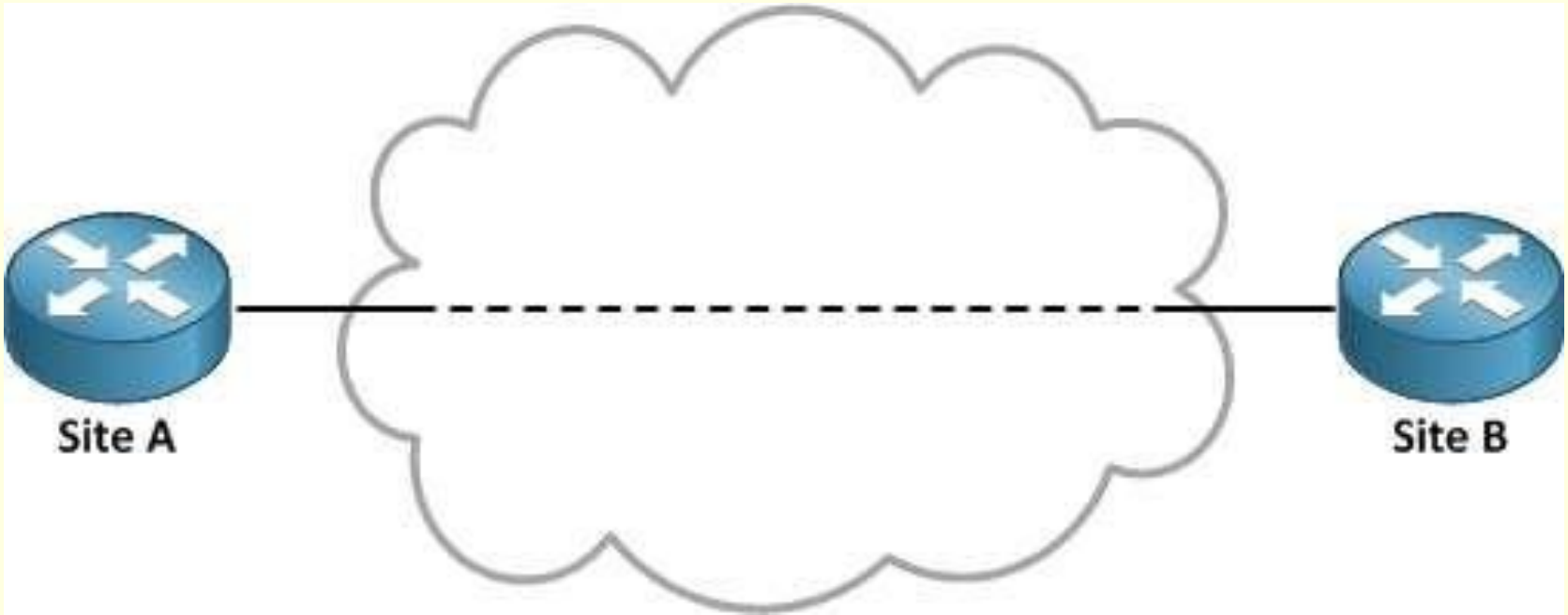
