Exercises 2: "Multiplexing and Duplexing Schemes"

Exercise 2.1: A network operator that owns a FDMA-based mobile communication system gets 12,5MHz spectrum for uplink and downlink, respectively.

a) How many channels are available under the assumption, that for each channel 30kHz bandwidth is required and that at the edges of the spectrum 10kHz guard bands have to be provided?

b) Calculate the maximum data rate of a user, if channel coding is performed with code rate 1/3 and a modulation scheme with spectral efficiency of 1,48bit/(sHz) is used.

c) Calculate the maximum possible channel capacity according to Shannon, if a SNR of 6dB is required.

Exercise 2.2: In a GSM system (with FDMA/TDMA multiplex and FDD duplex) 25MHz bandwidth is available for the uplink. This bandwidth is divided into 200kHz channels. The TDMA frame structure of a channel consists of 8 time slots, with 156,25bits per time slot. The overall bitrate of a channel is 270,833kbit/s.

a) How many users could be served in parallel, if the 25MHz bandwidth is used completely?

b) How long is the bit duration, the time slot duration and the frame duration?

c) Calculate the waiting time between two consecutive transmissions of an user that occupies a time slot.

d) Calculate the maximum achievable throughput per channel according to Shannon, if a SNR of 10dB is required.

Exercise 2.3: A CDMA system with a chip rate of 3,84Mchip/s is considered. For simplification only a single omnidirectional cell is considered.

a) Calculate the spread factor for a voice service with a bitrate of 12.2kbit/s?

b) How many users n with a bitrate of 384kbit/s are allowed in the cell at the same time, assuming an ideal power control, an required E_b/N_0 of 5dB and a negligible thermal noise? (Assumption: $E_c/N_0 \approx 1/(n-1)$)

Exercise 2.4: a) The binary source signal (1, 0, 1) should be spread with the spreading code sequence (0, 0, 1, 0, 1, 1, 1, 0). Draw the signal in the following stages: binary source signal, spreading code, spreaded signal.

b) The binary source signal (0, 1, 1) should be spread with the spreading code (1, 1, 1, 0, 0, 1, 1, 1). Draw the signal in all 3 stages again.

c) How does the superposition of both spreaded signals look like, if they are transmitted with the same power level?