HNDIT1032 Computer and Network Systems

Week 12- Data Communication & Computer Network

Introduction

- This chapter provides an introduction to Computer networks and covers fundamental topics like data, information to the definition of communication and computer networks.
- The main objective of data communication and networking is to enable seamless exchange of data between any two points in the world.

Data Communications

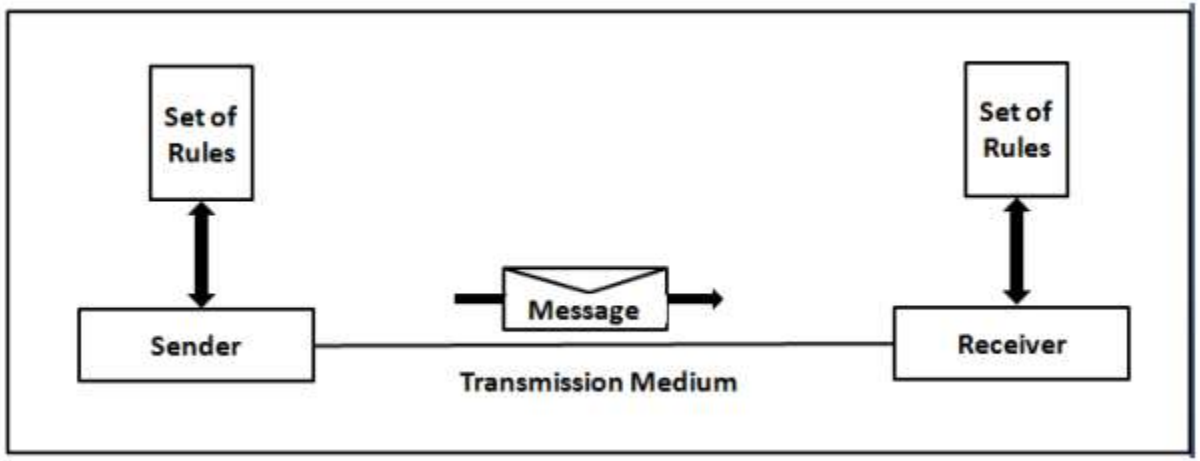
- Data Communication is a process of exchanging data or information In case of computer networks this exchange is done between two devices over a transmission medium.
- This process involves a communication system which is made up of hardware and software.

Characteristic of Data Communication

- The effectiveness of any data communications system depends upon the following three fundamental characteristics
  - Delivery
  - Accuracy
  - Timeliness
  - Jitter

Components of Data Communication

- Message
- Sender
- Receiver
- Medium
- Protocol

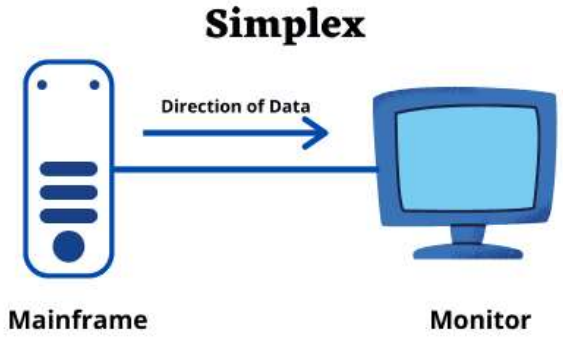


Data Flow

- Two devices communicate with each other by sending and receiving data. The data can flow between the two devices in the following ways.
  - Simplex
  - Half Duplex
  - Full Duplex

