Transmission Impairment

In the data communication system, analog and digital signals go through the transmission medium. Transmission media are not ideal. There are some imperfections in transmission mediums. So, the signals sent through the transmission medium are also not perfect. This imperfection cause **signal impairment**.

It means that signals that are transmitted at the beginning of the medium are not the same as the signals that are received at the end of the medium that is what is sent is not what is received. These impairments tend to deteriorate the quality of analog and digital signals.

Consequences

1. For a digital signal, there may occur bit errors.
2. For analog signals, these impairments degrade the quality of the signals.

Causes of impairment

There are three main causes of impairment are,

1. Attenuation
2. Distortion
3. Noise

1) Attenuation

Here attenuation Means loss of energy that is the weaker signal. Whenever a signal transmitted through a medium it loses its energy, so that it can overcome by the resistance of the medium.

* That is why a wire carrying electrical signals gets warm, if not hot, after a while. Some of the electrical energy is converted to heat in the signal.
* Amplifiers are used to amplify the signals to compensate for this loss.
* This figure shows the **effect of attenuation and amplification**:

* A signal has lost or gained its strength, for this purpose engineers use the concept of decibel(dB).
* Decibel is used to measure the relative strengths of two signals or a signal at two different points.
* If a signal is attenuated then dB is negative and if a signal is amplified so the db is positive.  
  Attenuation(dB) = 10log10(P2/P1)  
  where P2 and P1 are the power of a signal at points1 and 2.

2) Distortion

If a signal changes its form or shape, it is referred to as distortion. Signals made up of different frequencies are composite signals. Distortion occurs in these composite signals.

* Each component of frequency has its propagation speed traveling through a medium and therefore, different components have different delay in arriving at the final destination.
* It means that signals have different phases at the receiver than they did at the source.
* This figure shows the effect of distortion on a composite signal:

3) Noise

Noise is another problem. There are some random or unwanted signals mix up with the original signal is called noise. Noises can corrupt the signals in many ways along with the distortion introduced by the transmission media.