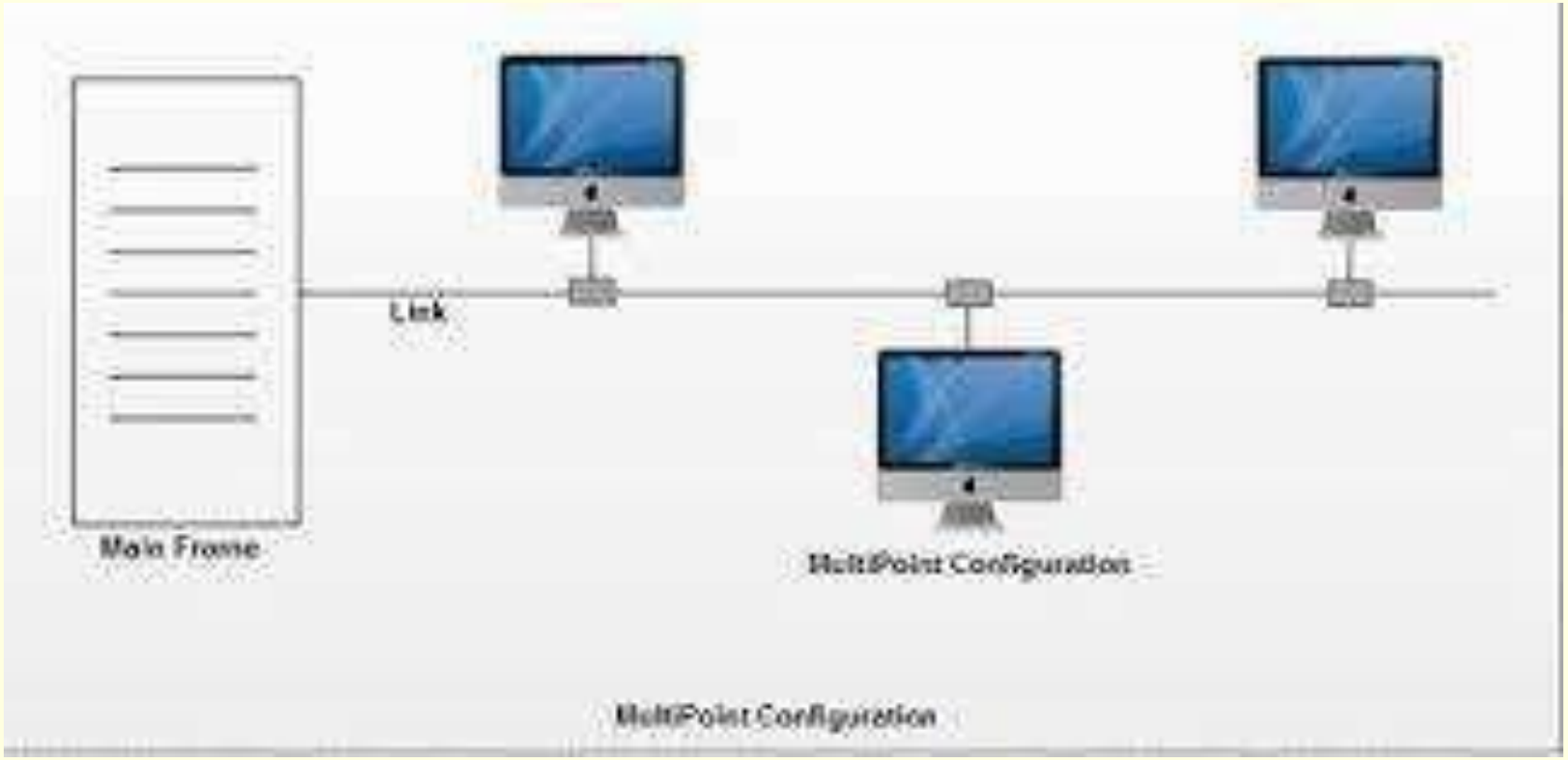
Transmission Impairments