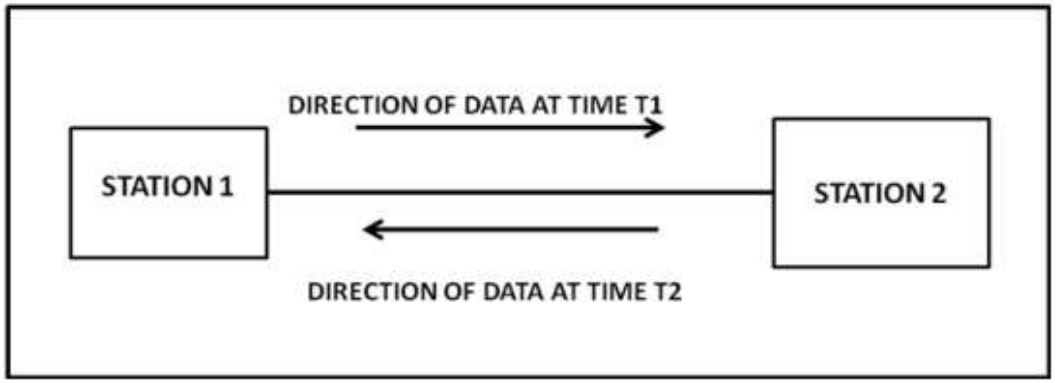
Simplex

- In Simplex, communication is unidirectional Only one of the devices sends the data and the other one only receives the data.
- Example: in the above diagram: a cpu send data while a monitor only receives data.



Half Duplex

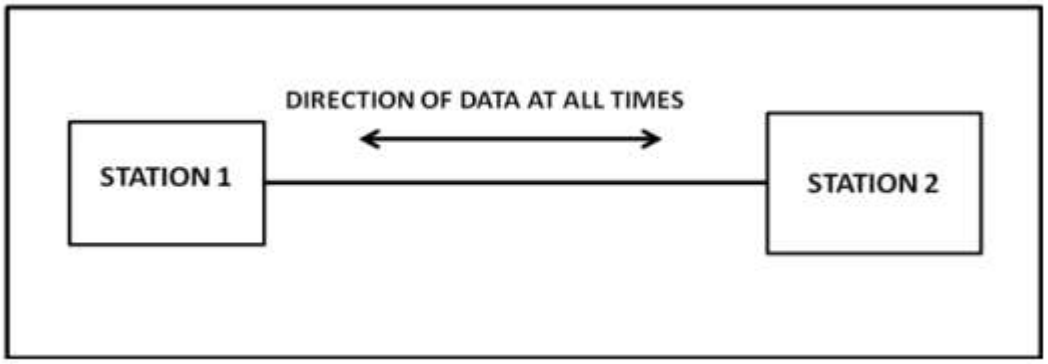
- In half duplex both the stations can transmit as well as receive but not at the same time.
- When one device is sending other can only receive and vice versa (as shown in figure above.) Example: A walkie-talkie.



Full Duplex

In Full duplex mode, both stations can transmit and receive at the same time.

Example: mobile phones



Computer Network

- A computer network can be defined as a collection of nodes.
- A node can be any device capable of transmitting or receiving data.
- The communicating nodes have to be connected by communication links.
- Computer Networks are used for data communications.

Categories of Network

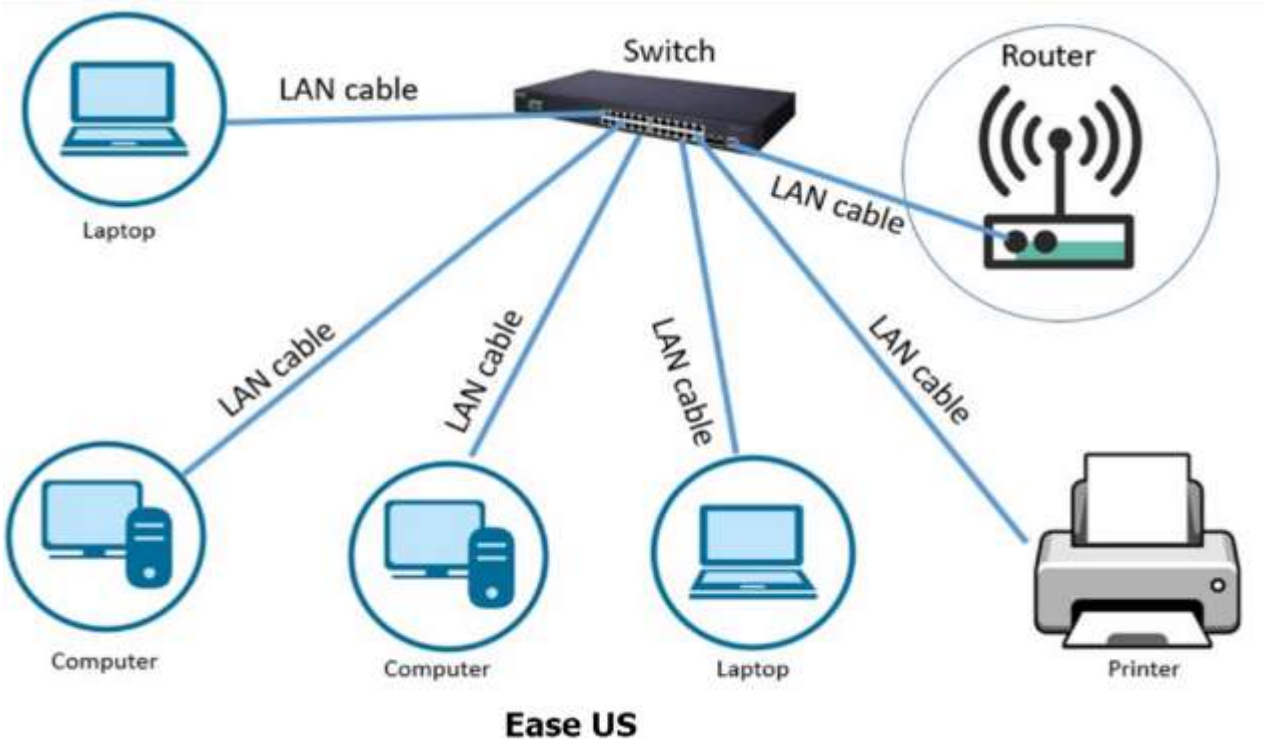
Networks are categorized on the basis of their size. The three basic categories of computer networks are:

