

The Islamic University of Gaza  
Engineering Faculty  
Department of Computer Engineering

# **Data Communications**

## **Lab 1**

### **Introduction**

## Data Communication

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).

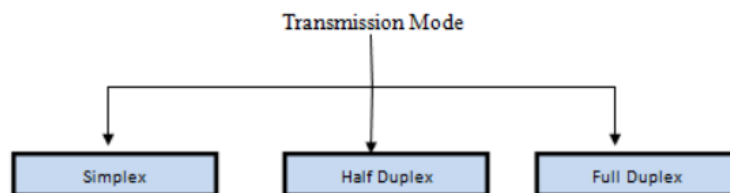
### The components of Data Communication System

- 1. Message** - It is the information to be communicated. Popular forms of information include text, pictures, audio, video etc. Text is converted to binary, number does not convert, image is converted to pixels, etc.
- 2. Sender** - It is the device which sends the data messages. It can be a computer, workstation, telephone handset etc.
- 3. Receiver** - It is the device which receives the data messages. It can be a computer, workstation, telephone handset etc.
- 4. Transmission Medium** - It is the physical path by which a message travels from sender to receiver. Some examples include twisted-pair wire, coaxial cable, radio waves etc.
- 5. Protocol** - It is a set of rules that governs the data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

### Data Flow techniques

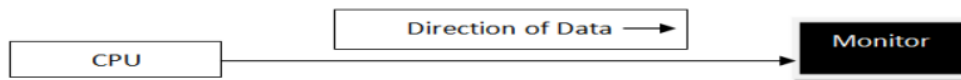
Transmission mode refers to the mechanism of transferring of data between two devices connected over a network. It is also called Communication Mode. These modes direct the direction of flow of information. There are three types of transmission modes. They are:

- 1. Simplex Mode**
- 2. Half duplex Mode**
- 3. Full duplex Mode**



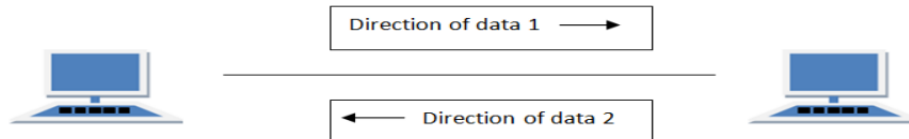
## 1. SIMPLEX Mode

In this type of transmission mode, data can be sent only in one direction i.e. communication is unidirectional. We cannot send a message back to the sender. Unidirectional communication is done in Simplex Systems where we just need to send a command/signal, and do not expect any response back. Examples of simplex Mode are loudspeakers, television broadcasting, television and remote, keyboard and monitor etc.



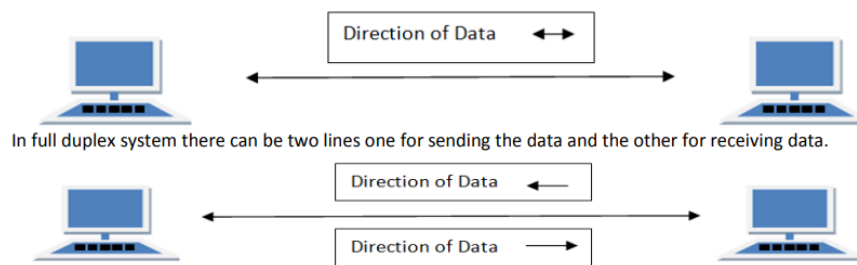
## 2. HALF DUPLEX Mode

Half-duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half-duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted. Hence half- duplex transmission implies a bidirectional line (one that can carry data in both directions) but data can be sent in only one direction at a time. Example of half duplex is a walkie- talkie in which message is sent one at a time but messages are sent in both the directions.



## 3. FULL DUPLEX Mode

In full duplex system we can send data in both the directions as it is bidirectional at the same time in other words, data can be sent in both directions simultaneously. Example of Full Duplex is a Telephone Network in which there is communication between two persons by a telephone line, using which both can talk and listen at the same time.



## Types of Connection in Computer Networks

A **Network** is nothing but a connection made through connection links between two or more devices. Devices can be a computer, printer or any other device that is capable to send and receive data. There are two ways to connect the devices:

1. Point-to-Point connection
2. Multipoint connection

### 1. Point-To-Point Connection

It is a protocol which is used as a communication link between two devices. It is simple to establish. The most common example for Point-to-Point connection (PPP) is a computer connected by telephone line.

We can connect the two devices by means of a pair of wires or using a microwave or satellite link.

