Communications Networks

Communication

- **Communication:**

- When we communicate we *share* information.
- Sharing can be *local* or *remote*.

- Local: face-to-face
- Remote: over distance

Communication

- What is **Communication?**

- **Data ->** "*Information presented in whatever form is agreed upon by the parties creating and using the data*".
- **Data Communication ->**It is the *exchange of Information* from one *entity* to the other using a *Transmission Medium*".

Communication

- **Data Communication Definition** (Modified)

- "Data Communication is the exchange of data (in the form of 0's and 1's) between two devices (computers) via some form of the transmission medium."

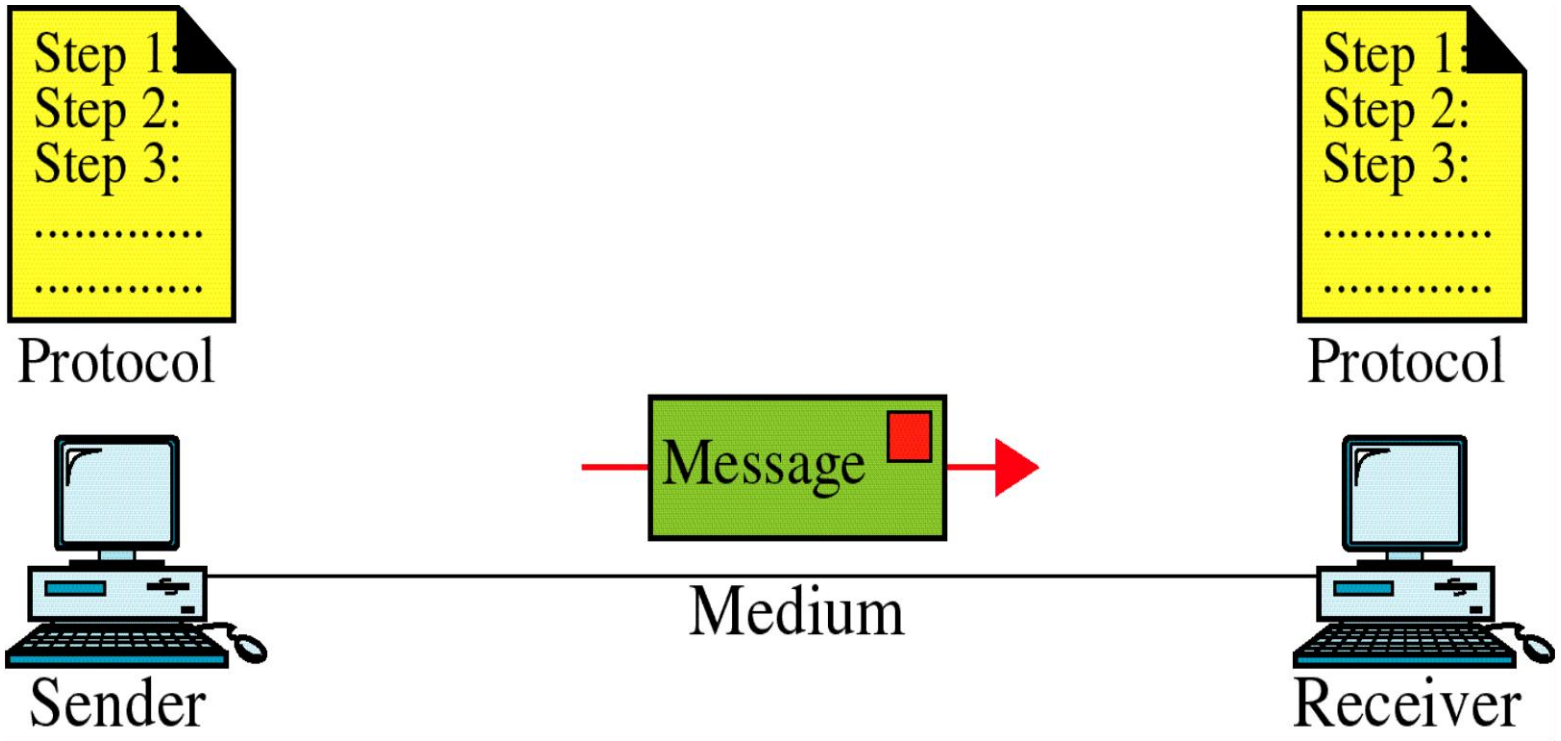
Communication

- **Effectiveness of Data Communication System**

- Effectiveness depends upon three fundamental characteristics:
  - **Delivery:** the system must deliver data to the correct destination.
  - **Accuracy:** the system must deliver the data accurately. Data that is altered during the transmission and left uncorrected are unusable.
  - **Timeliness:** the system must deliver data in a timely manner.

Communication

- Components of a Simple Communication System



Communication

- **Components of a Communication System**

- A Communication system is made up of 5 components:

  - **Message**
  - **Sender**
  - **Receiver**
  - **Medium**
  - **Protocol**

Communication

- **Components of a Communication System**

  - **Message**
  - It is the information (data) to be communicated.
  - It can consist of *text*, *numbers*, *pictures*, *sound* or *video*.
  - **Sender:**
  - The sender is the device that send the data massage.
  - It can be a:
    - Computer
    - Workstation
    - Telephone handset
    - Video camera etc

Communication

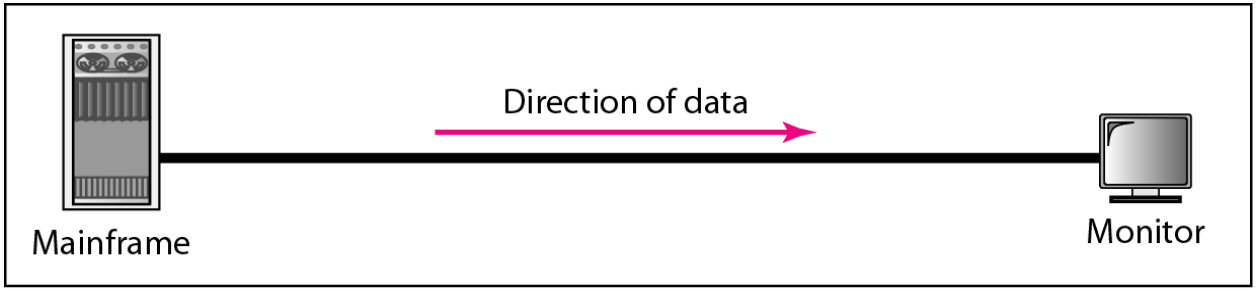
- **Components of a Communication System**

  - **Receiver:**
  - The ***device*** that receives the message.
  - **Medium:**
  - The medium (or communication channel) is the path through which the message travels from the sender to the receiver. Can be wired or wireless
  - **Protocol:**
  - A protocol is a set of rules that defines how data is transmitted and received in a communication network.