- Local Area Network (LAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN).

Local Area Network

- LAN connects computers in a small area like a room, building, office or a campus spread up to a few kilometers.
- They are privately owned networks, with a purpose to share resources and to exchange information.
- The computers in a LAN are generally connected using cables.

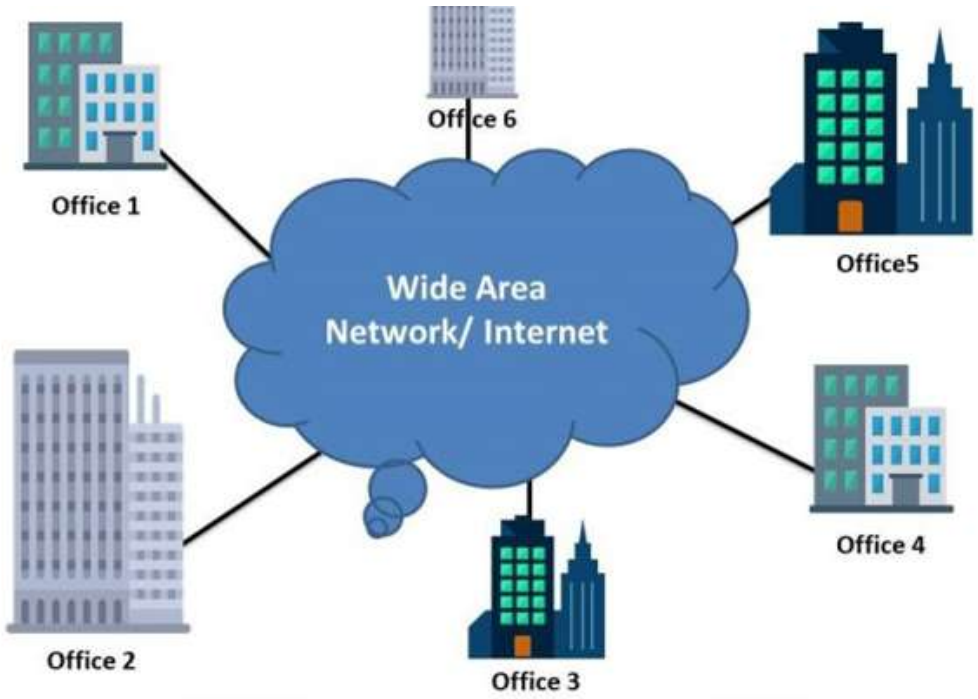
Example-LAN


Switch
Router
LAN cable
Laptop
LAN cable
LAN cable
LAN cable
LAN cable
LAN cable
Computer
Computer
Laptop
Printer
Ease US

Wide Area Network

- WAN is a network that connects computers over long distances like cities, countries, continents, or worldwide .
- WAN uses public, leased, or private communication links to spread over long distances.
- WAN uses telephone lines, satellite link, and radio link to connect.

