Wireless Networking

Course code: CS4222/5422, Tutorial session: #4

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: An embedded device utilizes its radio transceiver to emit radio waves with a transmission power of 15 dBm. During its journey from the transceiver to the board's antenna, the signal undergoes a 2 dB attenuation owing to mismatch. The antenna itself has a gain of 8 dBi. Please calculate the strength (power) of the radio signal radiated out from antenna? This is also referred to as effective radiated power (EIRP). Additionally, please provide the strength of the radiated signal expressed in the unit of watts and dBm.

Question 2: An antenna is engineered to emit a wireless signal that is 1000 times stronger than an isotropic antenna. Could you calculate the antenna's gain expressed in dBi and dBd units? Furthermore, if the Effective Isotropic Radiated Power (EIRP) is 18 dBm, and there is a loss of 4 dB between transceiver and antenna, what would be the transmitter power (i.e., the strength of the signal generated by the transceiver)?

Question 3: Please identify the type of the following antenna. All these are commercial antennas are designed to radiate or receive energy at very similar frequency. Furthermore, please align the antenna and type with their corresponding gain.
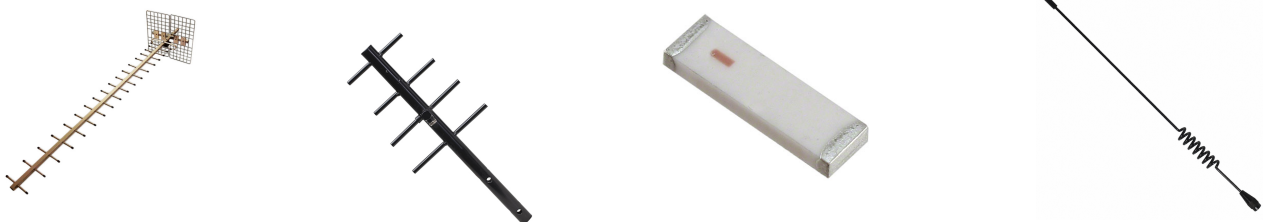
Gain of antenna (random ordering): 8.8 dBi, -1 dBi, 23 dBi, and 3.8 dBi

Question 4: Please identify the category and specific kind of sensors that you would employ for support of the following application scenarios.

• To estimate the number of steps traversed by the user of a wearable device
• To measure the blood pressure of the end-user using sensors on a smart watch
• To estimate the distance of a vehicle from a wall to prevent collisions while parking
• Detect breathing rate using sensors on a wearable device worn on the chest

Question 5: You are in the process of designing a wireless embedded device with the dimensions of a cube, each side measuring approximately one centimeter. The device utilizes compact batteries that are surface-mounted. An example of such a battery is the

CeraCharge from TDK. Specifically, the battery in question has a capacity of 100 µAh and operates at a rated voltage of 1.5 Volts. The microcontroller integrated into the device, an MSP430, exhibits a peak current consumption of 200 µA. Your task is to determine the operational lifespan of the device under the conditions. It is assumed for the purpose of this calculation that no other components are consuming power. Also assume that the sensors are continuously active. They are always ACTIVE. Please provide the lifespan estimation for the device utilizing only one sensor at a time from the list provided.

Sensor	Current Consumption
Accelerometer	30 microamperes
Temperature and Humidity sensor	50 microampere
Camera	1500 microampere
Light sensor	100 microampere