

Exercise 10

Task 1. Calculate the capacity of a communication channel with bandwidth $W = 1$ MHz, when the signal-to-noise ratio is either 10 dB, 20 dB or 30 dB. Find out what is the upper limit of the capacity in the three cases, as the bandwidth is progressively increased.

Task 2. Explain the difference between frequency diversity, time diversity, and spatial (either transmitter or receiver antenna) diversity.

Task 3. The receiver in a diversity-based communication system has 4 replicas of the signal available, represented by the following complex-valued coefficients of the diversity branches:

$$h_1 = 0.5 e^{j\pi/4} \quad h_2 = 0.2 e^{j\pi/3} \quad h_3 = 0.2 e^{j\pi/2} \quad h_4 = 0.1 e^{j\pi}$$

Calculate the output when the receiver uses either the SC, EGC or MRC combining methods (assume noise to be small enough so that it can be omitted from the results).

Task 4. Explain what different conditions are required in a MIMO communication system to support spatial diversity/multiplexing or beamforming, and roughly estimate the needed size for a 5-elements antenna array in either case, when the operating frequency is 10 GHz.

Task 5. Explain the difference between the ARQ and FEC channel coding principles.

Task 6. Draw a picture of the ISO/OSI seven-layers model, summarizing the concepts of vertical data flow and peer-to-peer communication, as well as the general purpose of each layer.

Task 7. Explain the difference between RRM and RRC, and their purposes.

Task 8. Summarize the most common handover types in wireless networks.

Task 10. Explain the idea of Assisted GPS systems and its variants, and list the main benefits, costs and drawbacks of A-GPS compared to S-GPS.

Task 11. Summarize the main measurement alternatives upon which positioning systems are based, and their variants.

Task 12. Explain the concept and procedures of the RSS-based fingerprinting method for positioning. Assume that the four fingerprints below from three different APs are available to a user which currently measures RSS of AP1: -20, AP2: -10, AP3: -30, and find the user position estimation using MSE calculations.

POS NW	POS NE	POS SE	POS SW
AP1: -20	AP1: -30	AP1: -30	AP1: -20
AP2: -30	AP2: -20	AP2: -20	AP2: -30
AP3: -30	AP3: -30	AP3: -20	AP3: -20