CS252: Lab 1 (Wireless Measurements)
Spring 2021

Marks: 30

In this Lab, you will learn about making wireless signal strength measurements. This is related to the Physical (PHY) layer. You may have noticed that sometimes the signal strength (given by the number of bars) shown by your phone is low (for 4G or WiFi). Usually the download data rates and/or voice call quality degrades when signal strength is low.

Cellular providers such as Airtel, Vi, and Jio have to try to ensure that signal strength is good everywhere, to keep their customers happy. They have to place 4G base-stations (called "eNodeB" in LTE parlance) strategically to ensure this. The wireless signals can face attenuation due to (1) obstacles, and (2) multi-path effect. The latter happens when the signal bounces off many objects and cancels each other, that is "destructively interfere" at the phone of the receiver (more about this in CS224; you can also look it up online if you are curious). Because of this, it is not easy to theoretically predict exactly what the signal strength will be at all locations, given the placement of base-stations.

In this lab, you will use one or more "apps" on your mobile phone to
  (a) Record signal strength over some geographical area (try to measure signal strength over a path of at least 1 km), and pictorially represent it on a map. Use colours to say if the signal strength is good or bad etc. In your report state the range of signal strengths (in dBm) which correspond to different colours. (15 marks)
  (b) Make a list of all the unique base-stations (eNodeBIDs) your phone was connected to during the measurement. (5 marks)
  (c) Try to infer what may have caused poor signal quality in locations where you found this to be the case (you may not know for sure what the reason is, but try to make an intelligent guess). You may find that there are some obstacles, or that the base-station was far away, etc. State in words in your report what you think the reasons for poor signal strength were. If you can annotate your Map to show obstacles etc, that would be even better, but this is not essential. (5 marks)
  (d) Comment if when you are standing in a fixed location (when you are not moving) if the signal strength (RSRP: reference signal received power) is steady or if it varies, based on a measurement of a minute's duration. Give a plot of how RSRP varies with time at a fixed location. (5 marks)

Teams and report: You can work in groups of at most 3. Since you are all separated, all 3 can make measurements, discuss among themselves, and report measurements made by all team members. Each team can write a short report (pdf format), which includes some of their findings corresponding to (a) -- (d) above. The report should be uploaded (by anyone member) to Moodle before the deadline. The filename should include the roll numbers of all team members

and the Lab number. For example, for a 3 member team, the filename will be: <Roll No. of Member 1>_<Roll No. of Member 2>_<Roll no. of Member 3>_lab1.pdf.

Suggested Apps: There are many apps available on Android (and possible for Apple IoS as well). Here are some suggested apps for Android. Feel free to use any other Apps for doing the assignment.

(i) NetMonitor Cell Signal Logging Lite (https://play.google.com/store/apps/details?id=ru.v_a_v.netmonitor). For this app, under the "Main" tab, you can click on the red button on the top right to record, and then the white square button to stop recording. Each time you do this, a new Session is logged which you can later find under the "Sessions" tab. You can view the details of recorded sessions by going to "Sessions" → "click on session to view" → "Map icon to the left of the "dustbin" icon". This should give you a Google Map of signal strength. Clicking on any location of the path on the map will give you a list of measurement points corresponding to that location. Clicking on one of these will give you the raw data and some plots.

(ii) Open Signal (https://play.google.com/store/apps/details?id=com.staircase3.opensignal). This is a popular app that can help you locate mobile towers. It also shows you which mobile tower you are connected to. One issue is that the Cell ID information does not correspond to the eNodeBID given by the app mentioned above. But it still may give you some idea of the locations of base-stations, which may help you figure out why signal strength is good or bad.

(iii) Network Cell Info Lite (https://play.google.com/store/apps/details?id=com.wilysis.cellinfolite): In the "Map" tab it sometimes gives locations of base stations.

Do feel free to suggest other apps by posting information to the MS Team for CS 252.