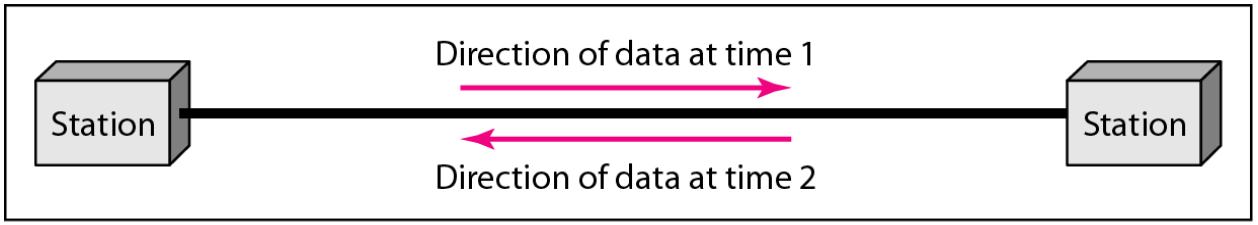
Communication

- **Direction of Dataflow:**
- Communication between two devices can be:
  - **Simplex**
  - **Half-duplex**
  - **Full-duplex**

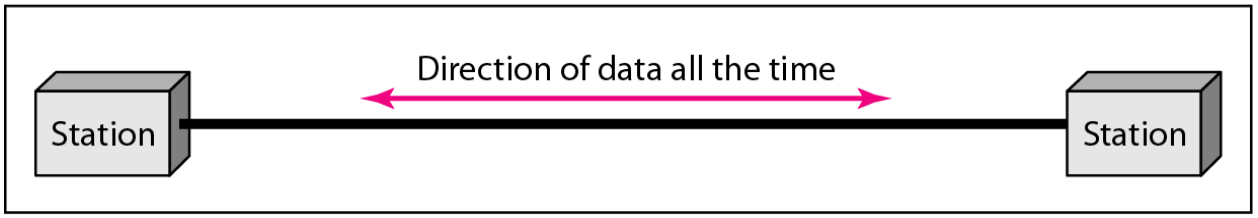
Communication



a. Simplex



b. Half-duplex



c. Full-duplex

Communication

- **Direction of Dataflow:**

- **Simplex:**
- The communication is unidirectional.
- i.e. one way street
- Only one of the two devices can transmit. The other can only receive.

Communication

- **Direction of Dataflow:**

- **Half-Duplex:**
- Each station can both transmit and receive, but not at the same time.
- When one devices is sending , the other can only receive and vice versa.
- **Full-Duplex:**
- Both station can transmit and receive simultaneously.

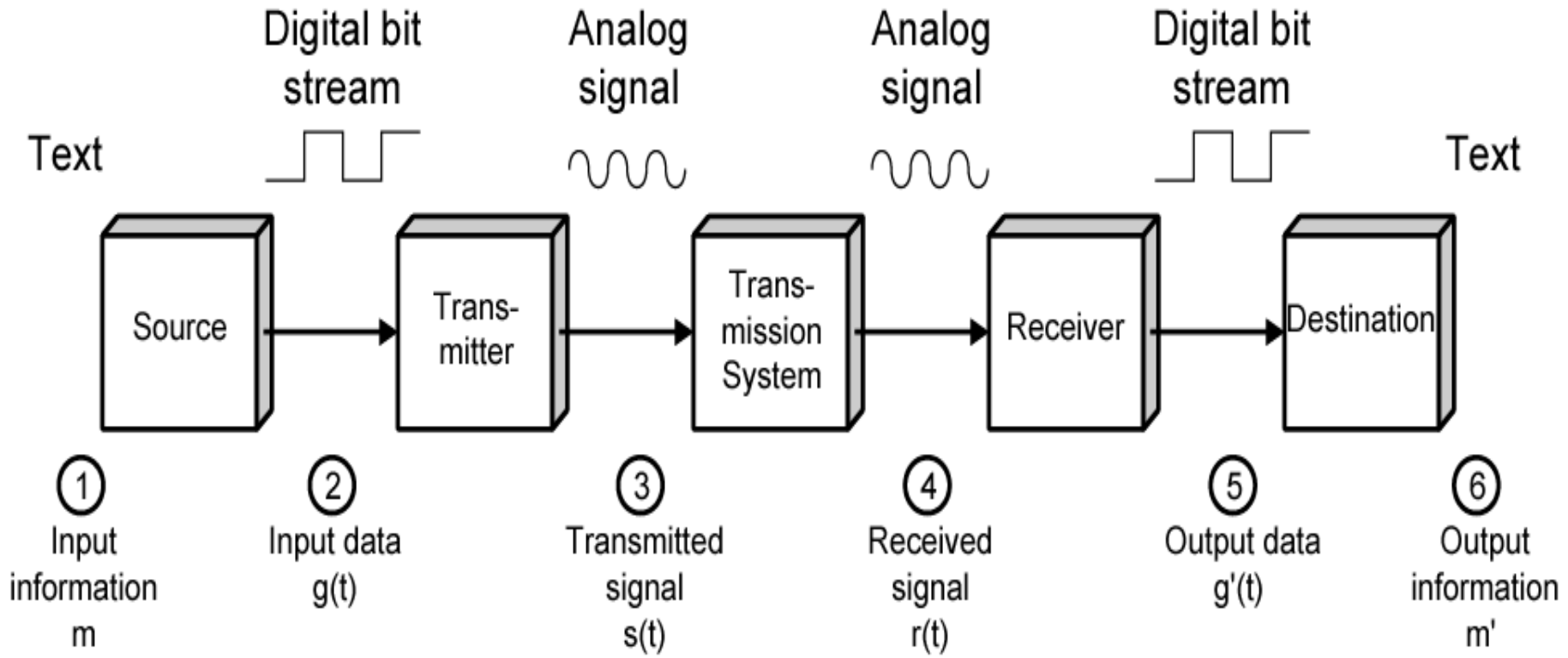
Communication

- **Transmission Media:**

Medium	Speed	Cost
Twisted Wire	300bps-10Mbps	Low
Microwave	256Kbps-100Mbps	Low
Coaxial Cable	56Kbps-200Mbps	Low
Fiber Optic Cable	500Kbps-10Gbps	High

Communication

- **A Complex Data Comm. System**



Communication

Communication

- **Sender Side**
- User of a PC wishes to send a message ‘m’
- User activates electronic mail package e.g. hotmail
- Enters the message via input device (keyboard)
- Character string is buffered in main memory as a sequence of bits ‘g’
- PC is connected to some trans system such as a Telephone Network via an I/O Transmitter like Modem
- Transmitter converts incoming stream ‘g’ into a signal ‘s’

Communication

- **Receiver Side**

- The transmitted signal ‘s’ is subject to a number of impairments depending upon the medium.
- Therefore, received signal ‘r’ may differ from ‘s’.
- Receiver attempts to estimate original ‘s’ based on its knowledge of the medium and received signal ‘r’
- Receiver produces a bit stream g’(t).
- Briefly buffered in the memory.
- Data is presented to the user via an output device like printer, screen etc.
- The data viewed by user m’ will usually be an exact copy of the data sent ‘m’

Communication

- **Key Communication Terminology**
- A "**Network**" is a set of devices (*Nodes*) connected by Communication *Links.*

- A ***node*** can be a computer, printer or any other device capable of sending and receiving data.