- Point - to - Point Connection : It **Provides a dedicated links between two devices**.

- For example, a wired system that connects two computers together can be thought of a point- to-point link.



- **Multi - Point Connection :** It is a link between two or more devices. It is also known as Multi-Point configuration. The networks having multipoint configuration are called **Broadcast Networks.**



Transmission Mode

- It refers to the direction of information flow between two devices.
- Data flow is the flow of data between 2points.
- The direction of the data flow can be described as
  - Simplex Mode
  - Half-Duplex Mode
  - Full-Duplex Mode

- **Simplex:** Data flows in only one direction on the data communication line (medium).

~~Examples are Radio and Television broadcasts.~~

- **Half-Duplex:** Data flows in both directions but only one direction at a time on the data communication line.

Ex. Conversation on walkie-talkies.

- **Full-Duplex:** Data flows in both directions simultaneously. Modems are configured to flow data in both directions.

Ex. Phone Conversation

Data Flow

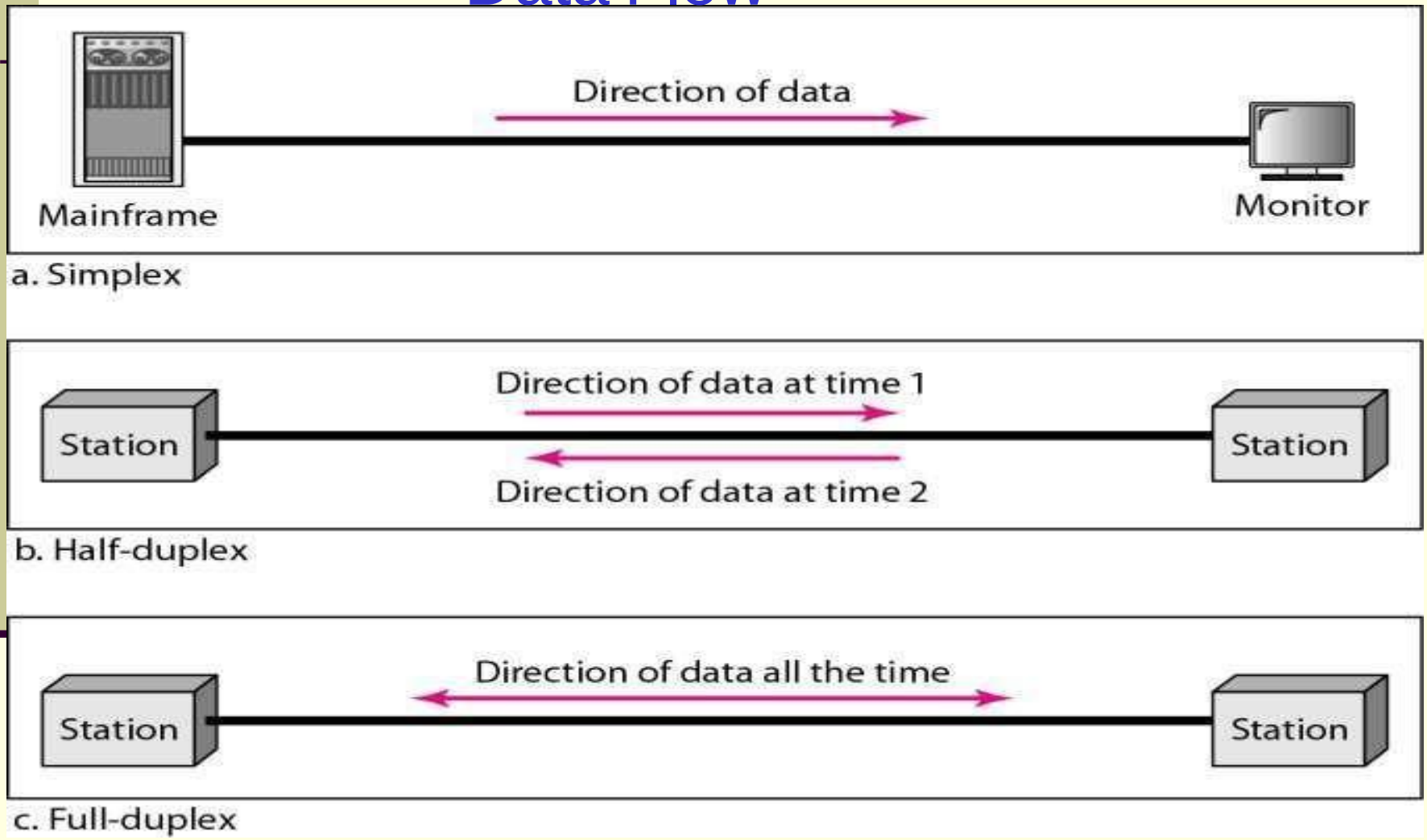
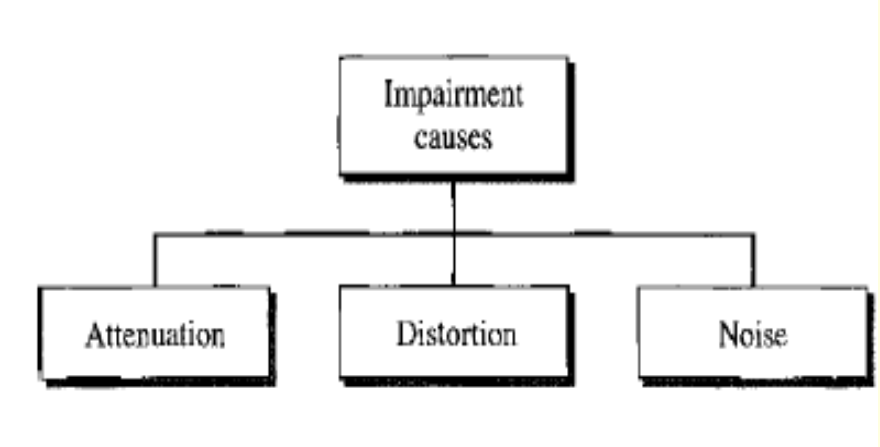


Figure 1.2 ***Data flow (simplex, half-duplex, and full-duplex)***

Transmission Impairment

- Signals travel through transmission media, which are not perfect. The imperfection causes signal impairment. This means that the signal at the beginning of the medium is not the same as the signal at the end of the medium.



