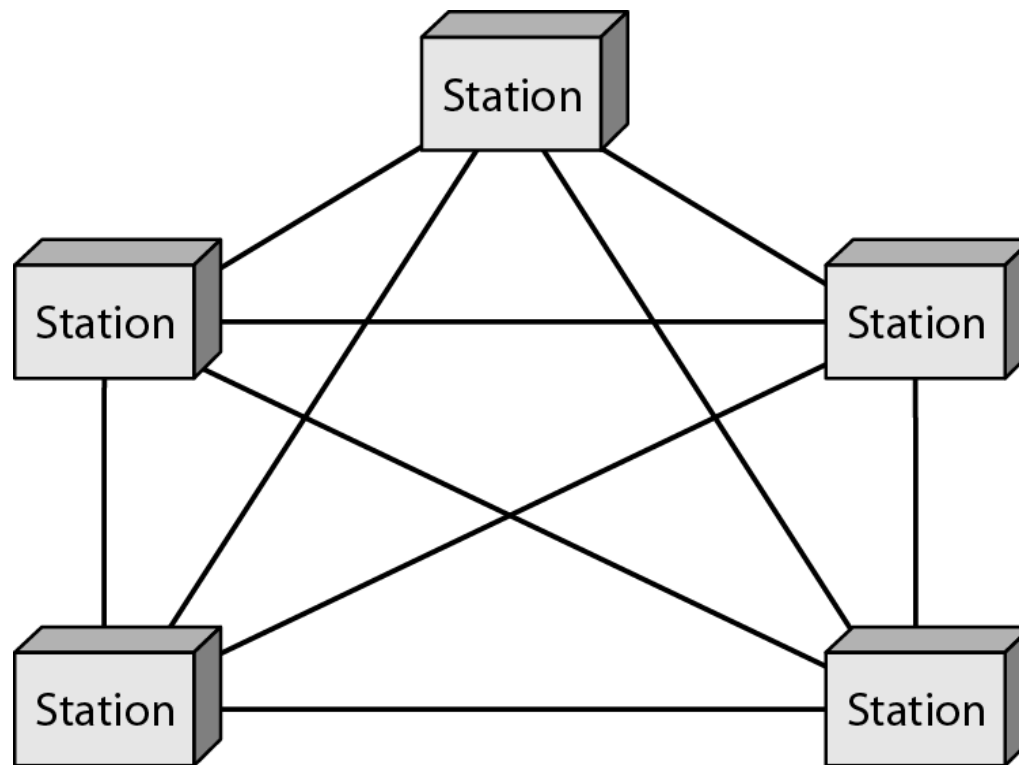


b. Multipoint

# Topology



# Mesh Topology:



# Advantages and Disadvantage:

## Pros:

- Dedicated links
- Robustness
- Privacy
- Easy to identify fault

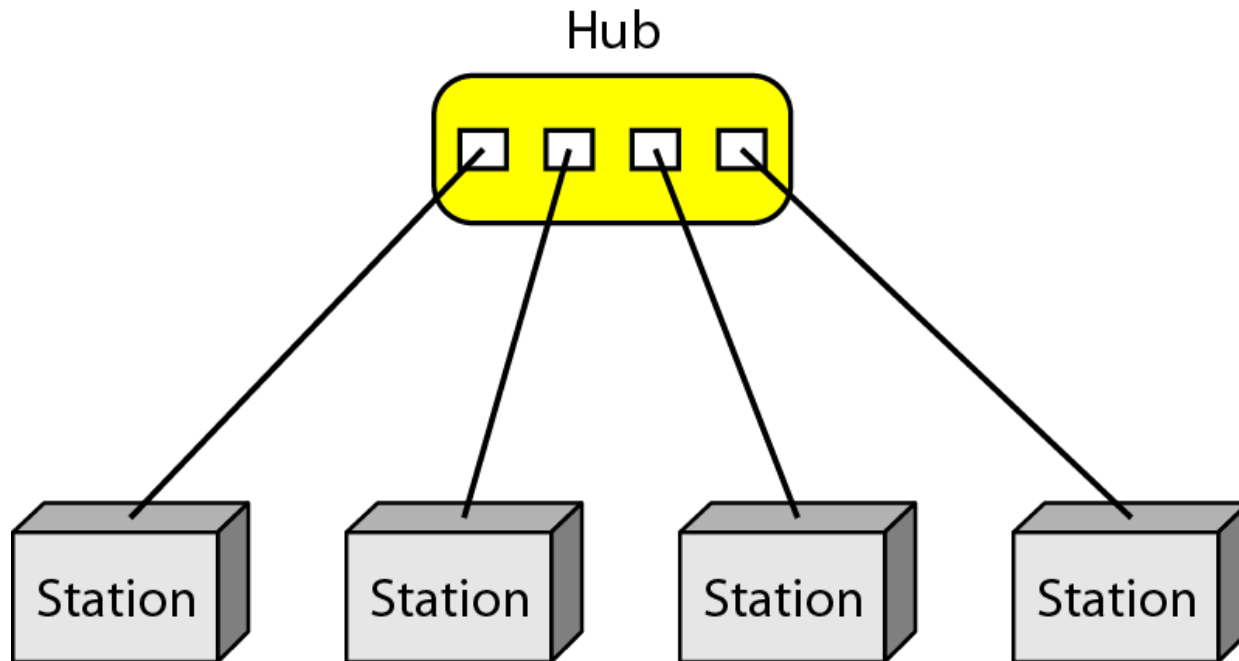
## Cons:

