Introduction to Wireless and Mobile Networking

Homework 4 Report

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1. Downlink

   1-1. Please plot the location of the central BS and 50 uniformly random distributed mobile devices in the central cell. Don't plot the location of other BSs and other mobile devices in other cells. The unit of x-axis and y-axis should be "meter". The central BS is located at (0, 0). Also, use mark or color to differentiate the central BS from mobile devices.

   For a mobile device located at (x, y) within the service area of the central base station, we use the random number generator to produce "distance to the center" and "angle from the center." Then, we converted the coordinate (r, θ) into (x, y). To simplify calculation and random point generation, we view the shape of the service area of the central base station as a circle. We have the following distribution of mobile devices in the central base station:

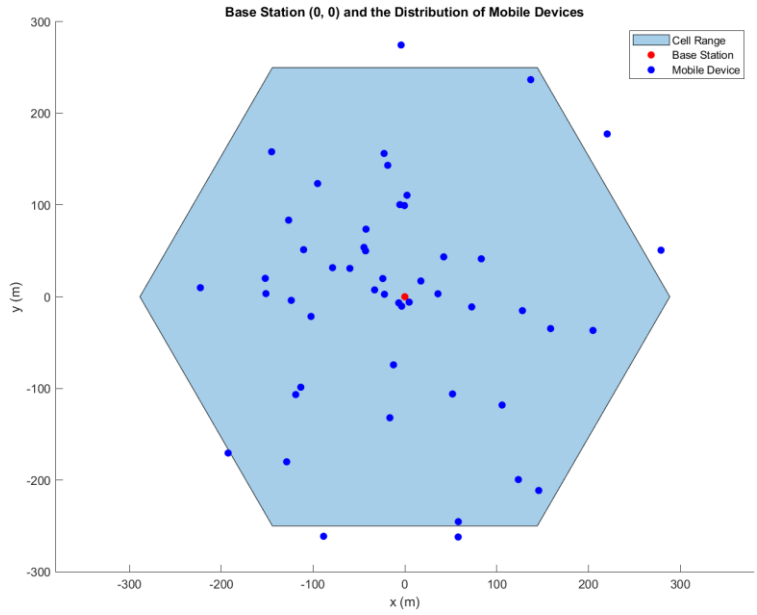

Figure 1. Distribution of mobile devices in the central base station

1-2. Based on the map in 1-1, please plot a figure with Shannon Capacity (bits/s) of a mobile device in a central BS as y-axis, and with the distance between the corresponding mobile device and the central BS as x-axis. Also, write down how to calculate the Shannon capacity of the mobile device in the central cell in your report. HINT: There should be 50 points in the figure.

From Homework 2, we already know how to calculate the SINR of each device. The Shannon capacity in bits per second is given below:

$$C = B \lg(1 + \text{SINR}) \tag{1}$$

By reuse of the code in Homework 2, we obtain the following graph.

