COMP4336/9336 Mobile Data Networking

Lab 3: Experimental study of wireless path loss – line-of-sight (LoS)

Objectives

1. To observe path loss phenomenon under LoS condition by analysing RSS at different distances
2. To estimate path loss exponent for indoor and outdoor under LoS

Prerequisites

- Access to two mobile devices, such as a laptop and a mobile phone with WiFi interfaces
- Wireshark (and any additional monitoring software, e.g., Network Monitor for Windows users) installed in one of the devices, such as in the laptop
- Familiarity with Wireshark, such as completion of Lab 1
- Understanding of the concepts of path loss, such as lecture notes from Week 2

Introduction

Path loss refers to the loss of signal power as it travels through space. Path loss exponent captures how fast the signal power decays with distance. Different environments, such as indoor and outdoor, usually exhibit different path loss. Having a good estimate of path loss for a given environment of interest is crucial in designing a mobile communication system. Commercial mobile network operators use sophisticated instruments to accurately estimate path loss in areas of their deployment. In this lab, you will use simple tools, such as laptops, phones, and WiFi packet capture tools (e.g., Wireshark), to observe the pathloss phenomenon and derive a crude estimate of path loss component for the indoor and outdoor environments that you have access to.

Your Tasks

RSS data capture [2 marks]: Your first task is to capture RSS data at different distances and save them in CSV files for post-processing. To capture RSS data, follow the following 3 steps (repeat the same steps for both indoor and outdoor):

Step 1: Configure your phone as a WiFi hotspot (set SSID to your UNSW ZID) and connect your laptop to it so that you can capture, e.g., using Wireshark, the beacon packets transmitted by the phone.

Step 2: Place the laptop at one corner of the indoor/outdoor area and mark 10 equally distant spots (locations) from it with the 10th spot located at the farthest corner of the area. Make sure that the laptop has LoS with the phone. and adjust the 9 other spots accordingly.

In total 10 CSV

Step 3: For each marked location, capture WiFi packets transmitted by the phone for at least 1 minute and save them in a CSV file. After this step, you should have 10 CSV files (10 for indoor and 10 for outdoor), one for each of the 10 locations. If you are taking the RSS values only from the beacon packets for consistence transmit powers, you should be able to accumulate between 200 to 600 RSS data in 1 minute assuming beacon intervals anywhere between 100ms to 300ms. Please make sure there are at least 200 RSS data in the trace file; you may need to extend the capturing duration to make sure that you have enough data to process.

minimum of 60 RSS value

Path loss exponent estimation [2 marks]: First, plot the raw RSS data against distance in *log scale*, i.e., in the y-axis plot RSS in dBm and x-axis $\log_{10}$(*distance*), where *distance* is in meters. You will find the graph very noisy and difficult to estimate path loss exponent. Next, plot only the average RSS values per location (x-axis still in log-scale). The later should look much clearer. Now fit a straight line to the average RSS values and find the *slope* of the line using packages such as Excel, Matlab etc. Show the important data about your fit, such as the equation of the straight line, the slope, and the R squared value ($0<R^2<1$), which represents the quality of the fit; the larger the R^2 the better the fit). If one or two data points are not good (far from a straight line or gives low R squared value, you can remove them as "outlier" when fitting the line). The path loss exponent for this environment is estimated as **the *slope*** of the straight line.

What to submit?

1. Submit a ZIP file containing 10 RSS CSV files for indoor and 10 RSS CSV files for outdoor. Please note that, the CSV file should only include necessary information (i.e., time, RSSI and other critical information for the task), *unnecessary data should be dropped*. **[2 marks]**
2. Submit a PDF report showing the RSS vs. log distance graphs, both raw RSS and average RSS with line fit and slope estimation for both indoor and outdoor. Write a one paragraph commentary on your observation of the indoor vs. outdoor path loss exponents, such as are they the same or different, if different which is smaller/larger and why. **[2 marks]**

Penalty at the rate of 5% for each day late will be strictly enforced for all lab submissions.

All submissions will be subject to strict UNSW plagiarism rules.

End of Lab 3 – Hope you enjoyed this lab.