- A lot of cabling
- I/O ports
- Difficult to move

**Example:** Zigbee, WAN, Telephone Office



# Star Topology



# **Advantages and Disadvantage:**

## **Pros:**

Dedicated links

Robustness

Privacy

Easy to identify fault

## **Cons:**

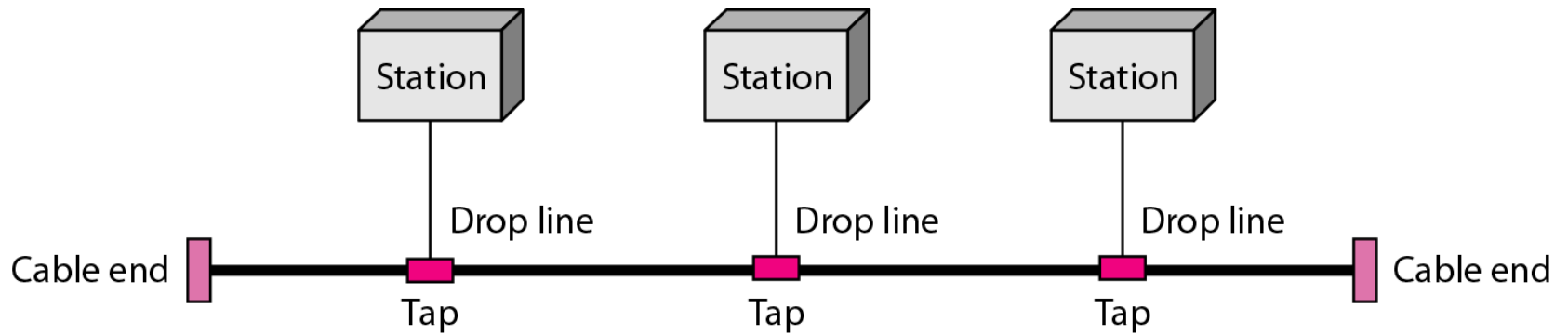
A lot of cabling

I/O ports

Difficult to move

**Example:** LAN

# Buss Topology:



# Advantages and Disadvantage:

## Pros:

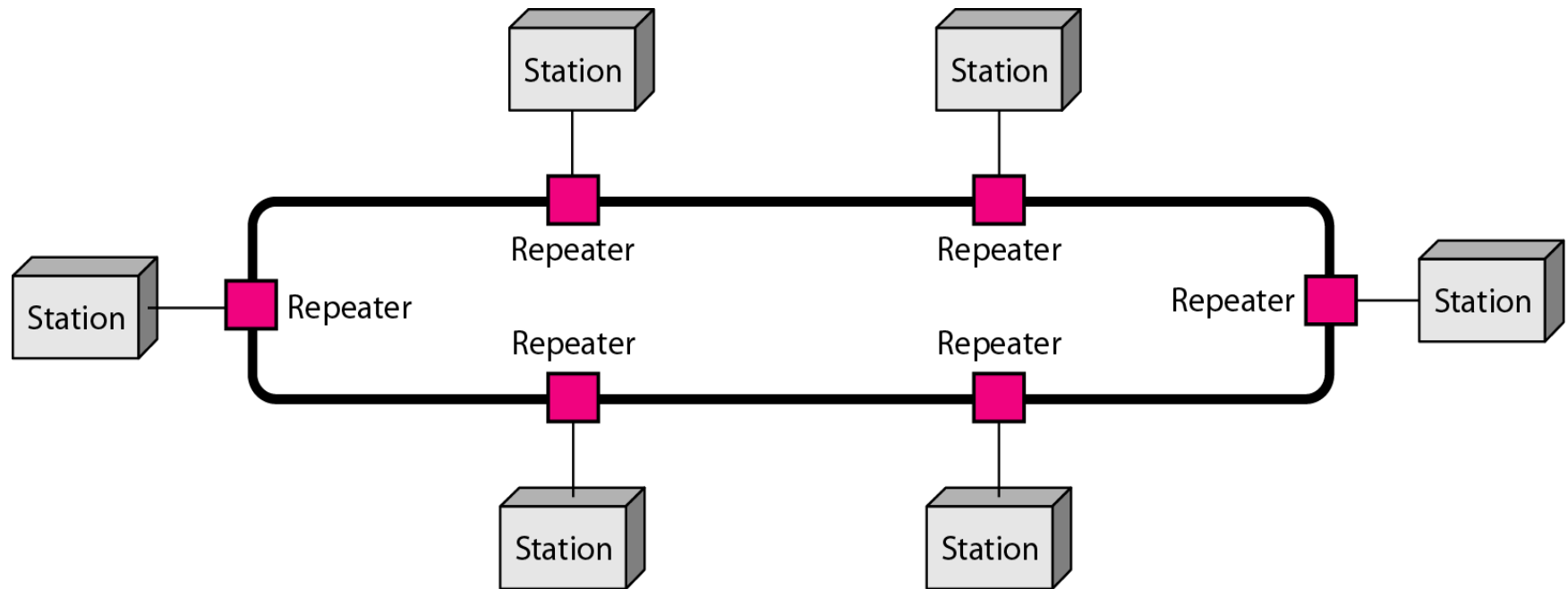
- Little cabling
- Easy to install

## Cons:

- Difficult to modify
- Difficult to isolate fault
- Break in the bus cable stops all transmission