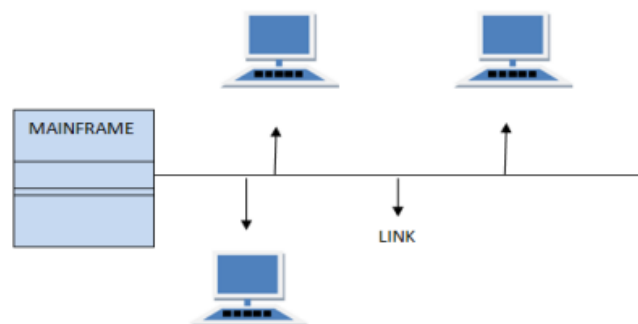
**Example:** Point-to-Point connection between remote control and Television for changing the channels.



### 2. Multipoint Connection

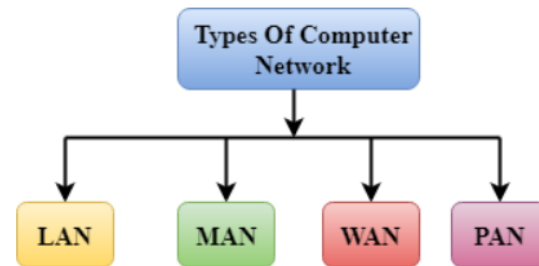
It is also called Multidrop configuration. In this connection two or more devices share a single link. There are two kinds of Multipoint Connections:

- If the links are used simultaneously between many devices, then it is spatially shared line configuration.
- If user takes turns while using the link, then it is time shared (temporal) line configuration.



## Types of computer Network:

**Computer Network** is a system of interconnected computers that enable the computers to communicate with each other and share their resources, data and applications.



### PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.
- Thomas Zimmerman was the first research scientist to bring the idea of the Personal Area Network.
- Personal Area Network covers an area of 30 feet.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.



- **Examples of PAN:** Bluetooth, USB

## **LAN(Local Area Network)**

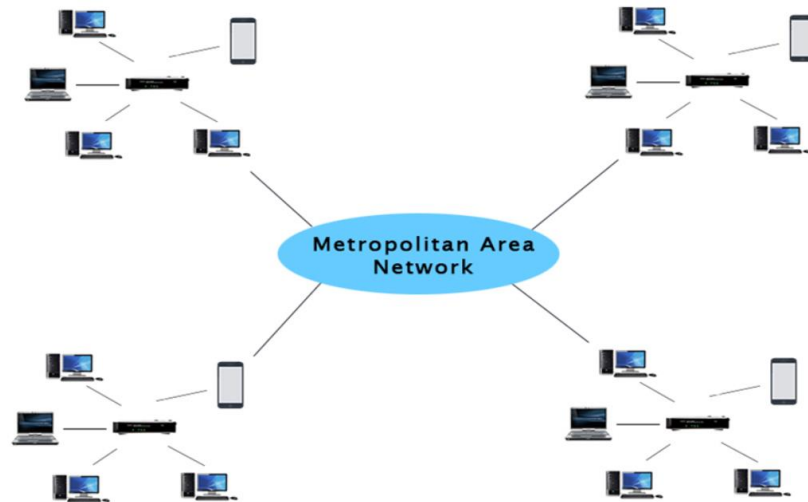
- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.



- **Example of LAN:** home network

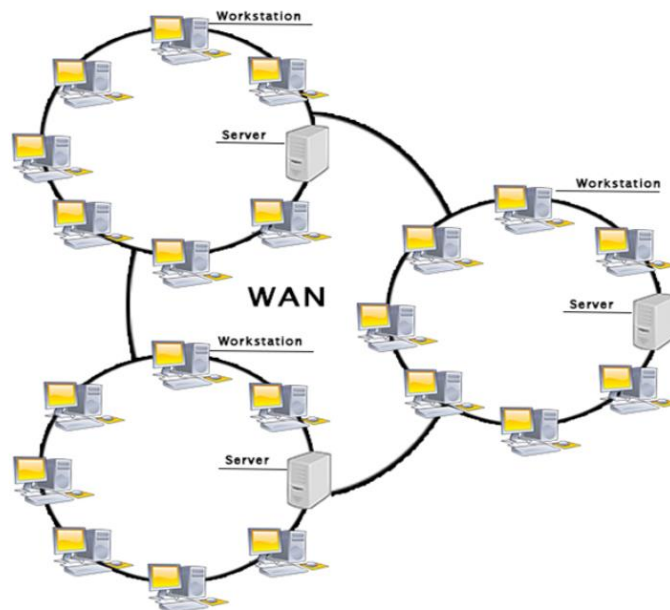
## **MAN(Metropolitan Area Network)**

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.
- It has a higher range than Local Area Network(LAN).



## WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.



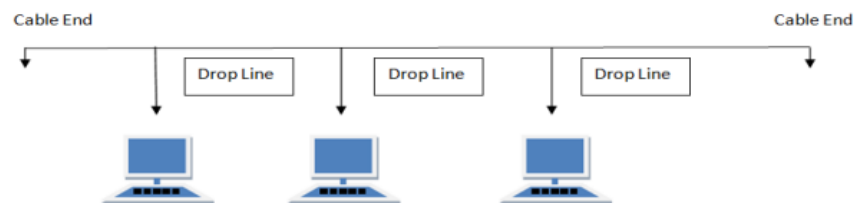
## Network Topologies

Topology defines the structure of the network of how all the components are interconnected to each other. There are two types of topology: physical and logical topology.

Physical topology is the geometric representation of all the nodes in a network.

### BUS Topology

Bus topology is a network type in which every computer and network device is connected to single cable.



### Features of Bus Topology

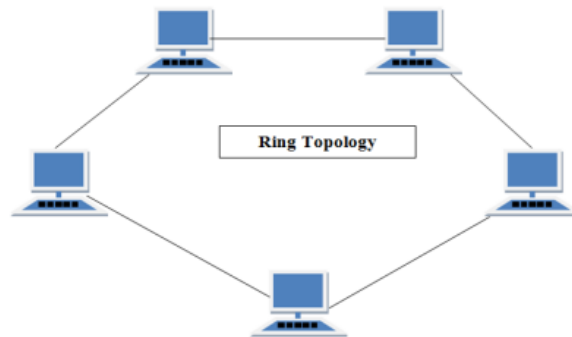
1. It transmits data only in one direction.
  2. Every device is connected to a single cable
- Advantages of Bus Topology
1. It is cost effective.
  2. Cable required is least compared to other network topology.
  3. Used in small networks.
  4. It is easy to understand.
  5. Easy to expand joining two cables together.

### Disadvantages of Bus Topology

1. Cables fails then whole network fails.
2. If network traffic is heavy or nodes are more the performance of the network decreases.
3. Cable has a limited length.
4. It is slower than the ring topology.

## RING Topology

It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbours for each device.



### Features of Ring Topology

1. A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.
2. The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called **Dual** Ring Topology.
3. In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
4. Data is transferred in a sequential manner that is bit by bit. Data transmitted, has to pass through each node of the network, till the destination node.

### Advantages of Ring Topology

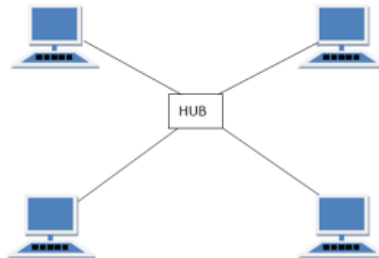
1. Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
2. Cheap to install and expand.

### Disadvantages of Ring Topology

1. Troubleshooting is difficult in ring topology.
2. Adding or deleting the computers disturbs the network activity.
3. Failure of one computer disturbs the whole network.

## **STAR Topology**

In this type of topology all the computers are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to the central node.



### **Features of Star Topology**

1. Every node has its own dedicated connection to the hub.
2. Hub acts as a repeater for data flow.
3. Can be used with twisted pair, Optical Fibre or coaxial cable.

### **Advantages of Star Topology**

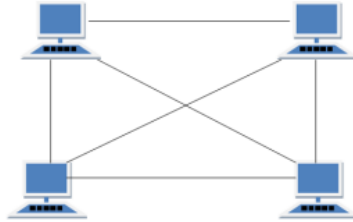
1. Fast performance with few nodes and low network traffic.
2. Hub can be upgraded easily.
3. Easy to troubleshoot.
4. Easy to setup and modify.
5. Only that node is affected which has failed, rest of the nodes can work smoothly.

### **Disadvantages of Star Topology**

1. Cost of installation is high.
2. Expensive to use.
3. If the hub fails then the whole network is stopped because all the nodes depend on the hub.
4. Performance is based on the hub that is it depends on its capacity.

## **MESH Topology**

It is a point-to-point connection to other nodes or devices. All the network nodes are connected to each other.



### **Features of Mesh Topology**

1. Fully connected.
2. Robust.
3. Not flexible.

### **Advantages of Mesh Topology**

1. Each connection can carry its own data load.
2. It is robust.
3. Fault is diagnosed easily.
4. Provides security and privacy.

### **Disadvantages of Mesh Topology**

1. Installation and configuration is difficult.
2. Cabling cost is more.