ECE 215 Spring 2025

Objective 3.9: Signal to Noise Ratio (SNR)

UNITED STATES
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ACADEMY

Objective 3.9

I can calculate signal-to-noise ratio (SNR) and determine the affects on wireless communications.

SNR Definition

$$\text{SNR} = \frac{\text{how loud you are talking}}{\text{how loud everyone else is talking}} = \frac{\text{the signal}}{\text{the noise}}$$

$$= \frac{P_{\text{Signal}}}{P_{\text{noise}}} = \boxed{\frac{P_{\text{Signal}}}{kT_{\text{sys}}\text{BW}}}$$

$$k = 1.38 \times 10^{-23}\text{J/K}(\text{Boltzmann's constant})$$

$T_{\text{sys}} \rightarrow$ effective noise temperature in system, in K

$\text{BW} \rightarrow$ bandwidth of the signal

EXAMPLE

The receiver on a search and rescue HC-130 requires a SNR of 7.5 to detect and process a signal. If the voice mode of a survival radio uses a bandwidth of 16kHz, what is the minimum received power needed by the HC-130? (Assume T_{sys} = 300K).

Recall: Radio Comm Problem Steps

- Read the problem, determine what you're looking for
- Determine if transmitter and receiver have LOS
- Determine if TX and RX radios have enough power to talk
  - Calculate received power
    OR
  - Calculate max distance
    OR

  - ***Calculate SNR***

Bottom Line

Receive radio **must** have LOS, enough power to communicate, **and** be able to hear over the noise!