**Example:** Most of the computer MotherBoard

# Ring Topology:



# Advantages and Disadvantage:

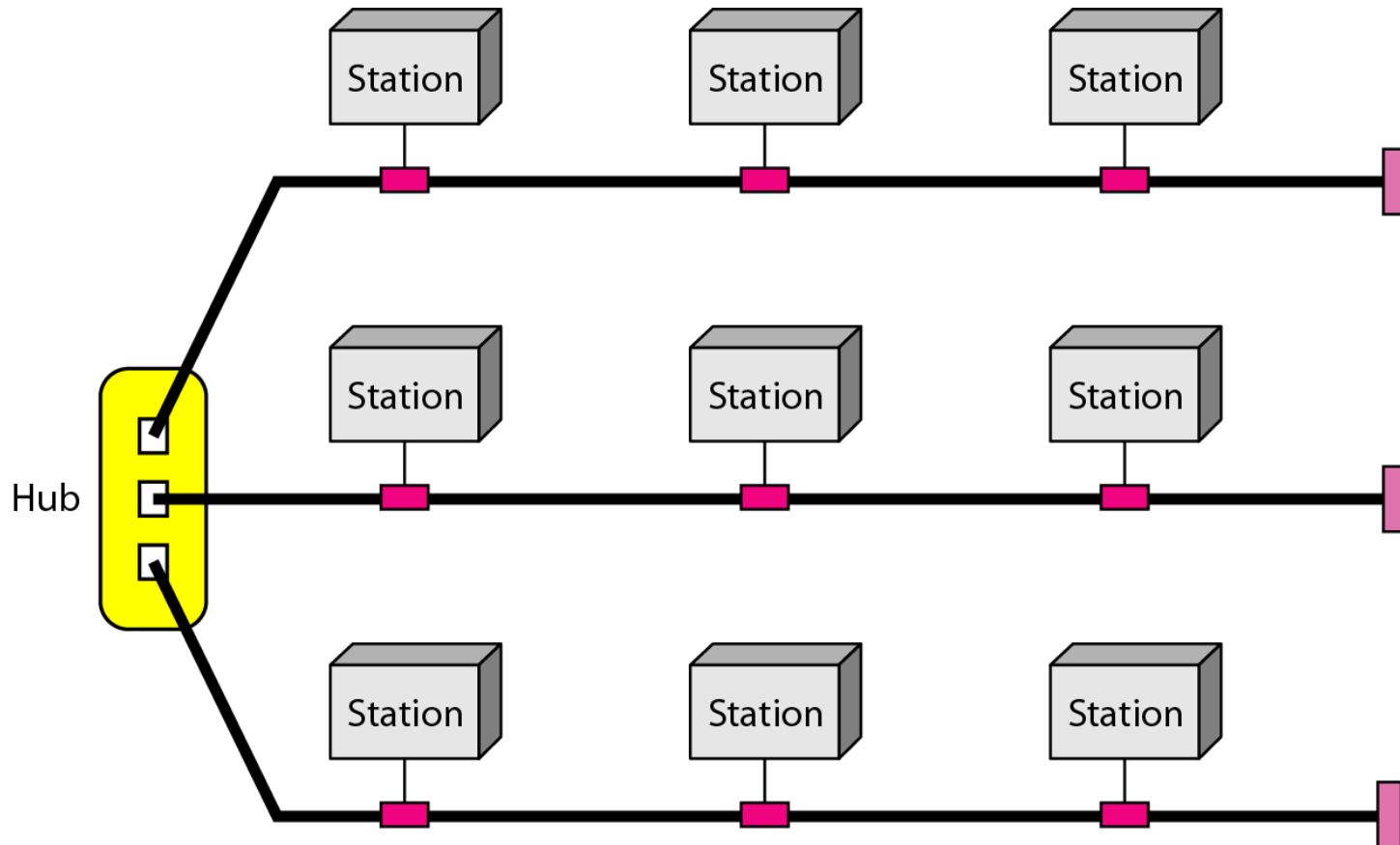
## Pros:

- Little cabling
- Easy to install

## Cons:

- Difficult to modify
- Difficult to isolate fault
- Break in the bus cable stops all transmission
- Example: Office or School