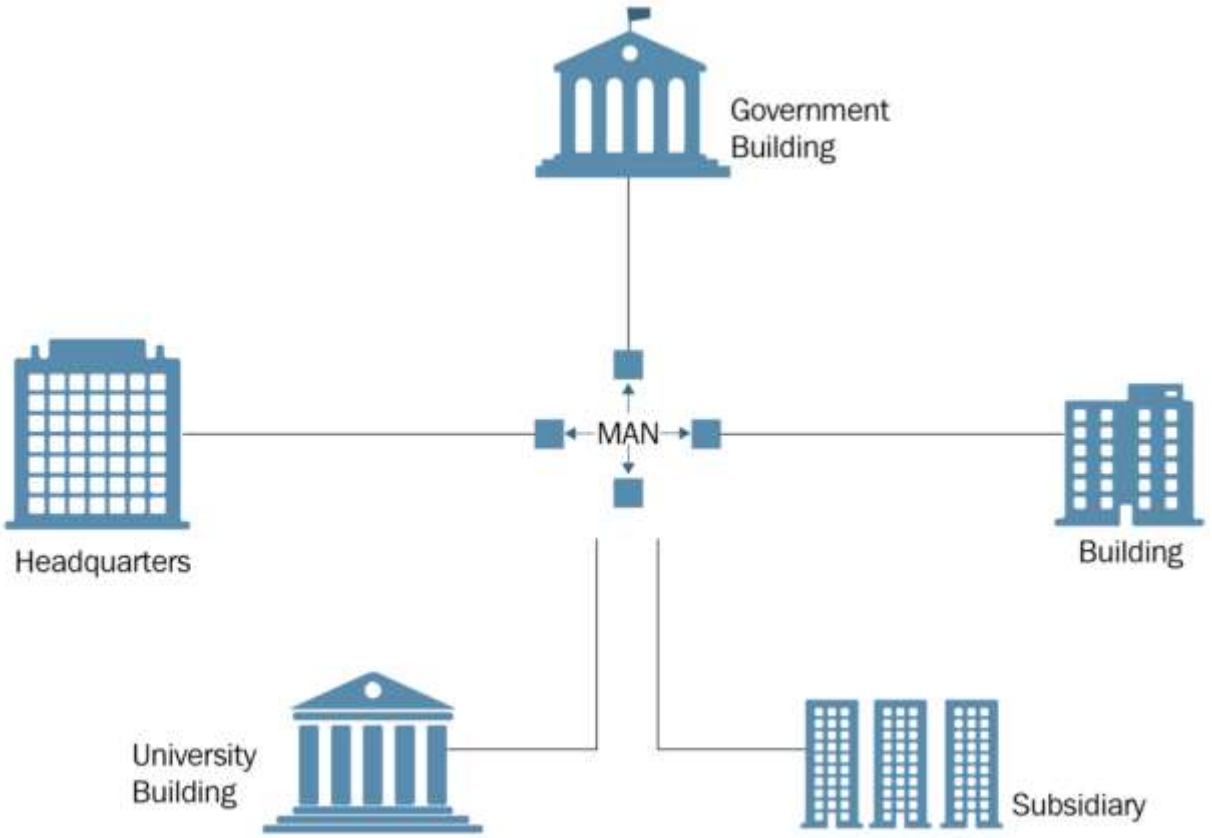
Example-WAN


Office 6
Office 1
Office5
Wide Area
Network/ Internet
Office 4
Office 2
Office 3
WAN Network Diagram

Metropolitan Area Network

- MAN is a computer network spread over a city. Cable television network is an example of MAN.
- The computers in a MAN are connected using coaxial cables or fiber optic cables.
- MAN also connects several LAN spread over a city

Example-MAN


Government Building
MAN
Headquarters
Building
University Building
Subsidiary

Advantages of Computer Networks

- Central usage of data
- Anyone can connect
- Data Sharing
- Flexible
- Reliable

