

# Wireless Networking

Course code: CS4222/5422, Tutorial session: #2

## 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:** What is whitespace networking? What frequency bands are used for the broadcasting of television and FM radio signals in Singapore and United States? What unoccupied bandwidth is available in these frequency bands for wireless communication? Can we use these frequency bands for communication between IoT devices?

**Question 2:** You designed a temperature sensor that is programmed to transmit in the 2.4 GHz band with an antenna gain (both receive and transmit) of 2 dBi and a transmit power of 10 dBm at the sensor. The application requires a communication range of 100 meters from temperature sensor to edge device. Please answer the following question.

- a) Considering 100 meters is the maximum achievable range. What is the receive sensitivity of the radio transceiver at the edge device?
- b) If you employ the 100 MHz frequency band instead of the 2.4 GHz band, what transmit power would suffice to support a range of 100 meters?
- c) How does the size of the antenna change (between 100 MHz and 2.4 GHz)? Please assume that you are using a monopole antenna for communication?
- d) What is the impact on battery lifespan when operating at the 100 MHz frequency band compared to the earlier case when the sensor was transmitting at 2.4 GHz?

**Question 3:** You are designing a wireless transmitter and considering the use of On-Off Keying (OOK), Frequency Shift Keying (FSK), or Chirp Spread Spectrum (CSS) as potential modulation schemes. For each specific application scenario, please select the most suitable modulation scheme and provide reasoning for your choice.

Application	Description
Urban deployment of sensors	Sensors communicate over distances of hundreds of meters in a complex urban environment. It consists of roads, buildings and vegetation.
Remote control	Communication between remote control and air conditioner or a television set
Simple sensors for agriculture monitoring	Simple, energy-harvesting sensors, communicating over long distances for monitoring soil.