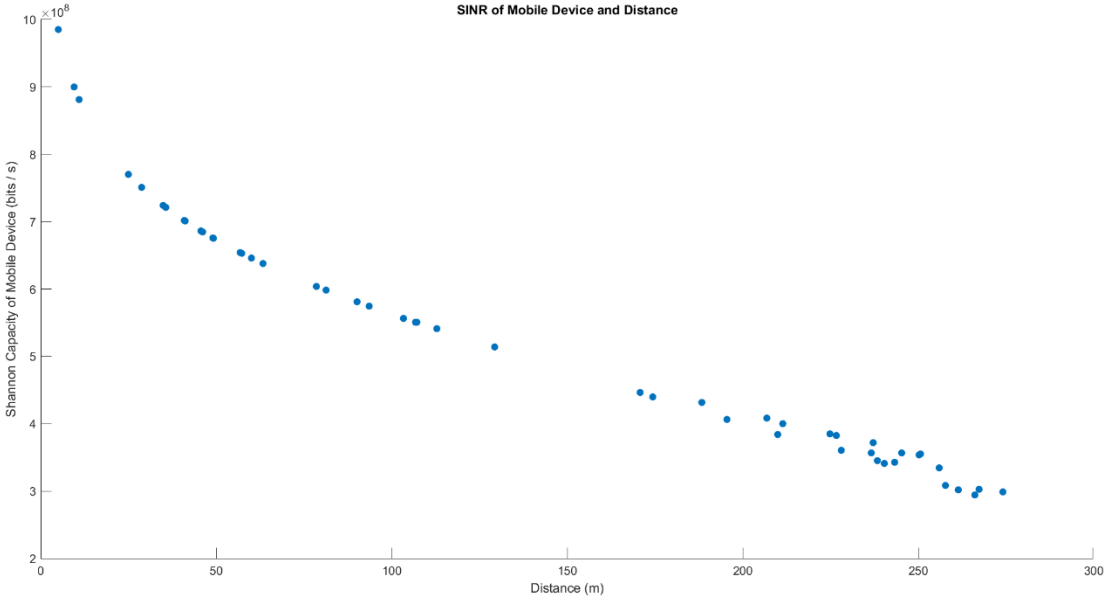

Figure 2. Capacity of each Mobile Device

From Figure 2, we see that if a mobile device is farther away from the central base station, its Shannon capacity decreases.

1-3. Based on 1-1 and 1-2, design the CBR parameters $\{X_l, X_m, X_h\}$ by yourself so that you can get different values of packet loss rate in the total simulation duration for each CBR parameter.

Write down the CBR parameters you used in your simulation. Plot a histogram figure with the bit loss probability in the central BS as the y-axis and the traffic load as the x-axis.

If you think the simulation duration 1000s is not enough, you can change it as you want. Write down the changed value of simulation time. If you think the size of the BS traffic buffer is too large or too small, you can change it as you want. Write down the changed value of the size of the BS traffic buffer.

The CBR parameters are $\{X_l, X_m, X_h\} = \{5\ \text{Mbps}, 10\ \text{Mbps}, 20\ \text{Mbps}\}$, and the simulation duration is 1000 seconds. We obtained the graph by simple simulation (without transmitting signals). As the traffic increases, the bit loss probability also increases. Hence, advanced techniques are needed to maintain the robustness of transmission in high speed scenario.

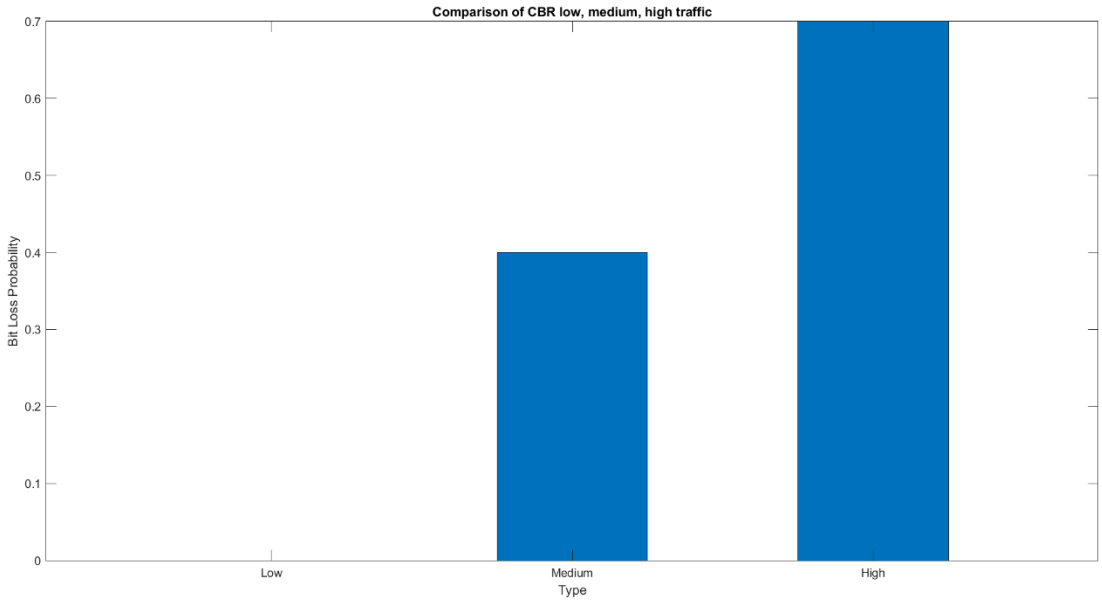

Figure 3. SINR of mobile device and distance