Disadvantages

- Cost of network
- Virus and malware
- Robustness
- Lack of indepence

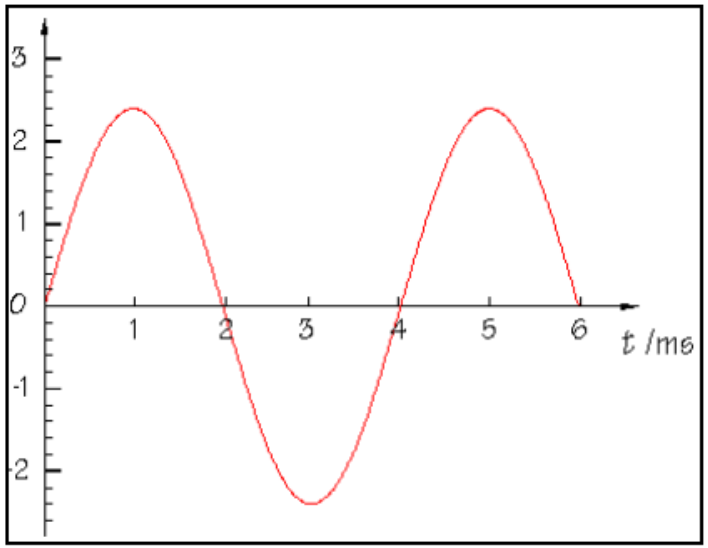
Data & Signal

- To be transmitted, data must be transformed to electromagnetic signals.
- Signal can be
  - Analog
  - Digital

Analog Signal

An analog signal has infinitely many levels of intensity over a period of time.

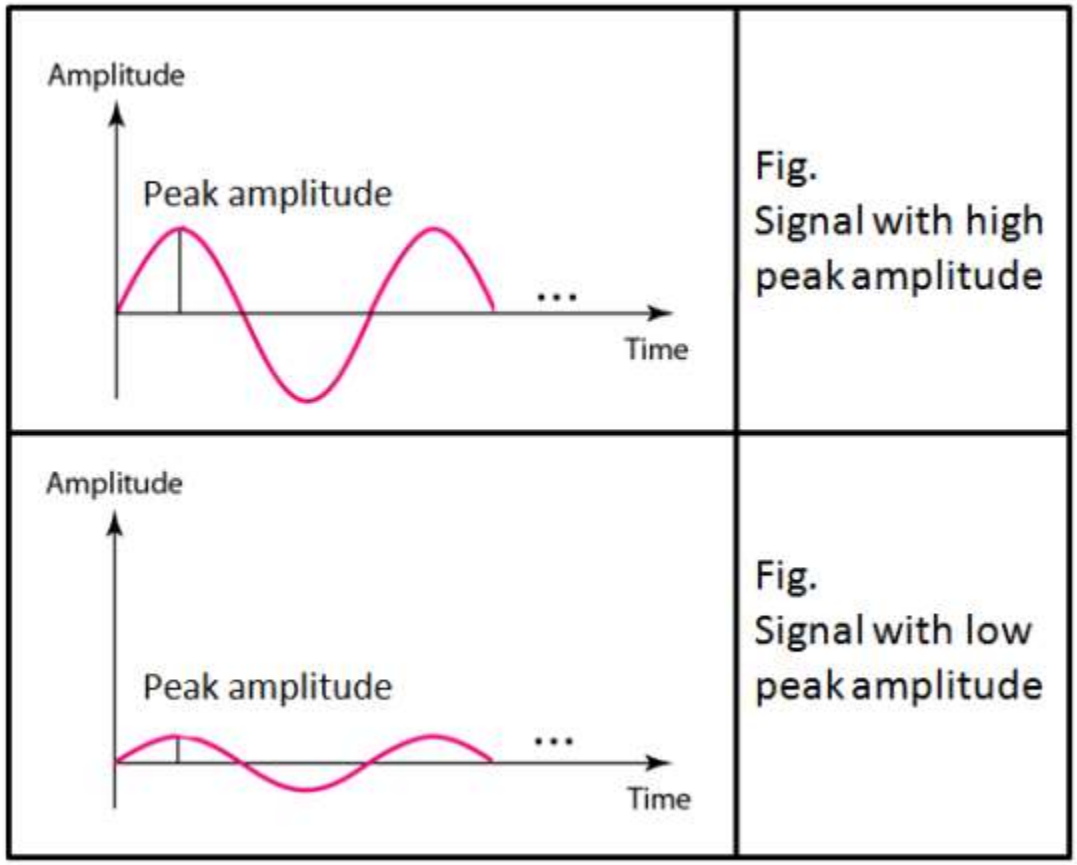
A simple analog signal is a sine wave that cannot be further decomposed into simpler signals.



