

## Exercise 8

**Task 1.** In a wireless CDMA communication system, the user data rate is 30 kbit/s, the channel coding rate is  $1/2$  and the spreading factor is 64 chips/bit. If two copies of a signals resulting from multipath can be properly distinguished by a receiver when they are separated at least by one chip length, what is the corresponding minimum difference of the path distance traveled?

**Task 2.**

- a) If a GSM system is designed to handle propagation delays as long as  $30\text{ }\mu\text{s}$  between the mobile and the base station, what is the maximum supported cell size?
- b) Calculate the physical layer bit rate for one user (one time slot) in the GSM system. Why is the resulting value considerably higher than the user data bit rate seen in practice (usually 13 kbps for voice and 9.6 kbps for data)?
- c) What is the physical layer bit rate for downlink DPCH in UMTS system when QPSK modulation is used and the spreading factor is 8?
- d) How does channel coding affect the physical layer bit rate and the user data bit rate?

**Task 3.** For a speech service, the required  $E_b/N_0$  is typically in the order of 5 dB. Consider that you have one user who speaks on the phone with a bit-rate of 12.2 kbps, and that the UMTS chip rate is 3.84 Mcps. Calculate the SINR and explain the result.