- A ***link*** can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.

Communication

- **Key Communication Terminology**

- **Session:** communication dialog between network users or applications. Temporary connection for a particular activity.

- **Path:** end-to-end route within a network

- **Circuit:** is basically the **path or channel** through which **data travels** between two devices during communication

Communication

- **Key Communication Terminology**

- **Packetizing:** dividing messages into fixed-length packets prior to transmission over a network's communication media

- **Routing:** determining a message's path from sending to receiving nodes

Communication

- **Network:**
- **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

Communication

- **Network:**
- **Network Criteria**

- **Security**
  - Data protection against corruption/loss of data due to:
    - Errors
    - Malicious users

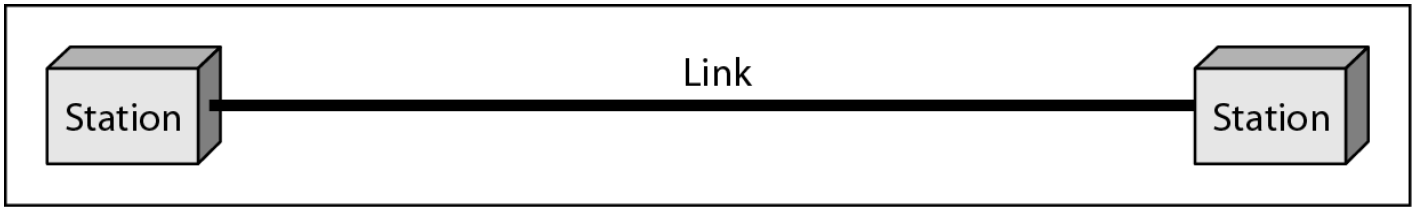
Communication

Physical Structures:

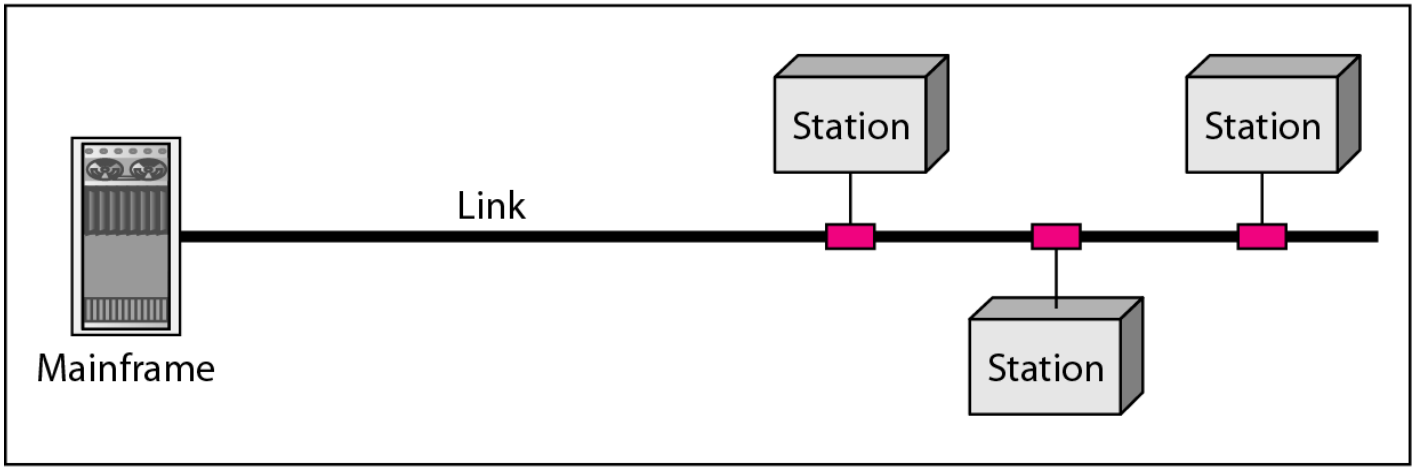
- Physical structure means the **actual way devices are connected and data is transmitted** in a network.It includes two main parts:
- **Type of Connection**
  - Point to Point - single transmitter and receiver
  - Multipoint - multiple recipients of single transmission
- **Physical Topology**
  - Connection of devices
  - Type of transmission - unicast, mulitcast, broadcast

Communication

- **Type of Connection**
- *Point-to-Point and Multipoint*



a. Point-to-point



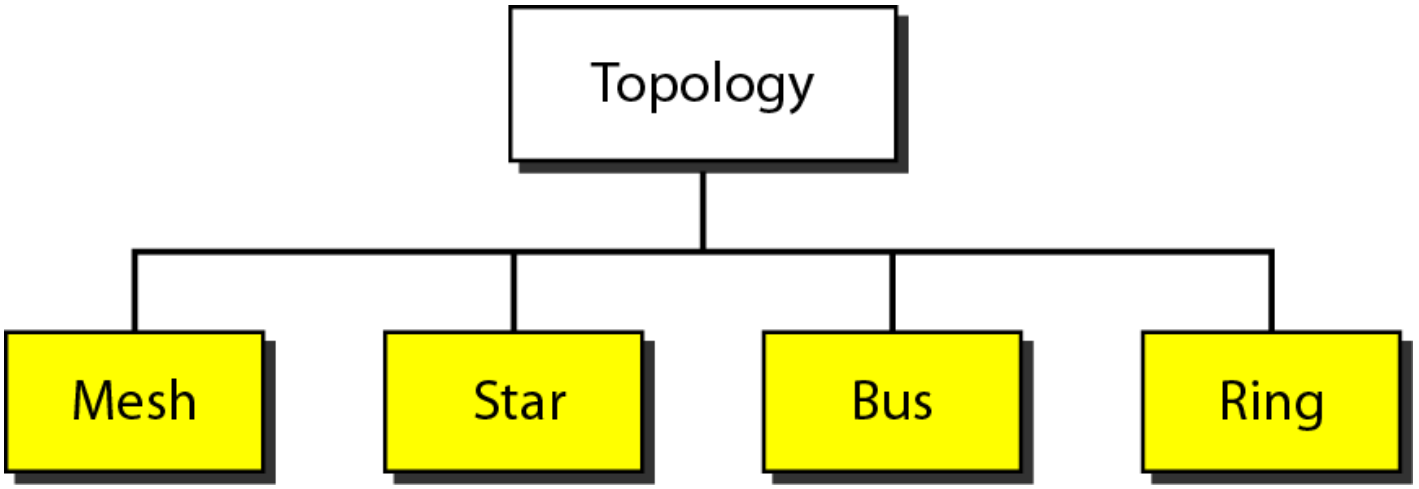
b. Multipoint

Communication

- **Physical Topology**
- The way in which a network is laid out physically.
- Two or more devices connect to a link .
- Two or more links form a ***topology***.
- Topology of a network is the geometric representation of the relationship of all the links and devices.