Transmission Impairments

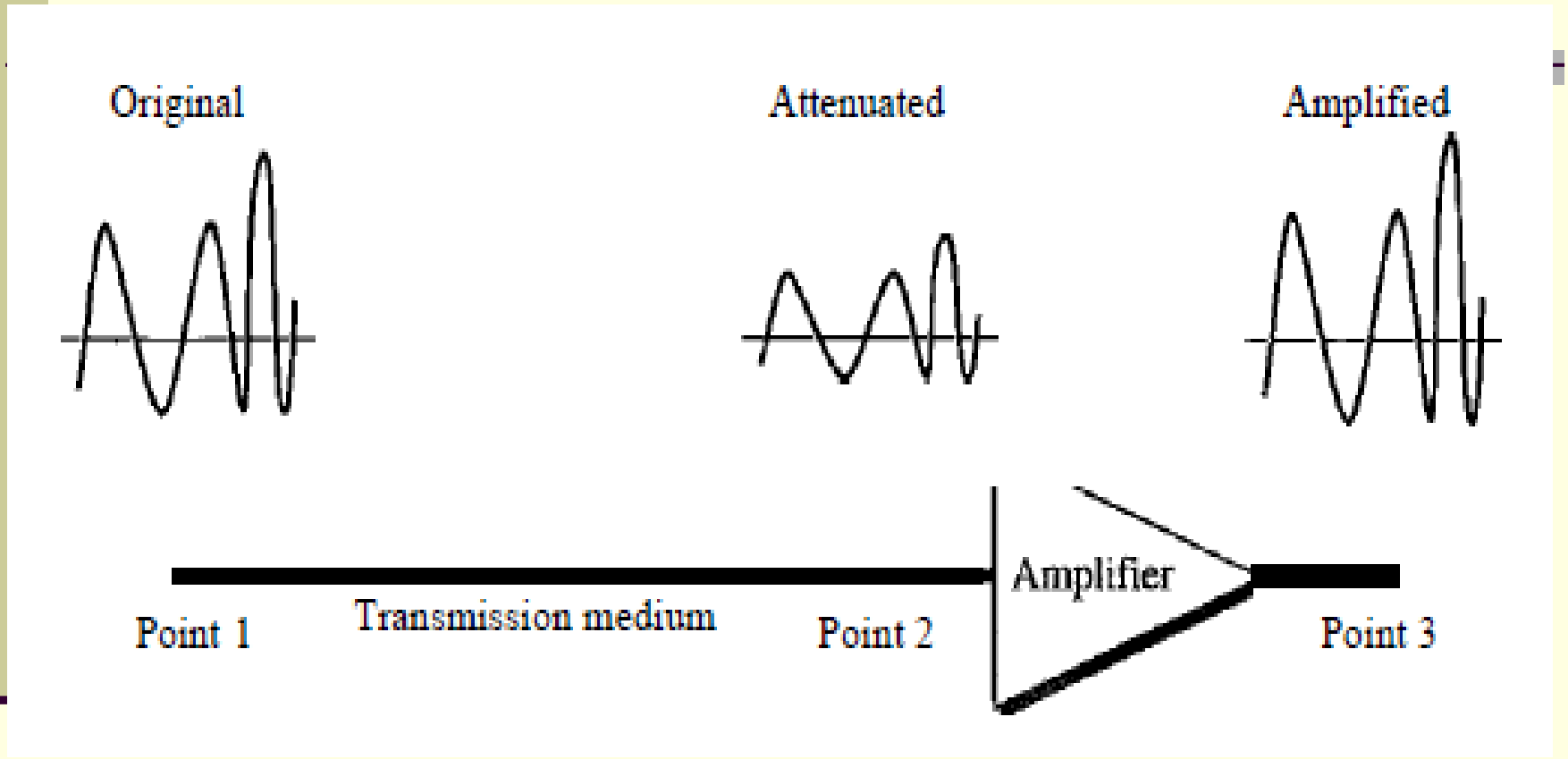
- *Signal received may differ from signal transmitted causing:*
  - *Analog - degradation of signal quality*
  - *Digital - bit errors*
- *Most significant impairments are*
  - *Attenuation and attenuation distortion*
  - *Delay distortion*
  - *Noise*

Attenuation

- *Where signal strength falls off with distance*
- *Depends on medium*
- *Received signal strength must be:*
  - *Strong enough to be detected*
  - *Sufficiently higher than noise to receive without error*
- *So increase strength using amplifiers/repeaters*
- *Is also an increasing function of frequency*

Attenuation

- Attenuation means a loss of energy. When a signal, simple or composite, travels through a medium, it loses some of its energy in overcoming the resistance of the medium.
- That is why a wire carrying electric signals gets warm, if not hot, after a while. Some of the electrical energy in the signal is converted to heat.
- To compensate for this loss, amplifiers are used to amplify the signal.



