Computer Networks

IT4405

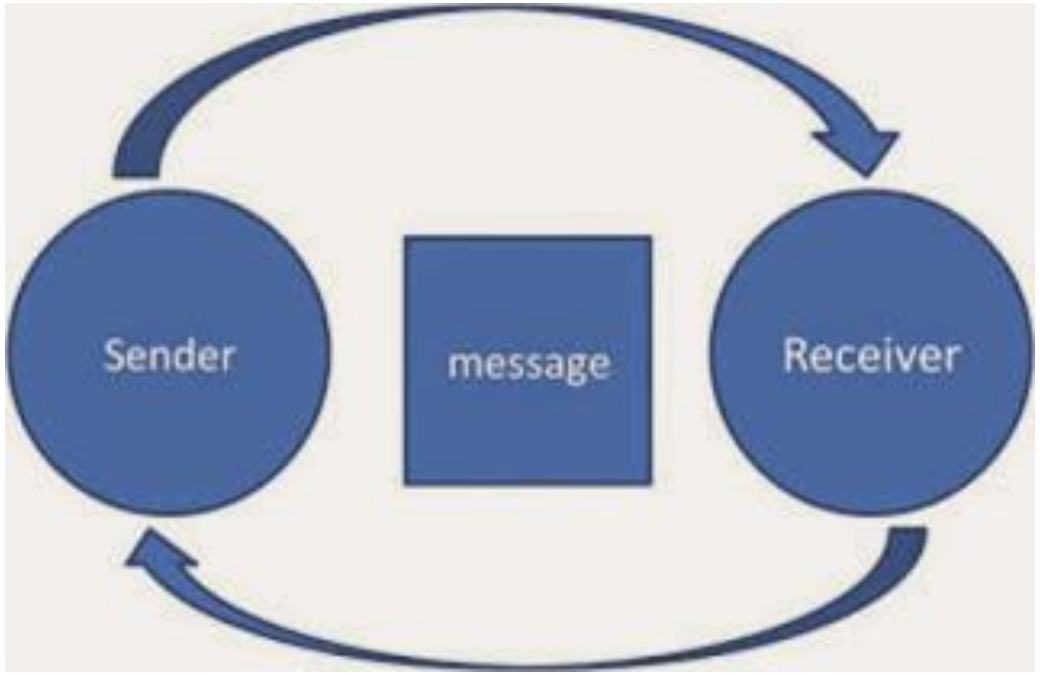
Syllabus

- Data Transmission Concepts
- Packet Network Architecture
- Internet Protocol Suit
- Local Area Networks
- Mobile Wide Area Networks
- Network Design
- Miscellaneous Concepts

Data Transmission Concepts

What is a Communication?

- A process of Exchanging Information



Transmission

- Transmission is the process of sending, propagating and receiving an **information signal (Analog / Digital)** over a physical point to point or point to multipoint **transmission medium** either **wired or wireless**.

Parallel Transmission

- Sending multiple data parallel at a time is known as Parallel transmission.
- Simply, Using ‘n’ wires to send ‘n’ bits at a time.
- Diagram

Serial Transmission

- In Serial transmission bits follow one another in one communication channel.
- Simply, Using ‘1’ wire to send ‘n’ bits at a time.
- Diagram

Analog Signal

- A continuous / smooth signal with infinite number of amplitude levels. OR
- Continuous wave form in nature represented by continuous electromagnetic waves.
- Graph

Digital Signal

- A signal with limited number of levels.
- Used in circuitry of a computer system.
- Graph

Transmission Medium

- Data transmission Occurs between transmitter and receiver over some path which is known the transmission medium .
- Classification Diagram.

Guided Media

- Waves are guided along a physical path.
- Copper or Optical

Unguided Media

- Wireless
- Provide a means of transmitting electro magnetic wave, but do not guide them.
- Propagation through air, vacuum and sea water.

Transmission Impairments

- With any communication system, the signal that is received may differ from the signal that is transmitted due to various transmission impairments.
- For Analog Signals,
  - Signal quality is degraded.
- For digital Signals,
  - Bit errors may be introduced that a binary 1 is transformed t binary 0 and vice versa.

- 1 – Attenuation
- 2 – Distortion
- 3 - Noise

Attenuation

- The loss of Signal strength with distance in any transmission medium.
- Amplifiers and repeaters are used to regain / strengthen signals along the transmission path.
- Diagram
- $dB = 10\log_{10} (P2/P1)$
  - P1, P2 are the powers of signal at points 1 and 2

Example

- A signal travels through a transmission medium and its power is reduced to half. What is the loss of power?
- A signal travels through an amplifier and its power is increased 10 times. What is the gain of power?

Distortion

- Distortion means the signal change its form of shape.
- This occurs in composite signals made of different frequencies.
- Each component has its own propagation speed through a medium and therefore its own delay in arriving at final destination.
- Diagram

Noise

- Noise is undesired and extra (additional unwanted) signals that are inserted somewhere between transmitter and receiver.
- Diagram
- Noise Types
  - Thermal Noise
  - Intermodulation Noise
  - Cross Talk
  - Impulse Noise

CHANNEL CAPACITY

- The maximum rate at which data can be transmitted over a given communication path, or channel, under given conditions, is referred to as the channel capacity.

- **Data Rate**
  The rate, in bits per second (bps), at which data can be communicated.
- **Bandwidth**
  a range of frequencies within a given band, in particular that is used for transmitting a signal.
- **Error Rate**
  The rate at which errors occur, where an error is the reception of a ‘1’ when a ‘0’ was transmitted or the reception of a ‘0’ when a ‘1’ was transmitted

- **Noise**
  The average level of noise over the communications path

Nyquist Bit Rate

- In the case of a channel that is noise free.
- if the rate of signal transmission is 2B, then a signal with frequencies no greater than B is sufficient to carry the signal rate.
- The converse is also true: Given a bandwidth of B, the highest signal rate that can be carried is 2B
- If the signals to be transmitted are binary (two voltage levels), then the data rate that can be supported by B Hz is 2B bps

Nyquist Formula

- Bit Rate = 2 x Bandwidth x log2 L

Where L is the number of signal levels.

Example 01

- Consider a noiseless channel with a bandwidth of 3000Hz transmitting a signal with two signal levels. What is the maximum bit rate?
- Consider a same noiseless channel with a bandwidth of 3000Hz transmitting a signal with four signal levels. What is the maximum bit rate?

Shannon Capacity Formula

- Specifies the theoretical highest data rate of a channel
- Capacity = Bandwidth x log2 (1 + SNR)
  - SNR : Signal to Noise Ratio

Examples

- A telephone line normally has a bandwidth of 3000Hz (300 Hz to 3300Hz). The SNR is usually 3162. What is the Capacity of this channel?