Communication

- **Categories of Topologies:**



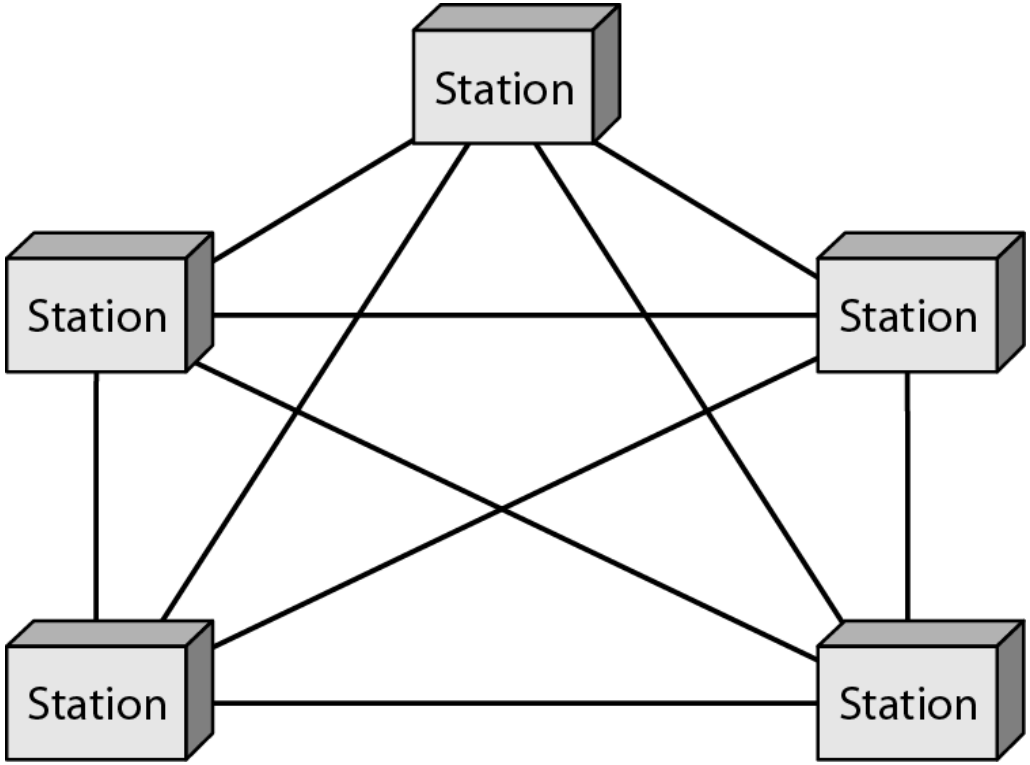
Communication

- **Physical Topologies:**
- **Mesh Topology**
- Every device has a dedicated point-to-point link to every other device.
- A fully connected mesh network has:
  - ***n(n-1)/2***

  physical channels to link ***"n"*** devices.
- Every devices on the network has n-1 input/output ports.
- Reliable
- Cost High
- Security

Communication

- **Mesh Topology**



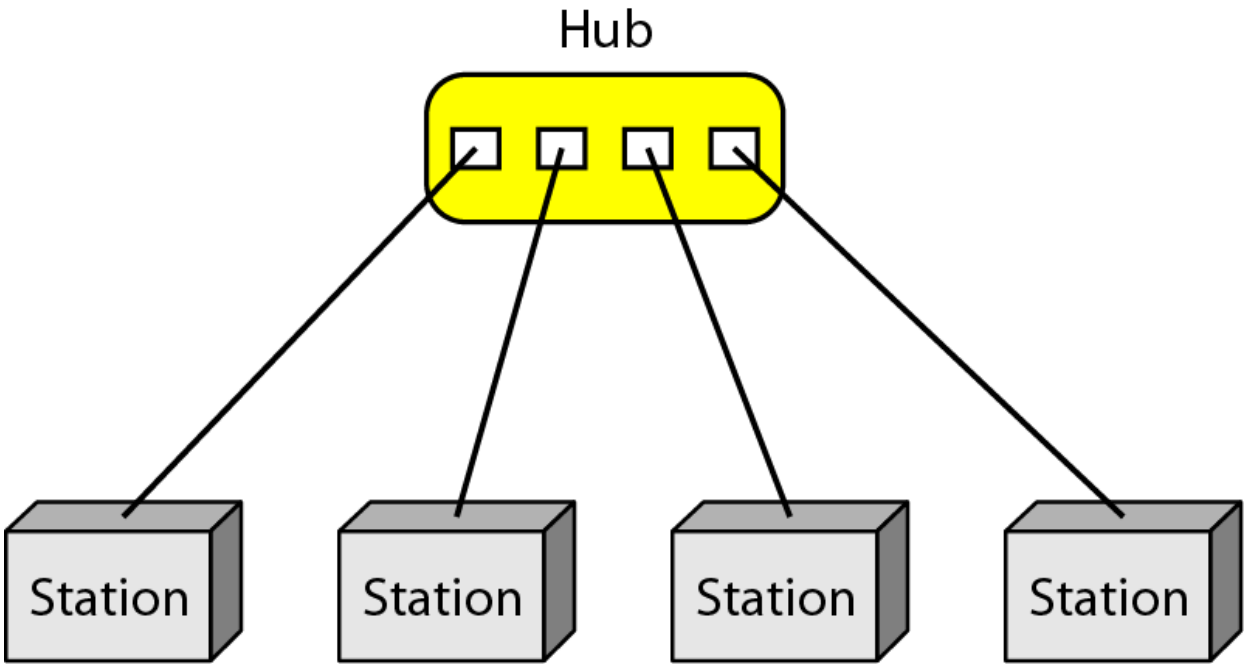
Communication

- **Physical Topologies:**

- Star Topology
- Each device has a point-to-point dedicated link to a central controller, usually a **hub**.
- The devices are not directly linked to each other.

Communication

- **Star Topology**



Communication

- **Physical Topologies:**

- **Bus Topology**
- It is multipoint.
- 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 between devices and 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.

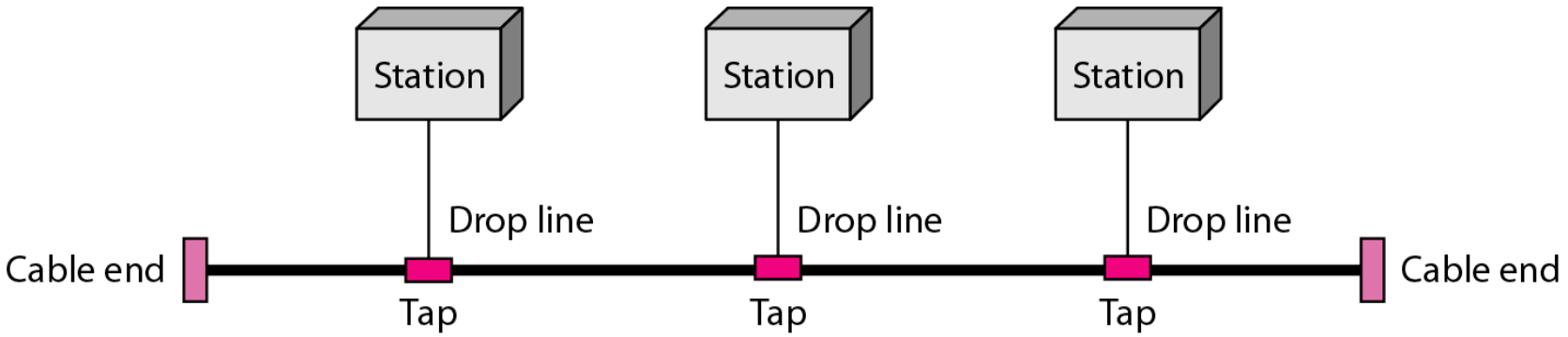
Communication

- **Physical Topologies:**

- **Bus Topology**
- A Bus Topology can *support limited number of taps* as the signal travels along the backbone, some of its energy is transformed into heat and becomes weaker.