# 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

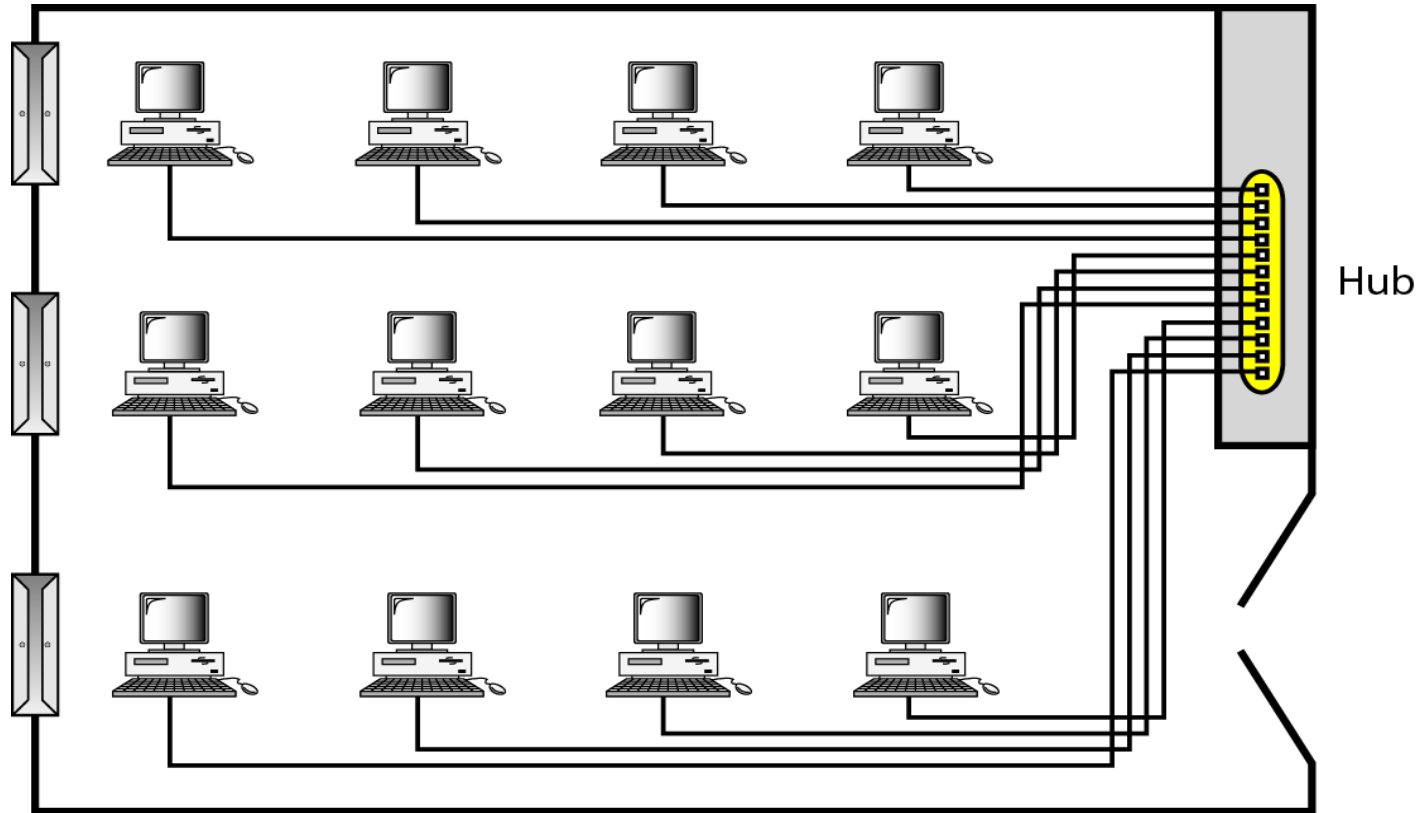
Provide connectivity over large areas

## **Metropolitan Area Networks (MANs)**

Provide connectivity over areas such as a city, a campus

