Wireless Networking

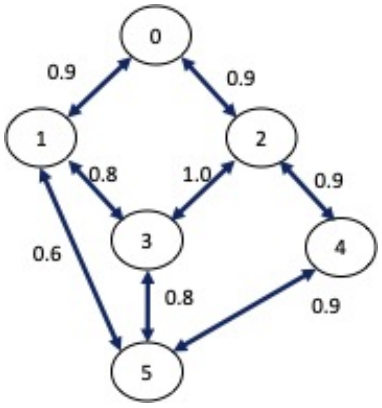
Course code: CS4222/5422, Tutorial session: #10

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.

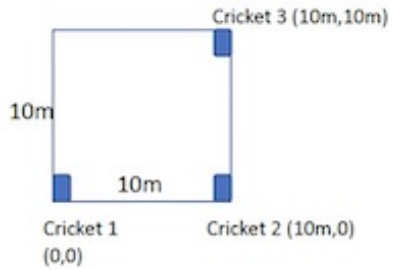
Question 1: In the figure below, nodes indicate IoT devices and two devices can communicate if there is a link between them. The number associated with each link is the link quality measured in expected packet delivery ratio. For the figure, find the shortest path from node 5 to node 0 using different routing metrics:

- Hop count
- Expected number of transmission (ETX)



Question 2: The per-hop packet error rate on a path with four hops are 0.25, 0.1, 0.5, and 0.2.
Please find the following:
(a) path ETX
(b) the probability that a packet can traverse the path with no error/retransmission?

Question 3: The figure below shows a 2D square of 10m by 10m with three cricket nodesplaced at different locations. The table below shows the wall clock time for the radio and audio signals from the node to be localized to reach each of the three cricket nodes. You can assume that the speed of light is 3x10^8 m/s and the speed of sound is 340 m/s. You can also ignore the processing time. Your task is to estimate the (x,y) coordinates of the node to be localized in meters, using cricket 1 as the origin (0,0).



	Cricket 1	Cricket 2	Cricket 3
Radio	1s	1s	1s

Audio	1.028s	1.020s	1.020s

Question 4: You are localising an electronic device. You are using the mechanism of time difference of arrival (TDoA) in the localisation system. In this case, the system uses acoustic transmissions and LiFi (visible light communication) for sending of the beacon messages from the anchors located in the infrastructure. If the acoustic transmissions are received at time 3.0303 seconds, and LiFi transmissions received at 3.00000003333 seconds when checking clock on the IoT device. You can assume that the anchors are co-located, and you are only required to determine distance of the target from the anchor.

a) Can you estimate the distance of the target device from the anchors?
b) If you can transmit beacons through LiFi and radio-waves together without using acoustic transmissions? Can you still leverage the time difference of arrival?

Question 5: You are deploying a wide area network that uses LoRa standard. You have configured the device into two different modes of operation. In the first mode, the LoRa device communicates at one of the lowest bitrates and the other mode it communicates at the highest data rate. These are as follows Bitrate: 980 bps (SF10, 125 kHz), 21900 (SF7, 500 kHz), for a receiver sensitivity of -135 dBm, and -121 dBm.

You can assume there are no losses in cable. The transmit, receive gain is 2 dBi.

a) If a Lora transceiver is transmitting at 10 dBm signal strength. What would be the maximum communication range?

b) If you would like to achieve the same range with a WiFi radio (2.4 GHz). If you assume the receiver sensitivity to be -90 dBm. What would be the transmit power required for Wi-Fi?

c) If the current consumption for LoRa and WiFi radio are 20 mA and 75 mA, and they operate at 3 Volts. If bitrate for 11 Megabit/seconds for WiFi. Can you compare the energy/bit for the both technologies?