

Wireless Networking

Course code: CS4222/5422, Tutorial session: #5

Brief Instructions regarding the tutorial session

1. The attendance to tutorial sessions would contribute towards the determination of final grade
2. Please review the questions before coming to the tutorial session
3. Make an effort to solve the questions before attending tutorial. The teaching assistants will help in case of issues
4. The designated time for the tutorial session is one hour. Please contact the teaching assistants or the instructor if you need any further clarification regarding the tutorials outside the allocated period. Please send them an email.

Question 1: You are developing a communication system for wireless embedded devices that are situated on the Alps mountains in Switzerland. These devices communicate directly (line-of-sight) over a distance of 300 kilometers. The transmitting device features an antenna with a gain of 4 dBi and includes an amplifier with a gain of 8 dB. It operates with a transmission power of 20 dBm at a frequency of 865 MHz. On the receiving end, the antenna boasts a gain of 12 dBi, with a cable loss accounted for at 4 dB. Based on the given parameters, please calculate the following:

- A) What is the free space path loss for the communication link? What is FSPL if the frequency of the signal is 2.4 GHz?
- B) What is the link budget for the communication link budget and the received signal strength based on the value that has been calculated in the part a)?

Question 2: You are designing a communication system where the receiver's noise floor is -110 dBm, and the signal-to-noise ratio (SNR) of the signal is 100. The system is intended to operate with a bandwidth of 1 MHz within the 865 MHz frequency band. Please address the following questions:

- A) Please estimate the signal to noise ratio (SNR) in terms of dB?
- B) What is the strength of the signal in terms of dBm?
- C) What is the maximum capacity in terms of bits for communicating on 865 MHz band?
- D) You are permitting the system to operate within the 5 GHz frequency band. The signal spans a bandwidth of 5 MHz. While the signal strength remains unchanged, the noise floor has shifted to -95 dBm. Could you please estimate the SNR (both as a ratio and in dB), and calculate the maximum capacity in terms of the bits carried?

Question 3: You are given two radio transceivers with the following state diagram and specifications. Please answer the following questions based on the provided information.

- a) Which radio (red or blue) transceiver is suitable for an application operating on batteries which involves the continuous streaming of video from a security camera? A beacon to communicate information about the object to nearby smartphone device whenever the object is moved? Please also give appropriate rationale.
- b) If the radio transceiver operates at voltage of 3 volts. Please assume that the transceiver is active for 100 milliseconds every second. What would be the radio duty cycle? What is the average power consumption of both the transmitter?