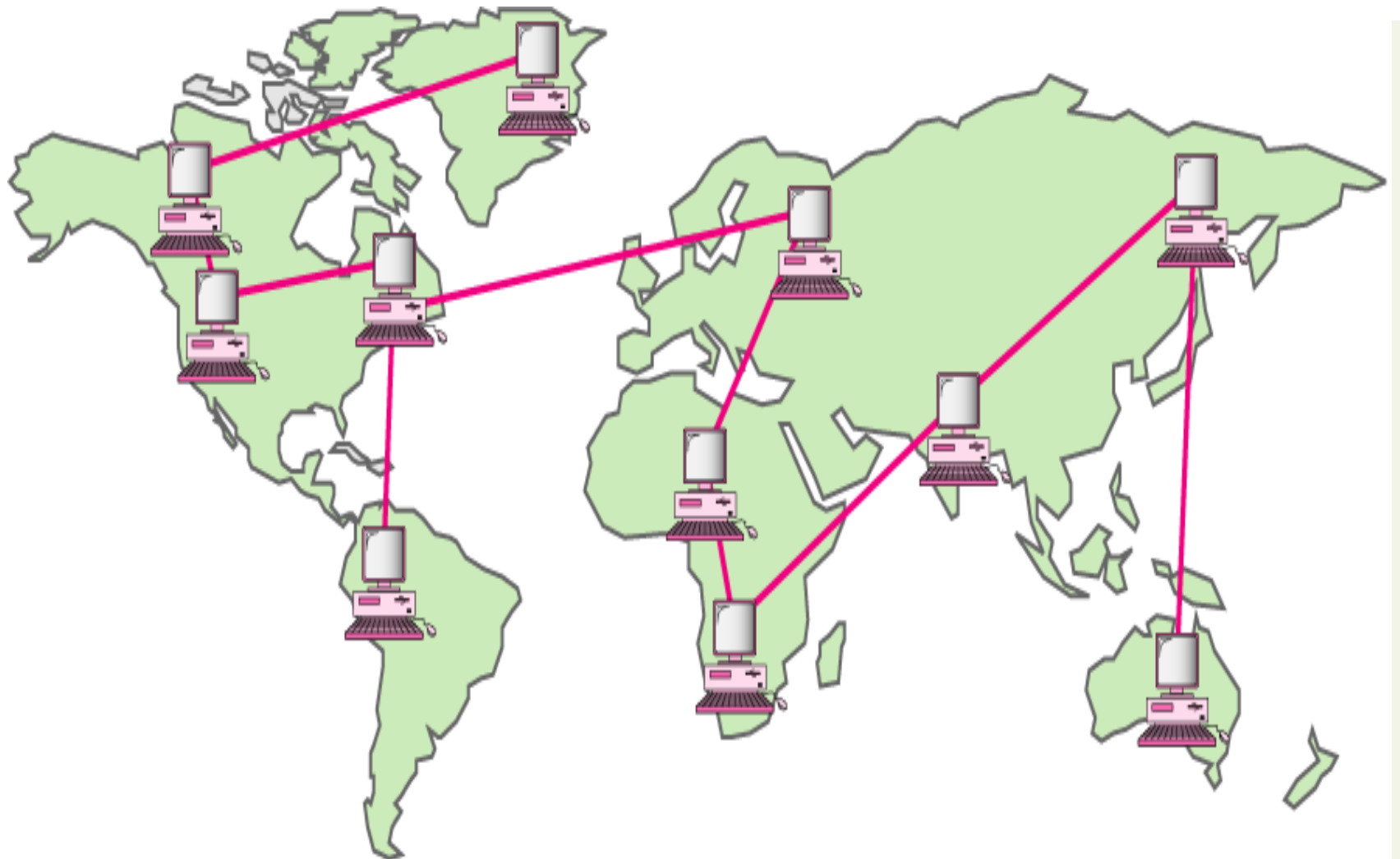


# An isolated LAN connecting 12 computers to a hub in a closet



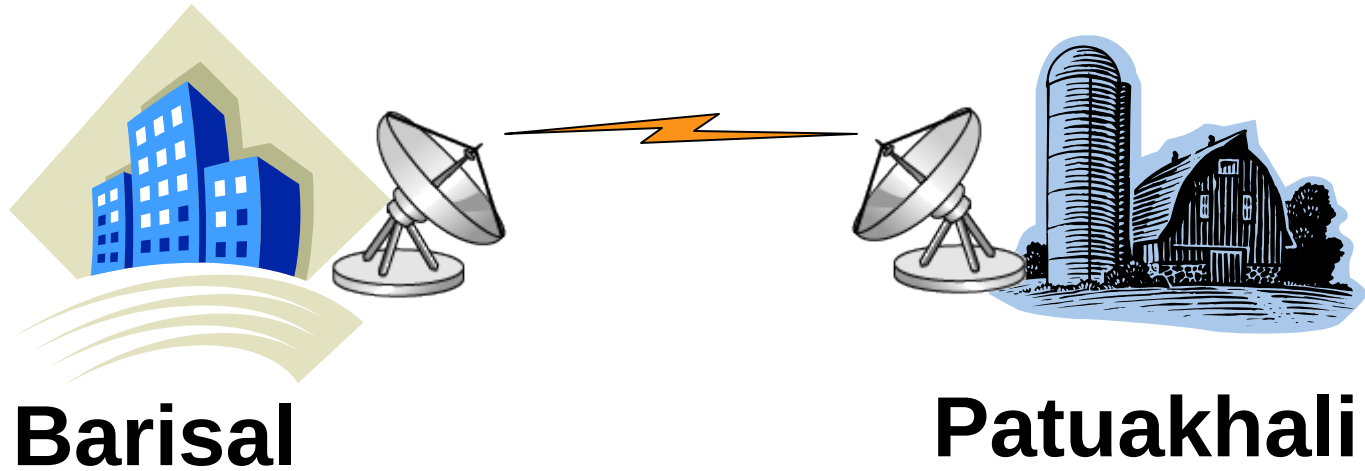
**Example: Single Office , Building or School**

# WANs

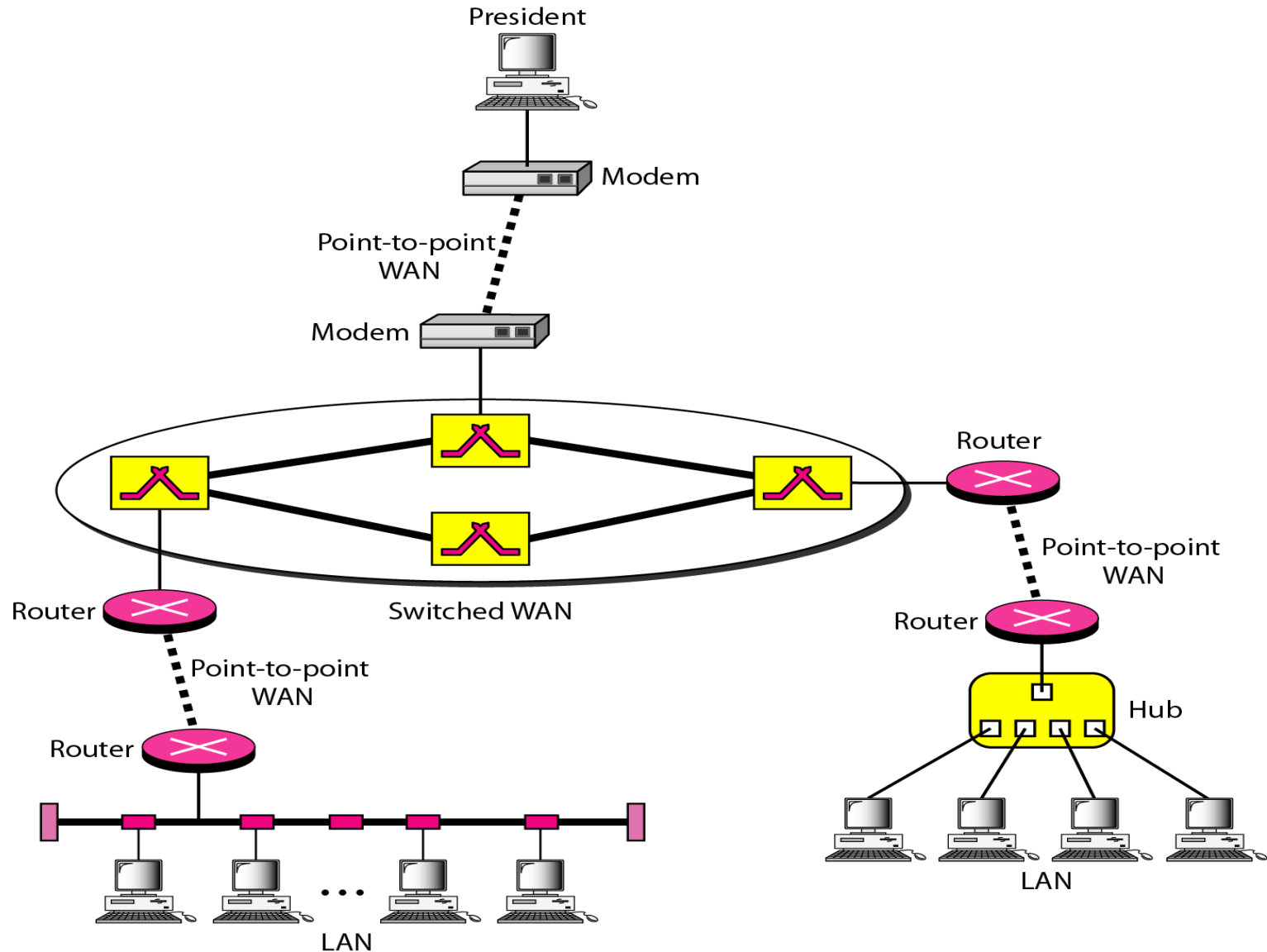


# Metropolitan Area Networks:

Network extended over an entire city

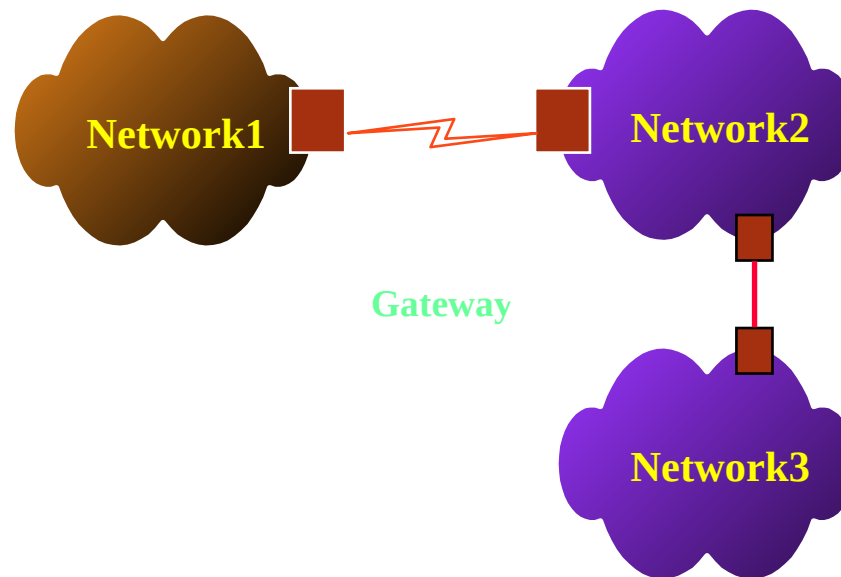


# A heterogeneous network made of four WANs and two LANs



# Internetworks:

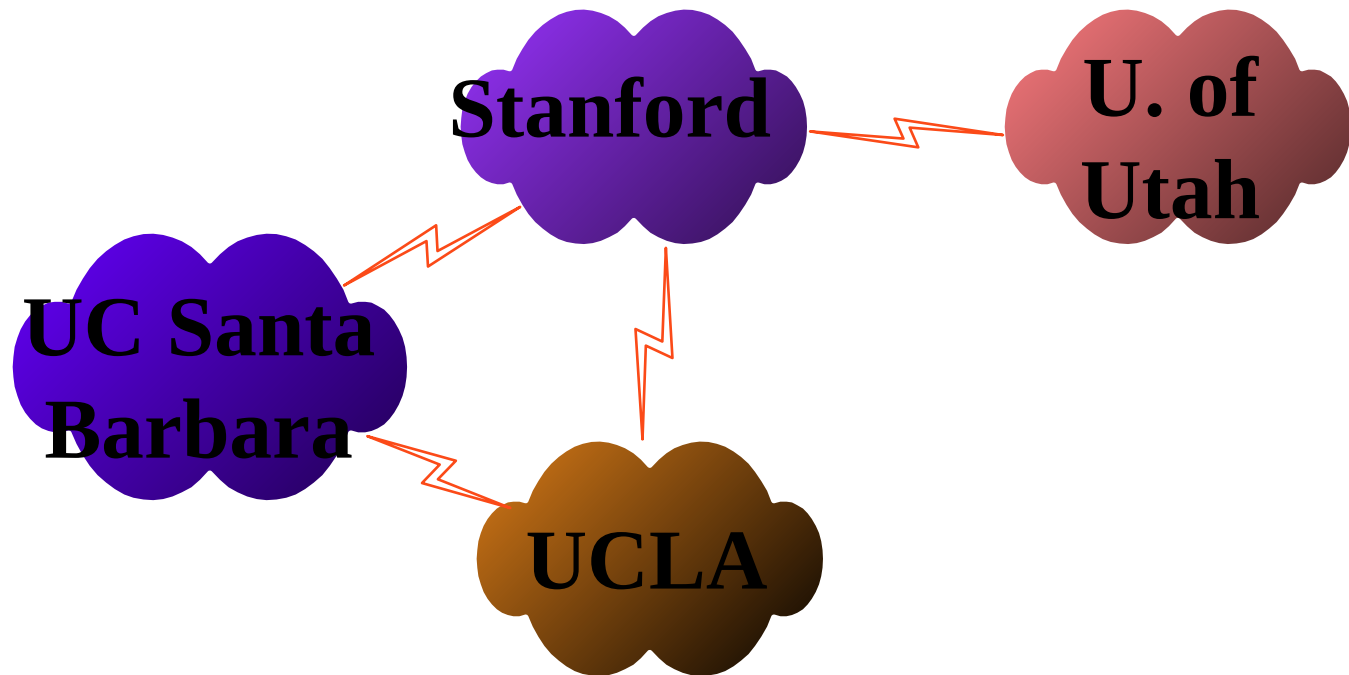
Two or more networks connected become an internetwork, or internet



**Example: The Internet**

# The Internet:

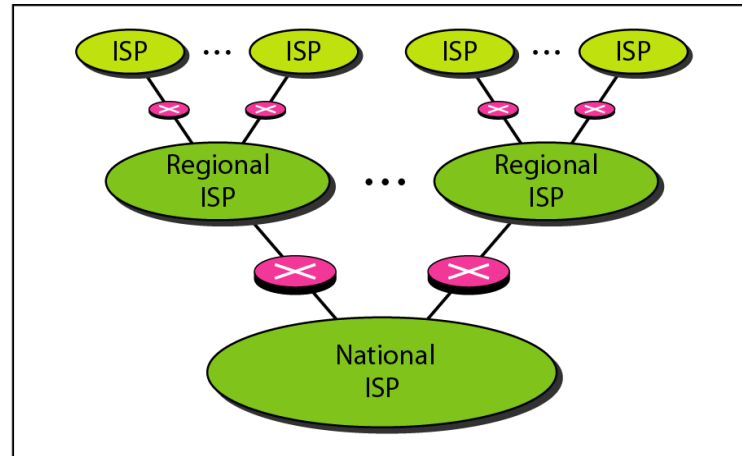
- The largest internetwork (network of networks) in the world
- Devices communicating with TCP/IP protocol suite



