

## Assignment 1 - Wi-Fi measurement

**Deadline:** 4.2.2022 (end of the day)

### Description:

This assignment includes Wi-Fi Access Point scanning, performance measurement of Wi-Fi data transmission, and impact analysis of signal strength and interference on throughput and retransmission rate. You can work in a pair on this assignment. Please read the tutorial online and start working on it already after the lecture on Jan 18. If you have any questions, you're welcome to attend the tutorial session on Jan 24. and exercise session on Jan 31.

**Please run experiments in the following steps and summarize your experiment setups and results in 4-6 slides.** Submit your slides to MyCourses.

1. Check the configuration of the Wi-Fi network interface on your own computer.
2. Use command line to scan the Wi-Fi access points and record information of all the APs you observe from one location, including SSID, BSSID, used channel, band, network protocol (e.g. 802.11g/n/ac), supported data rates, signal strength and anything else you can get.
3. Observe the changes in signal strength when moving around, and analyze the impact of distance and obstacles on wireless signal strength.
4. Associate your phone or laptop with one Wi-Fi AP, and parse the beacon frames. Compare the description of AP with the result of 1).
5. Send data from one station to another one connected to the same AP (check BSSID), and measure data rate. You can use iperf (<https://iperf.fr/>) for example to implement data transmission.
6. Analyze the impact on data rate from signal strength. You can measure the data rate with three different levels of signal strength. (Hint: there are many ways to configure the signal strength. Besides distance and obstacles, you can consider also configuring the transmit power of AP. In this case, it is not a good idea to run experiments in congested networks.)
7. Generate interference and monitor noise level and signal-to-noise ratio. Analyze the impact of interference on throughput. Repeat the experiment to compare the impact from different levels of interference. Bonus (2p): Also measure and analyse MAC retransmission rate in your measurement. (Hint: there are different ways to generate interference. For example, you can create background traffic using other stations, or put your stations close to microwave oven.)

**Assessment Criteria (max 14 points + 2 bonus points):**

<b>Topic (weight)</b>	<b>Unacceptable (0)</b>	<b>Marginal (1)</b>	<b>Acceptable (2)</b>
Wi-Fi AP scanning (1)	Does not use command line to implement AP scanning	Use command line to scan the Wi-Fi APs, but does not record all the related information	Use command line to scan the Wi-Fi APs, and correctly record the related information (at least 7 attributes mentioned in the description) of all the APs observed from one location.
Wi-Fi AP association (1)	Does not use command line to implement AP association	Associate your phone or laptop to one AP using command line	Associate your phone or laptop to one AP using command line, and be able to monitor and parse beacon frames using tools such as Wireshark.
Impact of distance and obstacles on signal strength (2)	Monitor the signal strengths from the same location, or only record the signal strengths without analysis	Record the signal strengths while moving around, and analyze the impact of distance between AP and the station on the signal strength	Record the signal strengths while moving around, and analyze the impact of both distance and obstacles (e.g. walls) on the signal strength.
Impact of signal strength on data rate (2)	Send data from one station to another one in the same basic service set without analyzing the impact of signal strength on data rate	Send data from one station to another one in the same AP, and repeat the experiments with at least 3 different settings of signal strength.	Send data from one station to another one in the same AP, and analyze the impact of signal strength (e.g. the value, the variance) on data rate. The experiments should be repeated with at least 3 different signal strength settings.
Impact of interference on throughput (1 + 1 Bonus)	Not able to generate interference	While sending data from one station to another at a fixed location, you can generate interference using at least one method and record the noise level, signal to noise ratio, and throughput. Experiments should be repeated to obtain at least 3 different levels of interference.	Generate interference, record the measurements of noise level, signal-to-noise ratio and throughput, and analyze the impact of interference on throughput. For bonus, also measure and analyze impact on MAC retransmission rate. Experiments should be repeated to obtain at least 3 different levels of interference.