Characteristic of Analog Signal

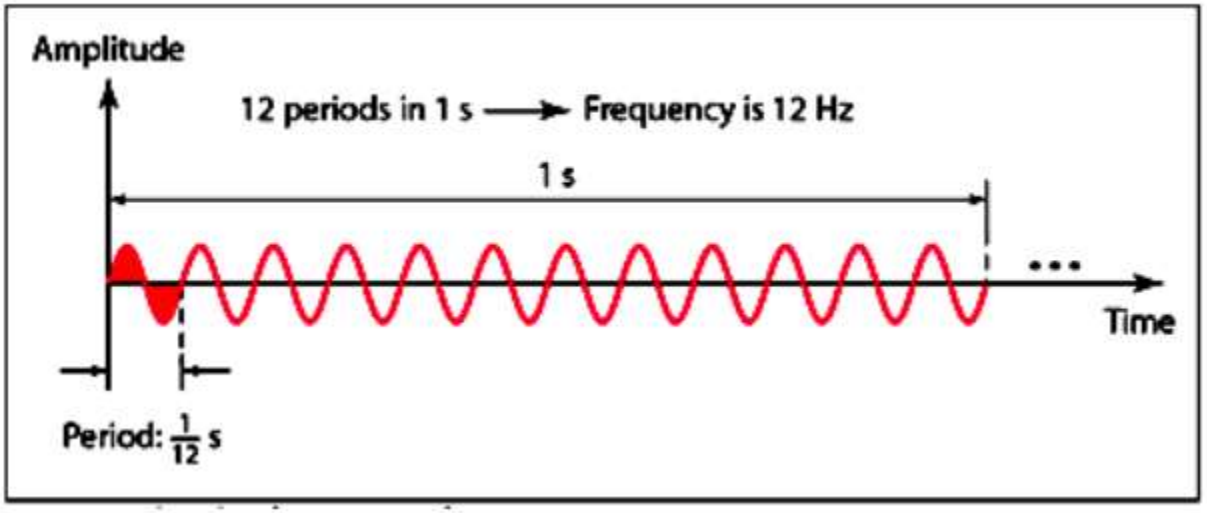
- A sine wave is characterized by three parameters:
  - Peak Amplitude
  - Frequency
  - Phase

Peak Amplitude

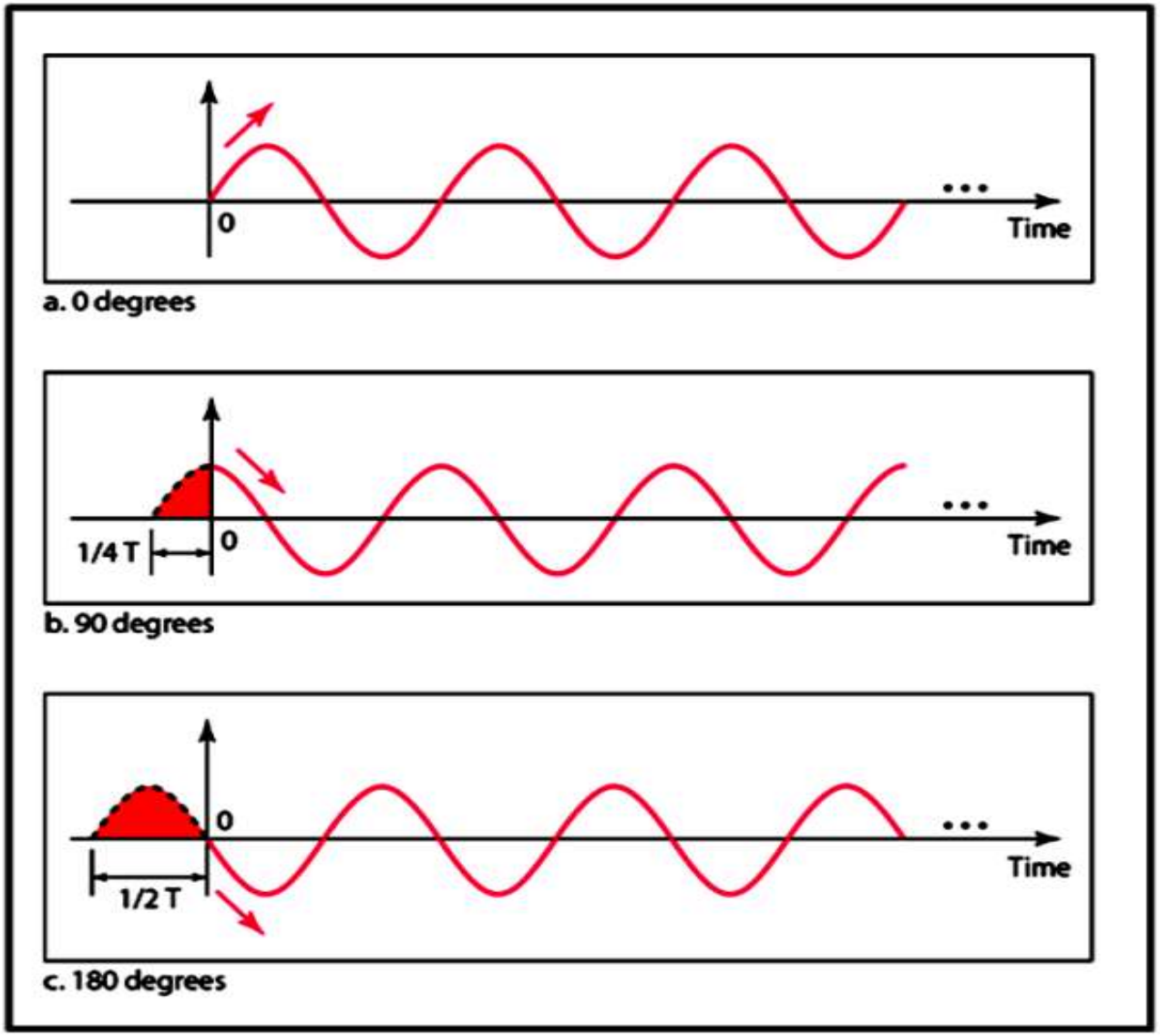


Frequency

- Frequency refers to the number of cycles completed by the wave in one second.
- Period refers to the time taken by the wave to complete one second.



Phase


0
Time
a. 0 degrees
1/4 T
0
Time
b. 90 degrees
0
1/2 T
Time
c. 180 degrees

Relation between Frequency & Period

$$T = 1/f$$
$$\text{Or}$$
$$f = 1/T$$

Example1. A wave has a frequency of 100hz. Its period(T) is given by

$$T = 1/F = 1/100 = 0.01 \text{ sec}$$

Example2. A wave completes its one cycle in 0.25 seconds. Its frequency is given by

$$F = 1/T = 1/0.25 = 4 \text{ Hz}$$

Wavelength

- The wavelength of a signal refers to the relationship between frequency (or period) and propagation speed of the wave through a medium.
- The wavelength is the distance a signal travels in one period.

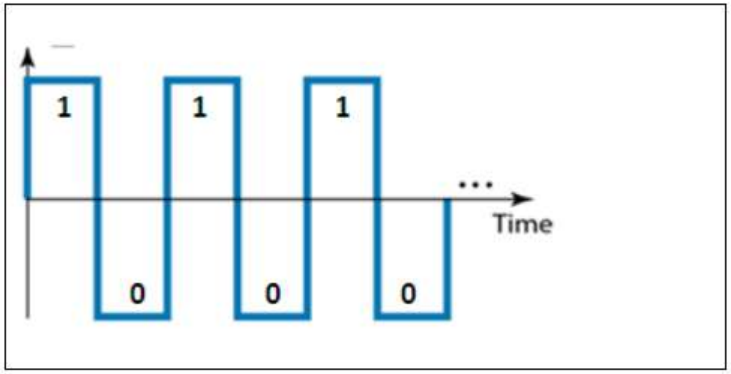
$$\text{Wavelength} = \text{Propagation Speed} \times \text{Period}$$

OR

$$\text{Wavelength} = \text{Propagation Speed} \times \frac{1}{\text{Frequency}}$$

Digital Signal

- A digital is a signal that has discrete values.
- The signal will have value that is not continuous.
- Information in a digital signal can be represented in the form of voltage levels.



