

Radio Communication Systems I, Examination, 9.2.2011

**Problem 1.**

- a) Explain two advantages and two disadvantages of Time Division Multiplexing.
- b) Explain two advantages and two disadvantages of Code Division Multiplexing.

**Problem 2.** Assume a radio system for which the base station transmission power is 46dBm, antenna gain in transmitter is 14dBi, receiver sensitivity is -102dBm, shadow fading margin is 8dB, indoor penetration loss is 20dB and fast fading margin is 0dB. Calculate the allowed propagation (path) loss. What is the maximum cell range  $d$  if average path loss is defined by equation (\*)?

$$(*) \quad L(d) = 137.4 + 35.2 \log_{10}(d)$$

**Problem 3.** Consider system of Figure 1 (desired signal and one interferer). What is the maximum reachable SINR in receiver when average path loss between receiver and transmitters is given by

$$L(r) = 137.4 + 35.2 \log_{10}(r) \quad (r \text{ given in kilometers})$$

Both transmitters apply the same TX power and antenna gains in transmitters are of the form

$$G(\theta) = G_{\max} + \max \left\{ -12 \cdot \left( \frac{\theta - \theta_0}{\theta_{3dB}} \right)^2, -G_{FB} \right\} \quad (\text{in decibels})$$

The main transmitter antenna directions are denoted in Figure 1 by solid arrows, 3dB beam width is 60 degrees, maximum antenna gains are 16dBi and front-to-back ratio is 25dB. Impact of shadow fading and fast fading are ignored. Give answer in decibels.

**Problem 4.** Explain briefly how static system level simulations can be carried out. What random variables are needed? What kind of performance measures can be used?

**Problem 5.** Direct Mode Operation (DMO) is a unique networking feature that is enabled in Professional Mobile Radio (PMR) networks, but not available in commercial Public Land Mobile Networks (PLMN), such as, GSM/GPRS, UMTS, CDMA2000 and so on.

- a) Provide a brief explanation on what is DMO.
- b) With the aid of simple sketches, illustrate various ways how DMO could be utilized in standard TETRA PMR networks?

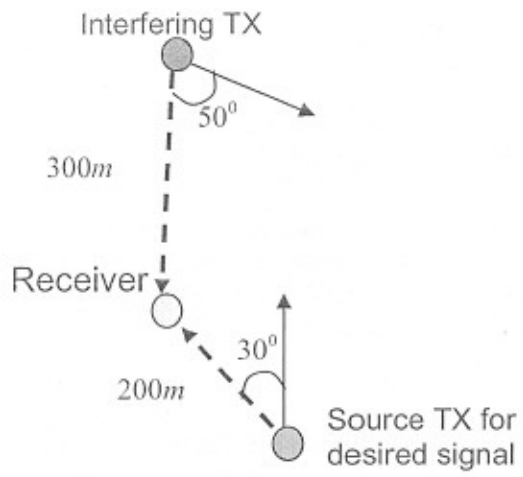


Figure 1 (for Problem 3).