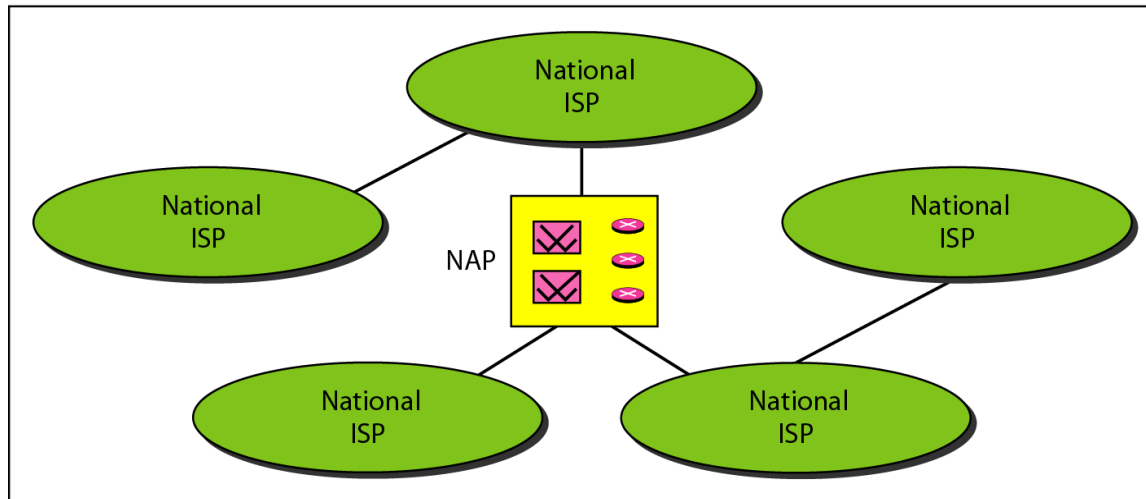
## **The Internet:**

The Internet has revolutionized many aspects of our daily lives. It has affected the way we do business as well as the way we spend our leisure time. The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

# Hierarchical organization of the Internet



a. Structure of a national ISP



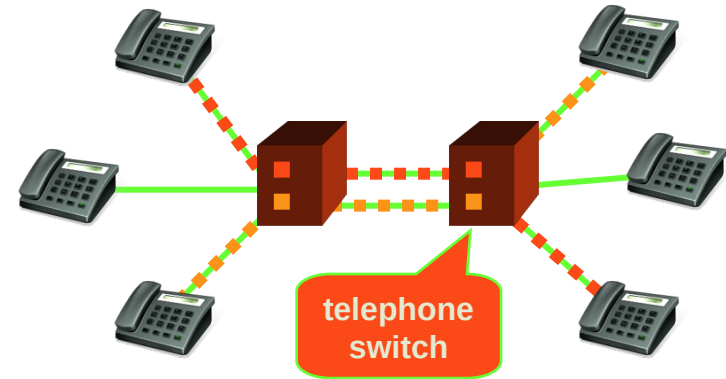
b. Interconnection of national ISPs



# Switching:

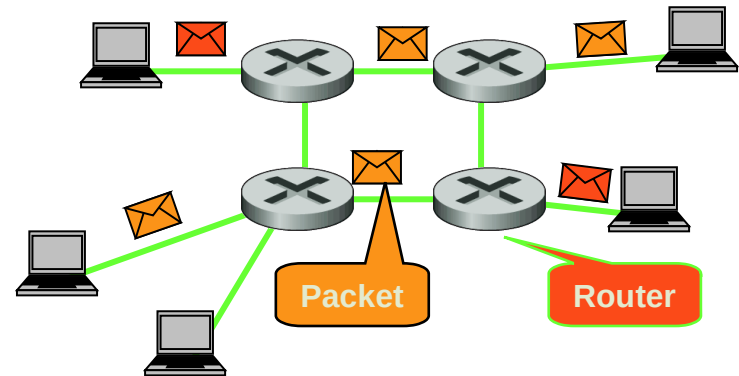
## Circuit switching

- Telephone switches establish circuits for communication



## Packet switching

- Data are put into packets
- Each stamped with **source** and **destination** addresses
- **Routers** know where to forward packets



## Circuit Switching

In-circuit switching has there are 3 phases:

- i) Connection Establishment.
- ii) Data Transfer.
- iii) Connection Released.

In-circuit switching, each data unit knows the entire path address which is provided by the source.

In-Circuit switching, data is processed at the source system only

Circuit switching is more reliable.

Wastage of resources is more in Circuit Switching

It is not a store and forward technique.

Transmission of the data is done by the source.

In-Circuit Switching there is a physical path between the source and the destination

## Packet Switching

In Packet switching directly data transfer takes place.

In Packet switching, each data unit just knows the final destination address intermediate path is decided by the routers.

In Packet switching, data is processed at all intermediate nodes including the source system.

Packet switching is less reliable.

Less wastage of resources as compared to Circuit Switching

It is a store and forward technique.

Transmission of the data is done not only by the source but also by the intermediate routers.

In Packet Switching there is no physical path between the source and the destination

# Protocol

A protocol is 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

# Elements of a Protocol

## Syntax

Structure or format of the data

Indicates how to read the bits - field delineation

## Semantics

Interprets the meaning of the bits

Knows which fields define what action

## Timing

When data should be sent and what

Speed at which data should be sent or speed at which it is being received.

Hub	Switch	Router
Work on physical Layer	Work on data link layer	Work on network layer
Layer 1	Layer 2	Layer 3
Half duplex	Full duplex	
Work on the basis of MAC address	Work on the basis of IP address	Work on the basis of IP address
Data Transmission is electrical signals or bits	Data Transmission is frame or packets	Data Transmission is based on protocol
Used in LAN	Used in LAN	Used in LAN / WAN

## References:

**1.**B.A. Forouzan, *Data Communications and Networking*, 4 rd. Edition.

**2.**[https://www.tutorialspoint.com/  
data\\_communication\\_computer\\_network/index.htm](https://www.tutorialspoint.com/data_communication_computer_network/index.htm)