Communication

- **Physical Topologies:**
- **Bus Topology**



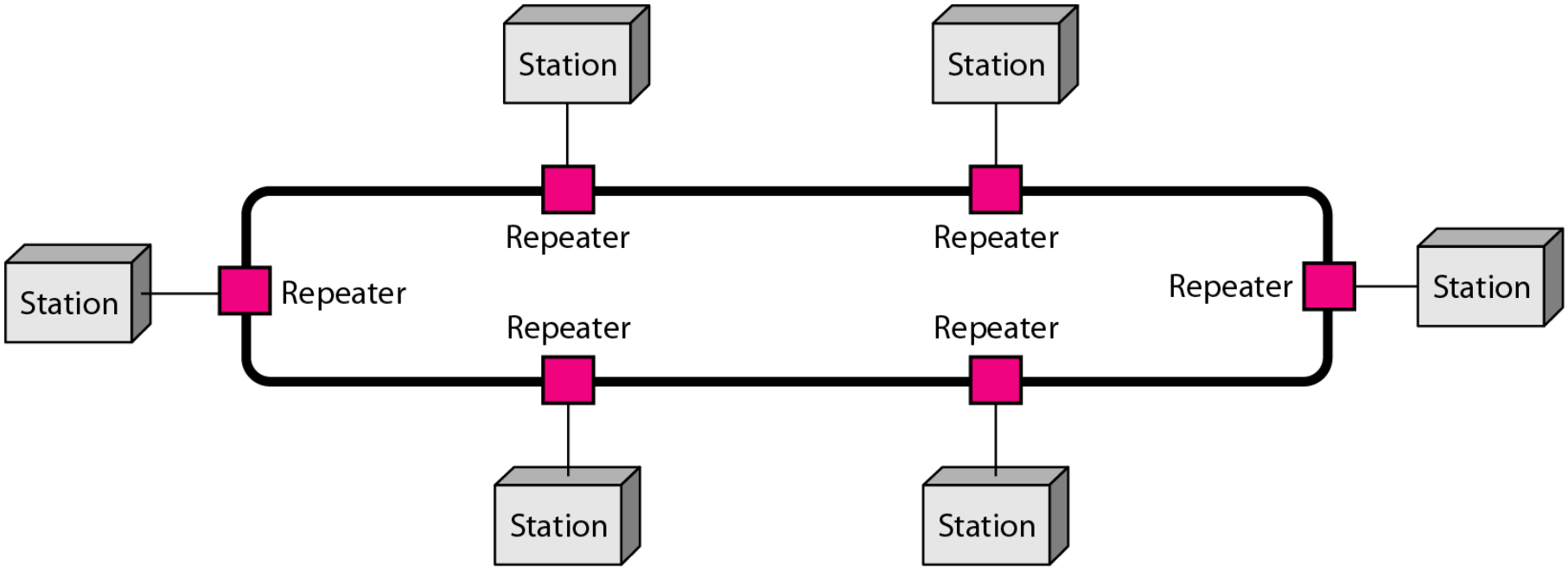
Communication

- **Physical Topologies:**

- **Ring Topology**
- Each device has a point-to-point dedicated connection with only two devices on either side of it.
- Signal is passed from *device to device* along the ring *in one direction*, until it reaches its destination.
- Each device has a ***repeater***.
- The received signal if intended for another device, then the device repeater regenerates the bits and passes them along.

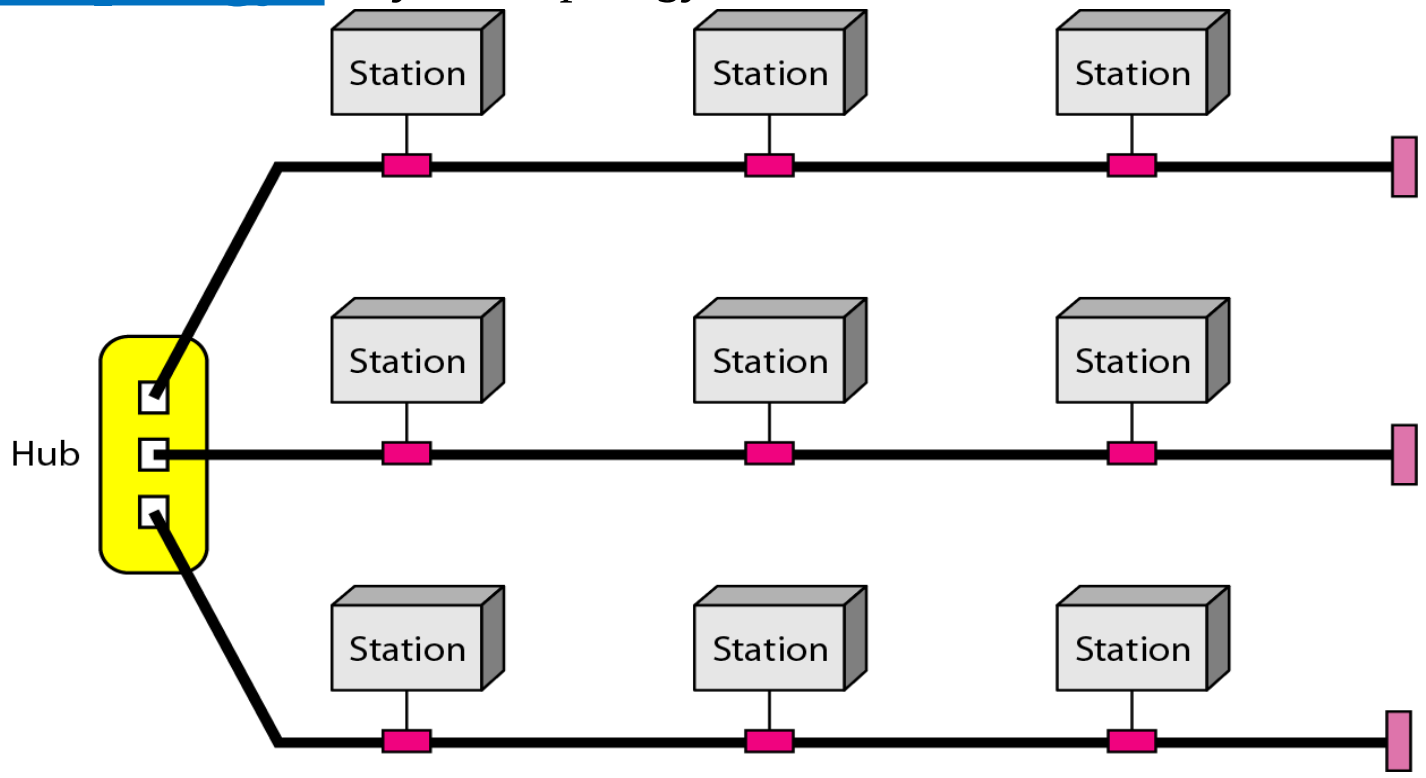
Communication

- **Physical Topologies:**
- **Ring Topology**



Communication

- **Physical Topologies:**
- **Hybrid Topology (***A hybrid topology: a star backbone with three bus networks)*



