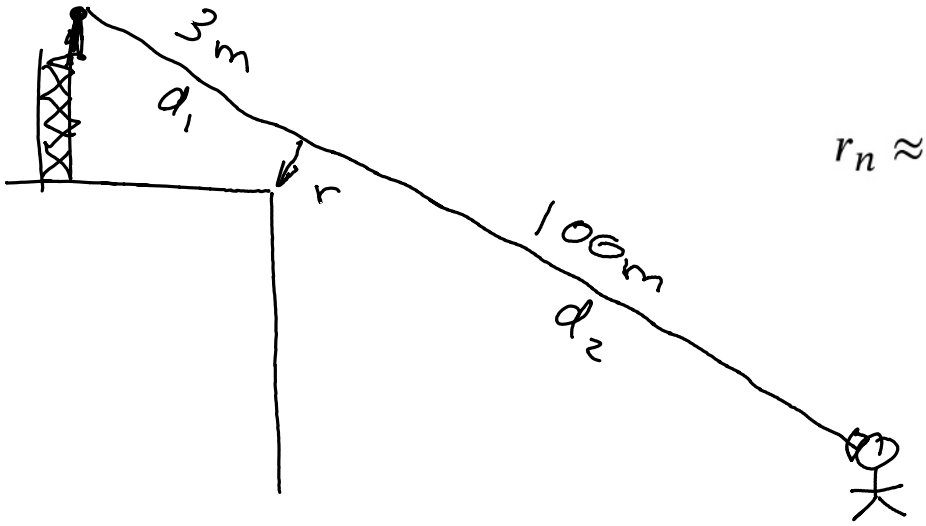
Deterministic Propagation Models

Exercise 1: An cellular base station antenna is mounted on a tower above a building. The line-of-sight path from the antenna to the nearest user passes near the edge of the building. The distance from the antenna to the edge is 3 metres and from the edge to the user is 100m. The system operates at a frequency of 900 MHz. By how much must the line-of-sight (LOS) path clear the edge of the building to ensure that diffraction effects are negligible?

$f = 900 \times 10^6$

$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{9 \times 10^8}$

$$r_n \approx \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}}$$



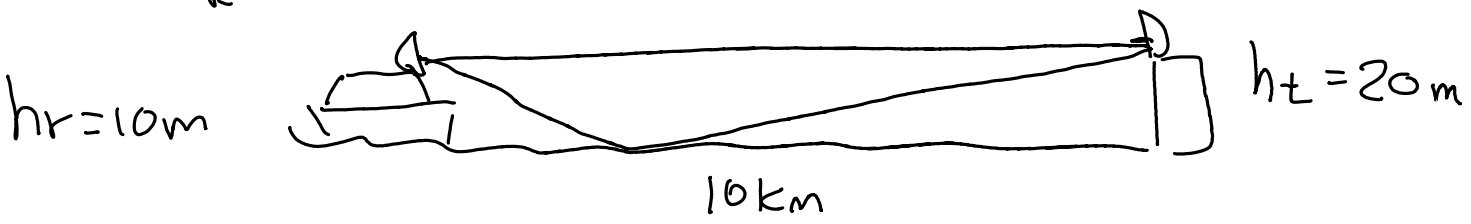
$$r = \sqrt{\frac{\frac{1}{3} \cdot 3 \cdot 100}{103}} \approx 1 \text{ m}$$

Exercise 2: You want to set up an over-water link to provide data service to a ferry. The maximum distance from the terminal to the ferry is 10km. The antenna heights are 20m at the terminal and 10m at the ferry. You can use 20dBi antennas at each end and 1W transmit power. On a very calm day (no waves) what will be the received power in Watts and dBm?

$P_T = 1W$

$G_T = 20dBi$

$G_R = 20dBi$



$$P_r \approx P_t G_t G_r \frac{h_t^2 h_r^2}{d^4}$$

$$P_R = 1 \cdot 10^{\frac{20}{10}} \cdot 10^{\frac{20}{10}} \cdot \frac{(20)^2 (10)^2}{(10^4)^4}$$

$$= 10^4 \frac{4 \times 10^4}{10^{16}}$$

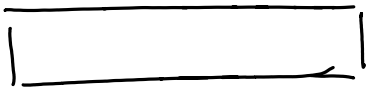
$$= 4 \times 10^{-8} W = 40 \times 10^{-9} W$$

$$= 40 \times 10^{-6} mW$$

$$= 4 \times 10^{-5} mW$$

$$= -44 dBm$$

Exercise 3: What is the path loss exponent for a signal propagating along a perfectly-conducting waveguide?



$$P_r \propto \frac{1}{d^n} \qquad n = 0$$