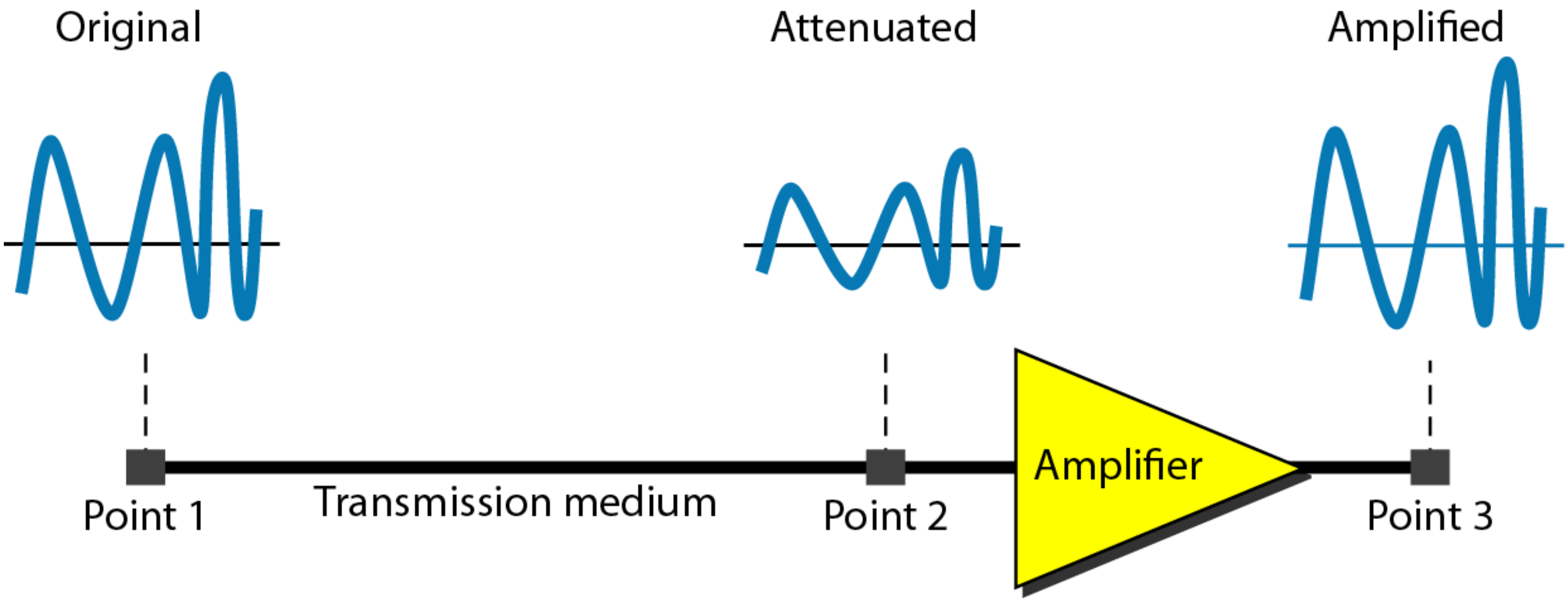
TRANSMISSION IMPAIRMENT

The imperfection causes to the signal during transmission is known as 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.

Three causes of impairment are attenuation, distortion, and noise.

Attenuation (the first impairment)



Decibels

- Signal strength is measured in decibels (dB)
- dB is a relative measure of loss (or gain)
- dB = 10 x $\log_{10}$ (P2 / P1)
  - P2 = ending power level in watts
  - P1 = beginning power level in watts

Example: P1 = 10 watts, P2 = 5 watts

dB =10(-0.3)=-3dB a loss of 3dB

Decibels cont.

Problem: If a signal at the beginning of a cable with -0.3db/Km has a power of 2mW ,find the power of the same signal at 5Km

The loss in the cable = -0.3 X 5 = -1.5dB

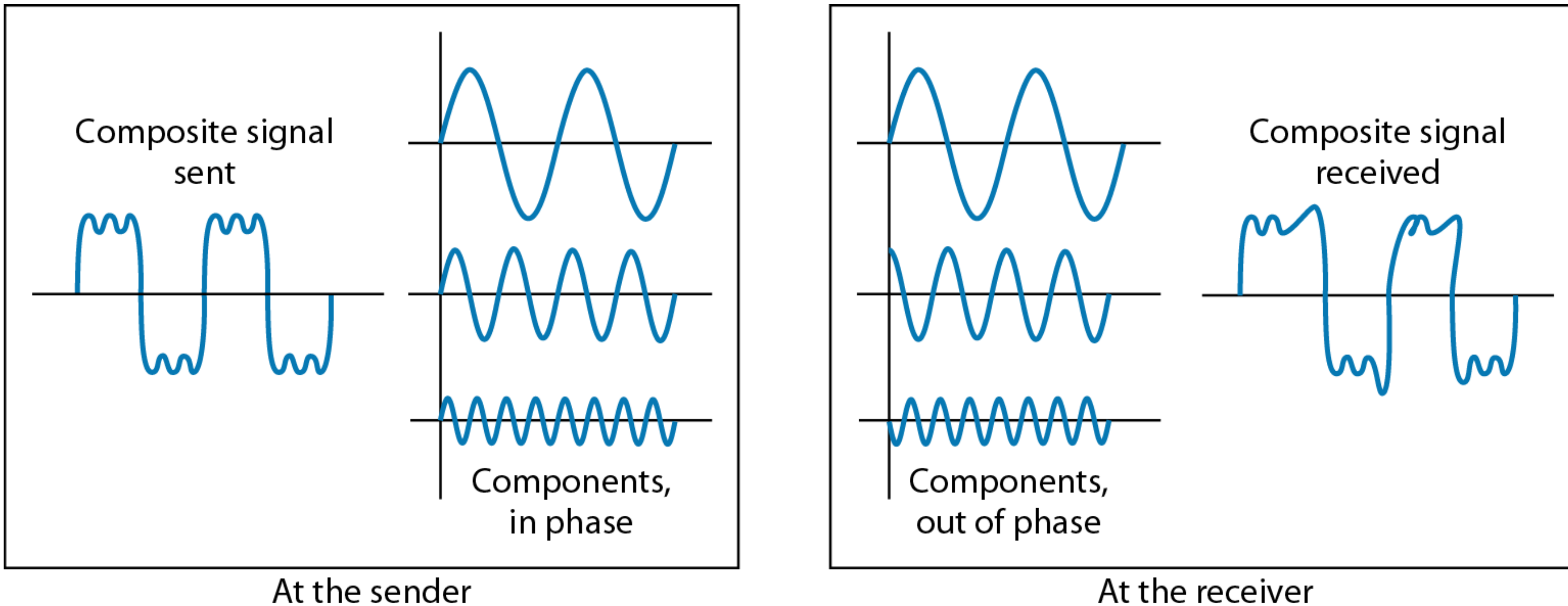
$$-1.5 = 10 \times \log_{10} (P2 / P1)$$

$$(P2 / P1) = 10\text{^}{-0.15} = 0.71$$

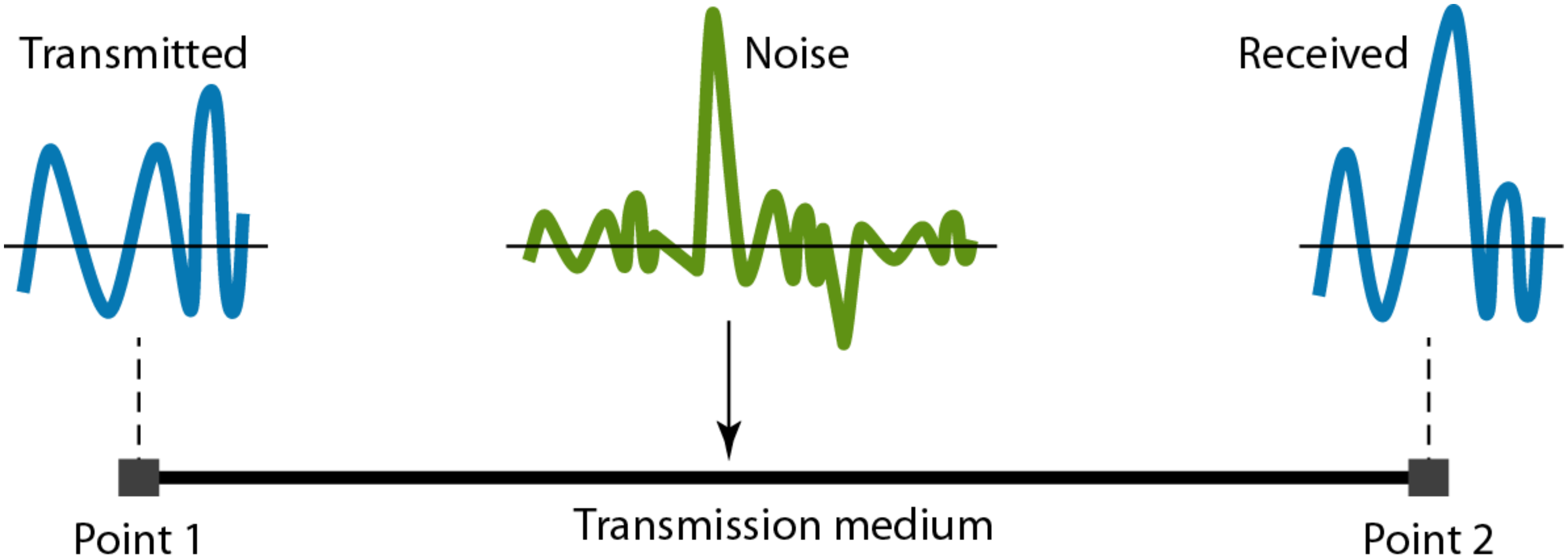
$$P2 = 0.71 \times P1 = 0.71 \times 2 = 14.2\text{mW}$$