Communication

- **Categories of a Network:**

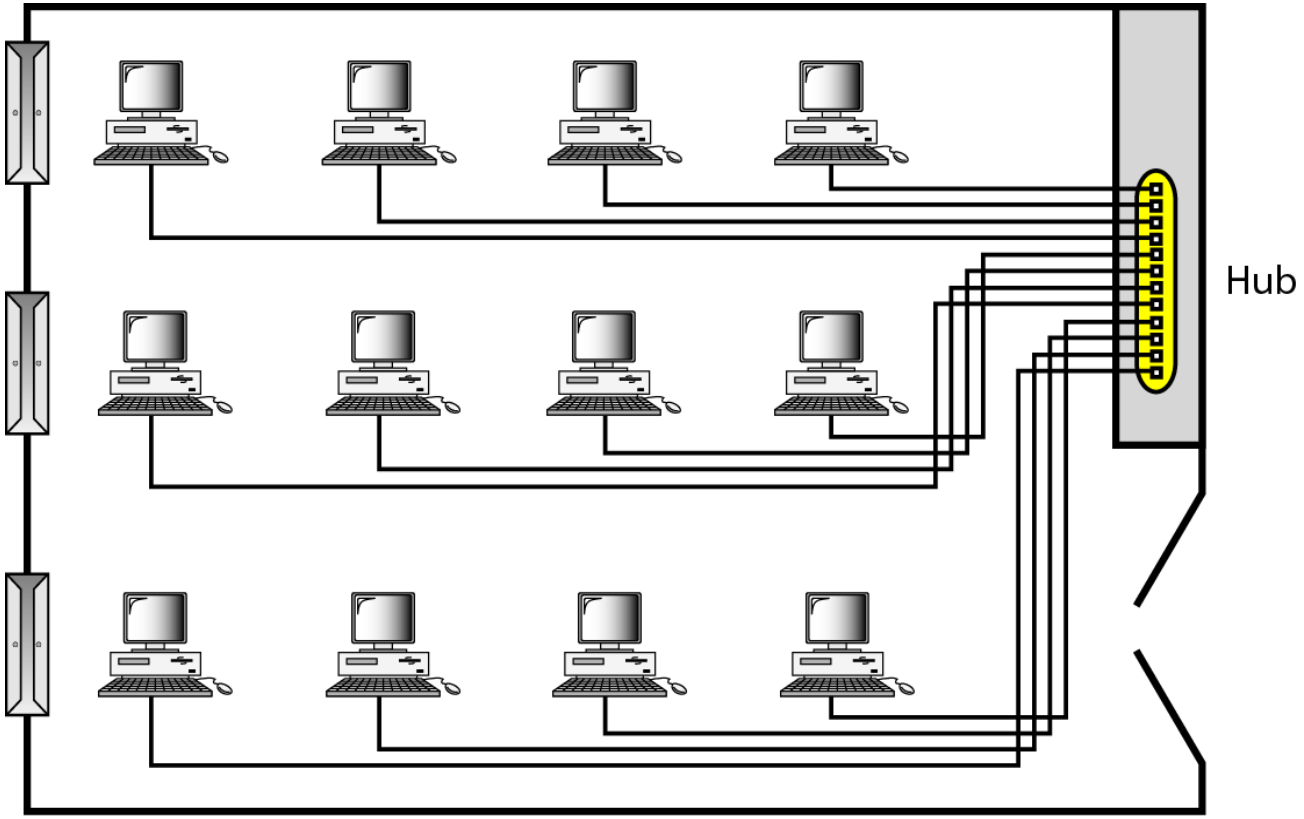
- The categories into which a network falls is determined by its size.
- Typically a network falls into the following types of network:
- **Local Area Network (LAN)**
- **Wide Area Network (WAN)**
- **Metropolitan Area Network (MAN)**

Communication

- **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 MAN is larger than a local area network (LAN) but smaller than a wide area network (WAN).

Communication

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



Communication

- **Local Area Network:**

- A **Local Area Network (LAN)** is a network that connects **computers and devices within a small area** — like a **room**, **building**, or **campus** — so they can **share data and resources** (like printers, files, or internet).
- LAN size is limited to few kilometers.