Bit Interval

- It is the time required to send one bit.
- It is measured in seconds

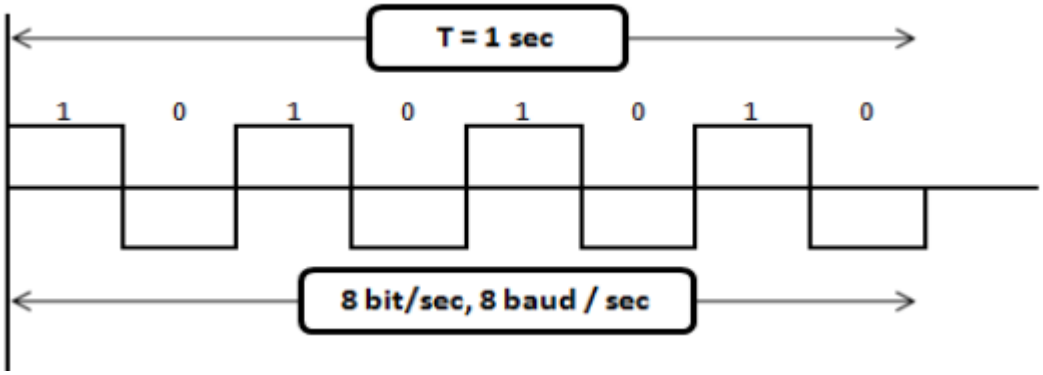
Bit Rate

- It is the number of bits transmitted in one second.
- It is expressed as bits per second (bps).
- Relation between bit rate and bit interval can be as follows.

Bit rate = 1 / Bit interval

Baud Rate

- It is the rate of Signal Speed, i.e the rate at which the signal changes.
- A digital signal with two levels _0‘ & _1‘ will have the same baud rate and bit rate & bit rate.



Transmission of Digital Signal

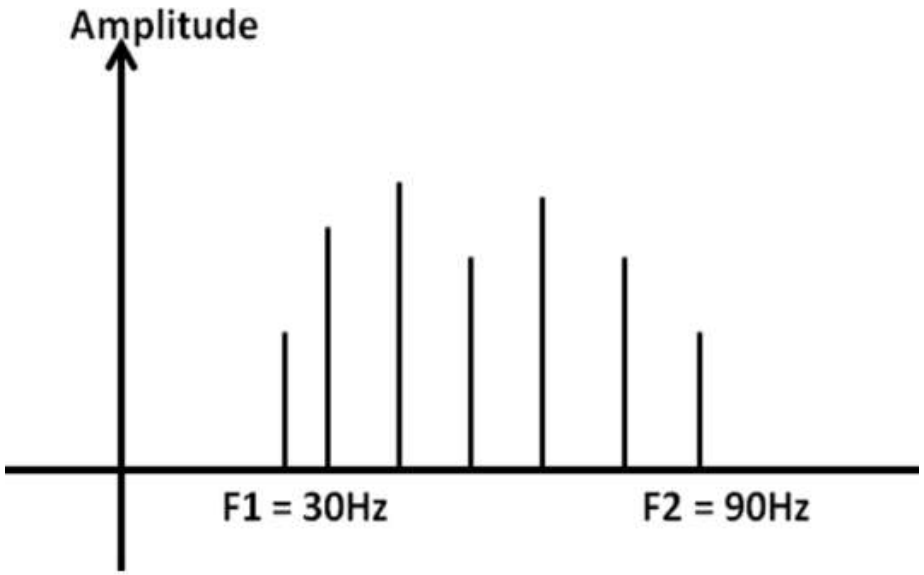
Baseband Transmission-The signal is transmitted without making any change to it (ie. Without modulation)

Broadband Transmission-In broadband transmission we use modulation, i.e we change the signal to analog signal before transmitting it

Bandwidth of a Signal

- Bandwidth can be defined as the portion of the electromagnetic spectrum occupied by the signal.
- It may also be defined as the frequency range over which a signal is transmitted.

Example-Bandwidth



It has a minimum frequency of F1 = 30Hz and maximum frequency of F2 = 90Hz.

Hence the bandwidth is given by F2 – F1 = 90 – 30 = 60 Hz

References

- Clements, A., The Principles of Computer Hardware, Oxford University Press (4th Ed), 2006.