Wireless Communication Fundamentals II

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Review

- Wireless = electro-magnetic waves
- Path-loss over distance
- Multi-path reflections
- Modulation

Symbol Rate & Bandwidth

- Modulation allows transmission of one of several possible symbols (two or more)
- Data stream is encoded by transmitting several symbols in succession
- Symbol rate ≈ bandwidth
  - Throughput (bits/sec)
  - Spectrum usage (Hz)
- Inter-symbol interference (ISI) occurs unless delay spread << symbol time

Thermal Noise

- Ever-present thermal noise in wireless medium
- Sums with any wireless transmission
- Potentially causes errors in reception (digital) or degradation of quality (analog)
- Effectively limits transmission range when transmitting signal strength falls below noise floor
- -174 dBm/Hz

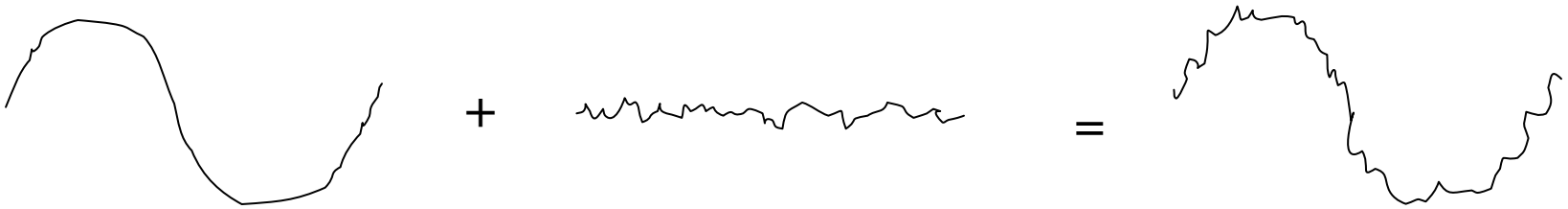
Thermal Noise Calculation

- Depends on channel bandwidth
  - About 25 MHz for 802.11b or 802.11a channel
- = -174dBm/Hz + 10log(bandwidth in Hz)
- So for 802.11
  - Noise Floor is about -100 dBm
  - -100 dBm = 10log(.0000000000001 Watts)

Noise Limits Transmitting Distance

Short range transmission (low path loss)

Signal to Noise Ratio (SNR)



High

Long range transmission (high path loss)

Low

Physical Channel Properties Review

- Wireless signal strength
  - Transmit power
  - Loss over distance (falls off by d^2)
  - Shadowing (e.g. absorption by walls)
  - Multi-path (e.g. bouncing off of metal objects)
- Noise
  - Thermal noise floor
  - Environmental noise (e.g. microwave ovens)
- Channel quality
  - Related to signal to noise ratio