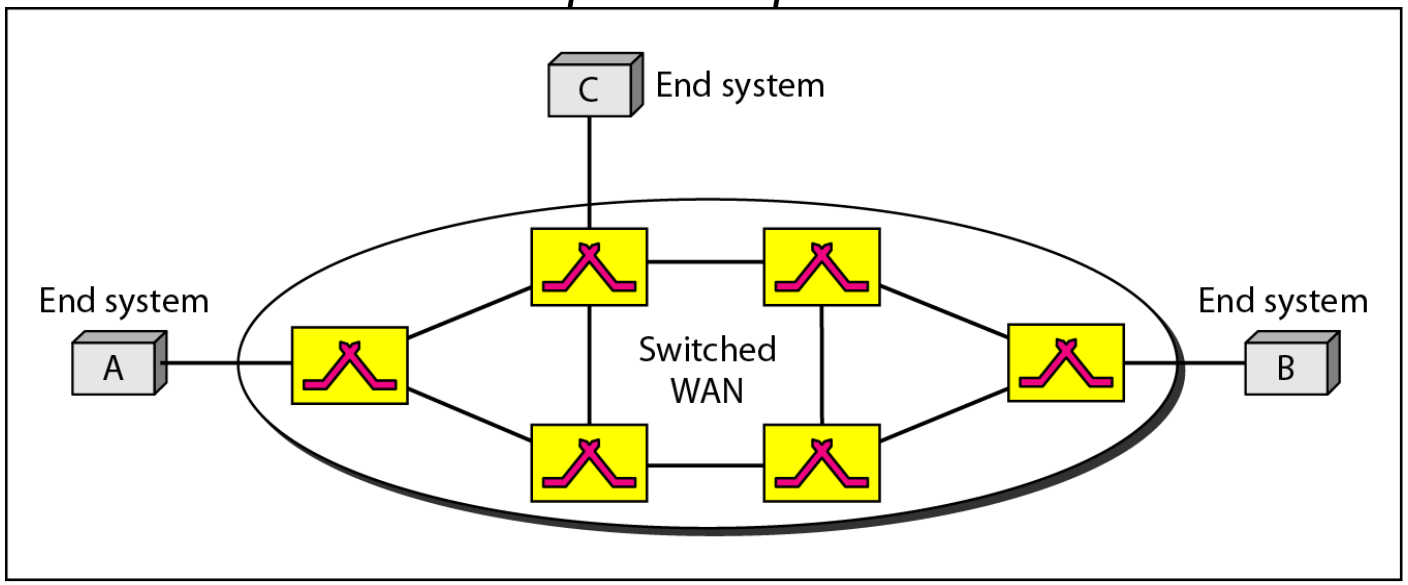
Communication

- **Wide Area Network (WAN)**

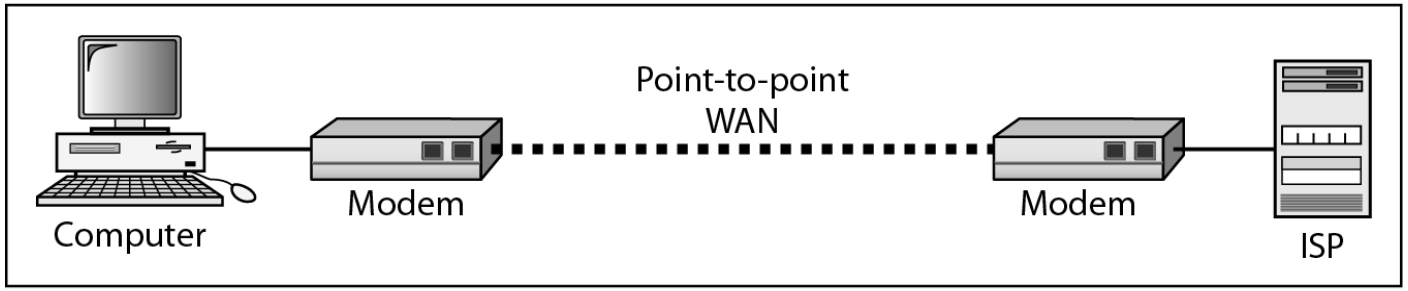
- A **Wide Area Network (WAN)** is a **communication network** that covers a **large geographical area** — such as **different cities, countries, or even continents**.
- It allows **data, audio, images, and videos** to be transmitted over **long distances** using **telecommunication lines, satellite links, or fiber optic cables**.
- E.g The Internet

Communication

- **Wide Area Network (WAN)**
- *WANs: a switched WAN and a point-to-point WAN*



a. Switched WAN



b. Point-to-point WAN

Communication

- **Metropolitan Area Network (MAN)**

A network with a size between a LAN and a WAN.

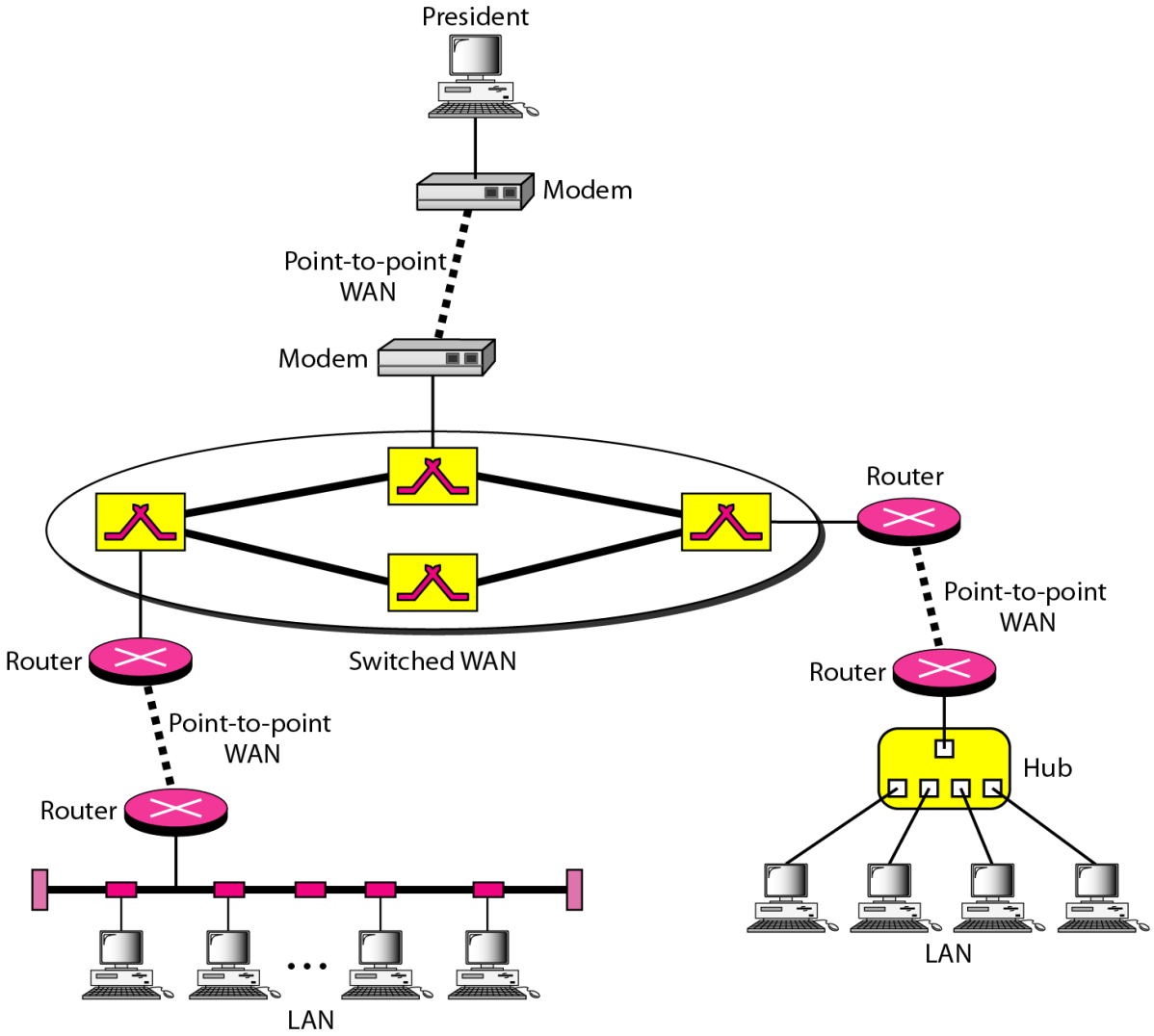
- It normally covers the area inside a town or a city.
- **Example 1: Telephone Network**
- Your **telephone company** connects thousands of phones within a city.
- It uses **fiber cables** and **switching centers** to route calls and Internet (DSL).
- This is a **MAN** because it connects users across a city.
- signals to homes all over the city. The **cable TV provider** has a central office that sends

.