The effect of attenuation and amplification

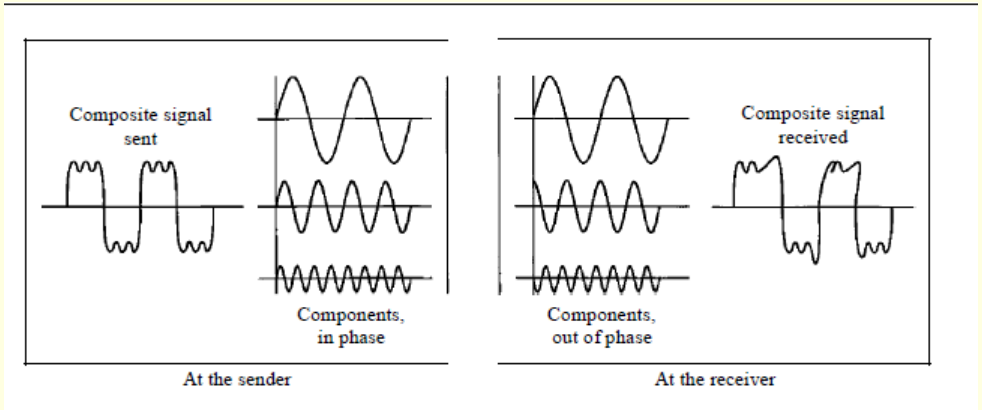
Decibel

- To show that a signal has lost or gained strength, engineers use the unit of the decibel.
- The decibel (dB) measures the relative strengths of two signals or one signal at two different points.
- Note that the decibel is negative if a signal is attenuated and positive if a signal is amplified.

$$\mathrm{dB} = 10 \log_{10} \frac{P_2}{P_1}$$

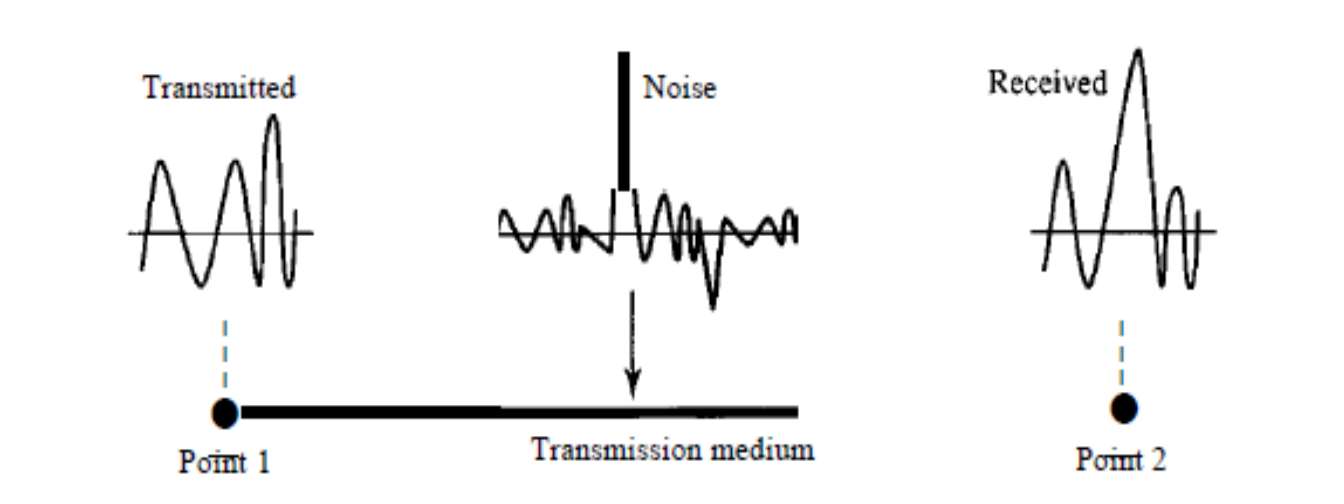
Distortion

- Distortion means that the signal changes its form or shape. Distortion can occur in a composite signal made of different frequencies. Each signal component has its own propagation speed through a medium and, therefore, its own delay in arriving at the final destination.



Noise

- Several types of noise, such as thermal noise, induced noise, crosstalk, and impulse noise, may corrupt the signal.
- Crosstalk is the effect of one wire on the other. One wire acts as a sending antenna and the other as the receiving antenna.



Signal-to-Noise Ratio (SNR)

- The signal-to-noise ratio is defined as

  SNR=average signal power/average noise power

- Because SNR is the ratio of two powers, it is often described in decibel units, SNR(dB), defined as:

  SNR(dB) = l0logl0 SNR