Distortion (the second impairment)

The signal changes its form or shape while traveling is called distortion



Noise (the third impairment)



Signal to Noise Ratio (SNR or S/N)

- *Signal to noise ratio* shows the ratio of signal power to noise power
- Power often expressed in *watts*
- SNR = signal power/noise power

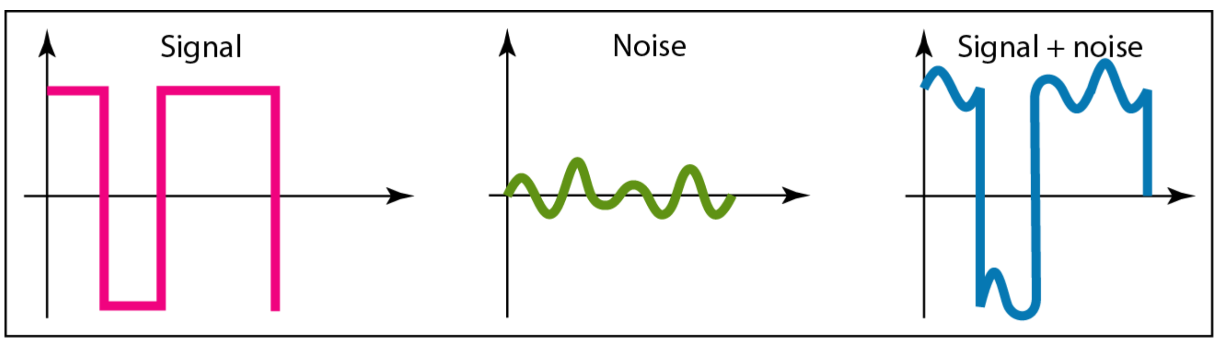
Types of Noises

- Thermal Noise
- Induced Noise
- Cross talk
- Impulse noise

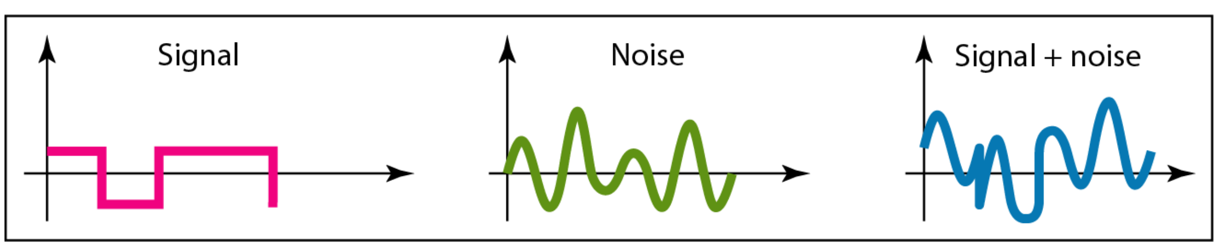
Signal to Noise Ratio (SNR)

- *Signal to noise ratio* shows the ratio of signal power to noise power in decibels

  SNR= average signal power/ average noise power
- High SNR indicates signal less corrupted by noise and small SNR indicates signal is highly corrupted by noise



a. Large SNR



b. Small SNR

Signal to Noise Ratio in decibel

$$SNR_{dB} = 10 \log_{10} (\text{signal power}/\text{noise power})$$

The power of a signal is 10 mW and the power of the noise is 1 μW; what are the values of SNR and SNR_{dB} ?

Solution

The values of SNR and SNR_{dB} can be calculated as follows:

$$SNR = 10000$$

$$SNR_{dB} = 10 \log_{10}(10000) = 40$$

The values of SNR and SNR_{dB} for a noiseless channel are

$$SNR = \frac{\text{signal power}}{0} = \infty$$

$$SNR_{dB} = 10 \log_{10} \infty = \infty$$

We can never achieve this ratio in real life; it is an ideal situation.