Communication

- **Interconnection of Networks**
- **Internetwork:**
- When two or more networks are connected.
- *Process or technique of connecting different networks by using intermediary devices such as routers or gateway devices.*
- **Internetworking** ensures communication among networks owned and operated by different entities using a common data data communication

A heterogeneous network made of four WANs and two LANs

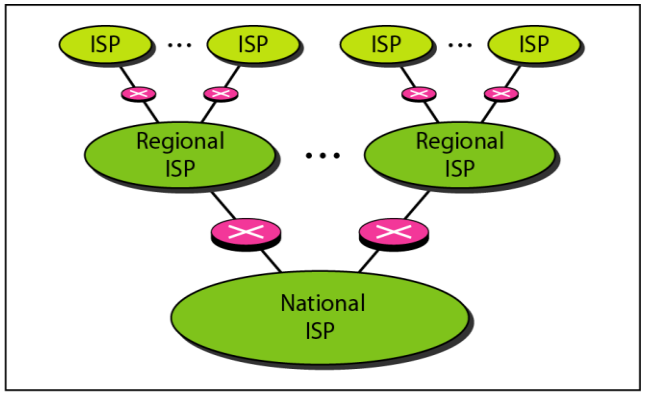


Communication

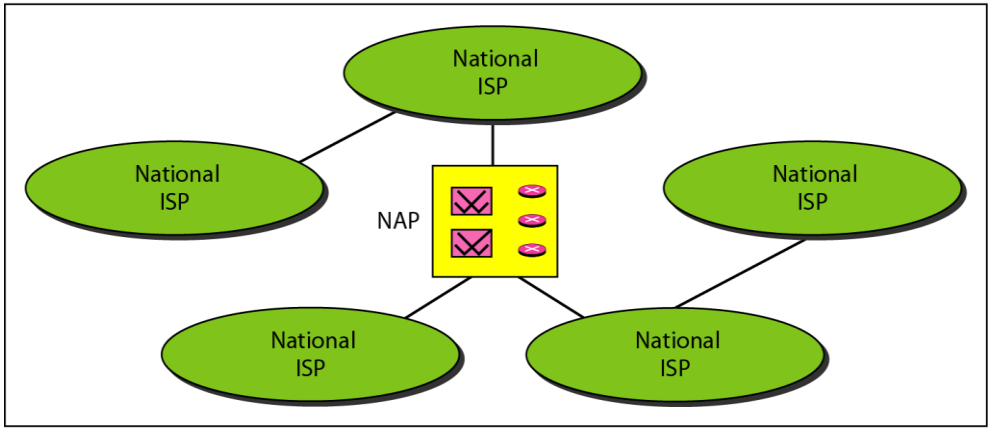
THE INTERNET

- The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

Communication



a. Structure of a national ISP



b. Interconnection of national ISPs

Communication

- **Standards**

- Provides guidelines to manufacturers, vendors, government agencies, and other service providers to ensure the kind of interconnectivity necessary in today's marketplace and in international communications.
- Communication standards fall into two categories:
- ***de facto*** (meaning "by fact" or "by convention") and
- ***de jure*** (meaning "by law" or "by regulation").

Communication

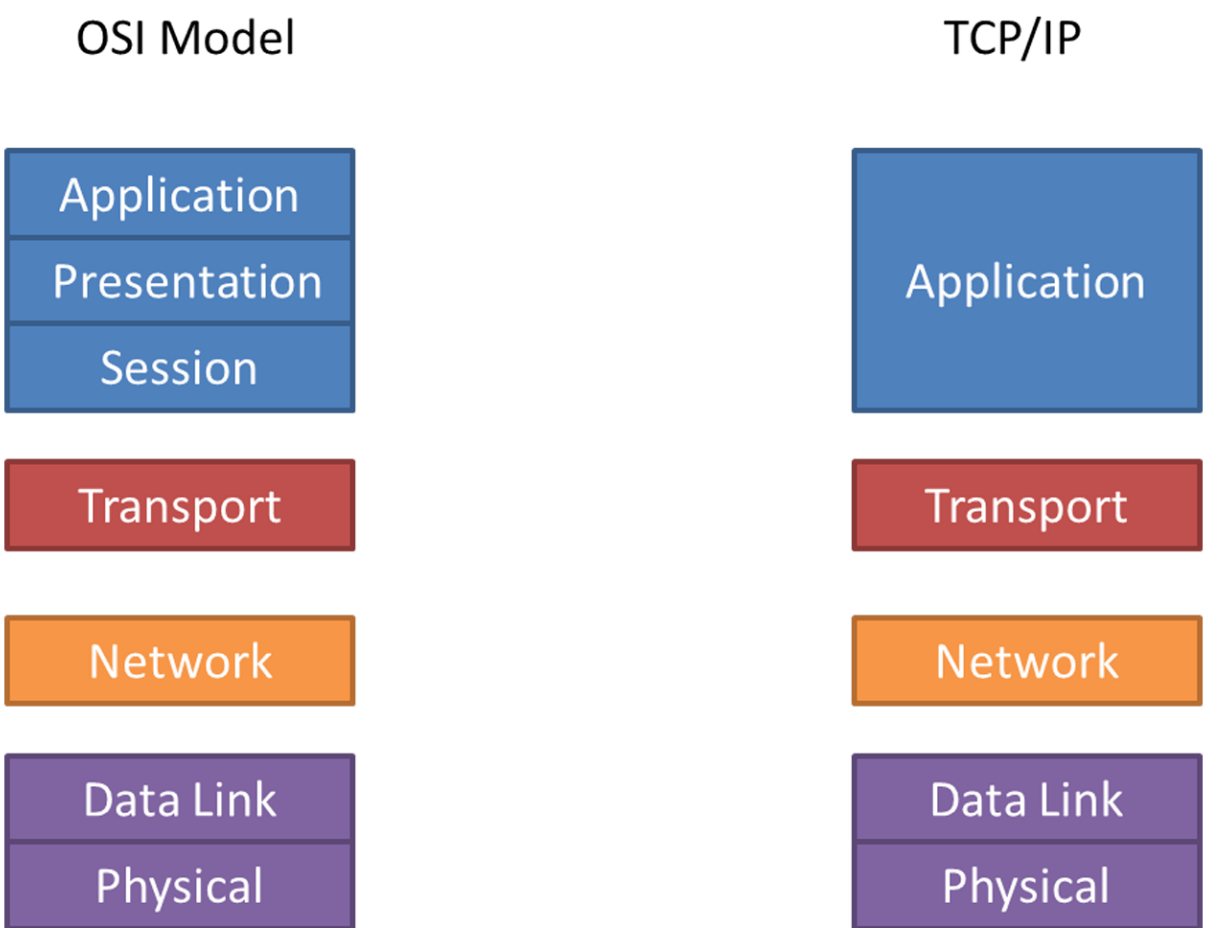
- **Standards**

- ***de facto:*** Standards that have not been approved by an organized body but have been adopted as standards through widespread use are de facto standards.

- ***de jure:*** Those standards that have been legislated by an officially recognized body are de jure standards.

Communication

- **Activity**


OSI Model
Application
Presentation
Session
Transport
Network
Data Link
Physical
TCP/IP
Application
Transport
Network
Data Link
Physical