136 lines (136 loc) · 3.66 KB

Link Budget: Example

** Consider a GSM system with the following characteristics:

- Carrier frequency fc = 900MHz,
- Bandwidth B = 200kHz,
- Operating temperature T = 300 K,
- Antenna gains GTX = 8 dB and GRX = −2 dB,
- Cable losses at TX LTX = 2 dB,
- Receiver noise figure F = 7 dB.

** The propagation characteristics are

- The path loss exponent is n = 3.8,
- the breakpoint distance is 10 m,
- the fading margin is 10 dB. The required operating SNR is 8 dB, the desired range of coverage 2 km.

What is the minimum TX power?

In [1]:

```
# Given parameters
𝑓꜀ = 900e6  # Carrier frequency in Hz
B = 200e3   # Bandwidth in Hz
T = 300     # Operating temperature in Kelvin
GTX_dB = 8  # Transmitter antenna gain in dB
GRX_dB = -2 # Receiver antenna gain in dB
LTX_dB = 2  # Cable losses at transmitter in dB
F_dB = 7    # Receiver noise figure in dB
n = 3.8     # Path loss exponent
d₀ = 10     # Breakpoint distance in meters
dᵩ = 2000   # Desired range of coverage in meters
Mf_dB = 10  # Fading margin in dB
SNR_req_dB = 8;  # Required operating SNR in dB
```

In [2]:

```
# Calculate path loss at the breakpoint distance (d₀) using the free-space path loss form
PL_d0_dB = 20 * log10(d₀) + 20 * log10(𝑓꜀) - 147.55

# Calculate total path loss at the desired distance (dᵩ)
PL_dᵩ_dB = PL_d0_dB + 10 * n * log10(dᵩ / d₀)

# Calculate noise power in dBm
N_dBm = -174 + 10 * log10(B) + F_dB

# Estimate the minimum required transmit power in dBm
P_TX_min_dBm = SNR_req_dB + N_dBm + PL_dᵩ_dB + Mf_dB - GTX_dB - GRX_dB + LTX_dB

println("Minimum required TX power: ", P_TX_min_dBm, " dBm")
```

```
Minimum required TX power: 38.98428998065759 dBm
```

In [3]:

```
# Convert dBm to watts
P_W = 10 ^ ((P_TX_min_dBm - 30) / 10)

println("Minimum TX power in watts: ", P_W)
```

```
Minimum TX power in watts: 7.914600498295329
```

In [ ]: