Network Technology and Programming Lab
Assignment 5: IEEE 802.11 Wireless Communications

Stefanos Papadakis

May 21, 2025

Introduction

During this assignment you will get familiar with the Ubiquity Rocket M2 wireless devices and the IEEE 802.11 protocol. However the main goal of this assignment is to get deep understanding of the CSMA/CA mechanism and how its performance is affected under different wireless scenarios.

1. Before you start

In order your results to be consistent and repeatable, instead of using antennas and transmitting signals through the air, we have prepared a simulated environment for you, using RF cables, a set of attenuators and an RF switch. This will ensure that your experiments will not be affected by other transmissions at the 2.4 GHz bands. **Do not connect directly with cables any of the devices. They will be permanently damaged. Use always at least 56dB of attenuation.**

For accessing the configuration interfaces of the Access Points you can either use the command line via SSH or the web interface. The default IP of each wireless device can be found on the table below, the username is *ubnt* and the password *hy435@csd*. **Do not forget to reset any settings applied before you leave the lab.**

Host	Address
AP1	192.168.4.21
Station1	192.168.4.22
Station2	192.168.4.23
AP2	192.168.4.24

2. Task 1: The hidden node problem

The topology of the task is presented in Figure 1. The setup of the wireless devices with the cabling is already for you available at the lab. Basically, the AP is connected on the COM port of the RF switch and the two stations are connected through 56 dBm of attenuation to the other ports.

1. Start by choosing the 3 PC's required for the experiment and assign their IP addresses to them
2. Connect the PCs to the wireless devices using the available Ethernet cables
3. Load the provided configuration on each device, based on the labeling.
4. At **AP1** an SSID has been preconfigured with the name **hy435**.
5. **Station1** and **Station2** should join the **hy435** network automatically. Verify that the RTS/CTS mechanism is disabled on all three radio devices.

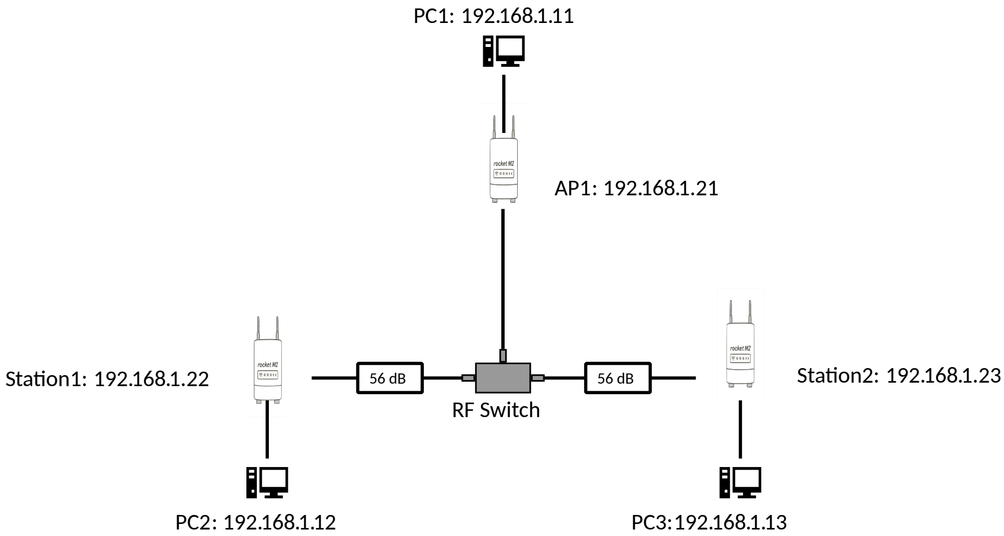

Figure 1: A hidden node topology

6. Run an *iperf3* server on the **PC1**

7. The table below describes the packet length and the throughput of each run. Start the run on PC2 for 10 seconds. Then, without stopping the first stream, start the run on PC3. Let it run at the same time for 10 seconds. Plot the throughput and the packet loss.

8. Now enable the RTS/CTS mechanism at all wireless devices. In most AP the RTS/CTS mechanism is enabled for frames larger than a specific value. For this assignment this number should be 256 bytes. Run again the throughput tests of the previous task. **Report** your findings, explaining what you observe. **NOTE: Do not run again the experiments with packet sizes that are not affected.**

3. Task 2: Adjacent channel interference

In this experiment you will observe how the CSMA/CA reacts in the presence of other transmissions and how interference from adjacent channels affects the performance.

This setup of this experiment is depicted in Figure 2. Unscrew the devices from the RF switch of the previous experiment. **Unscrew the cables *only*. Leave the attenuators in their place**. Screw the cables in the second RF switch that is available in the lab. It should have 4 sets of attenuators at each input of about 20 dB of attenuation and a terminator on the middle connector.

The **AP1 and Station1** will be the network under test, whereas the **AP2 and Station2** will be the source of interference.

1. Load the provided configuration on each device. Browsing the settings, make sure

Bandwidth (Mbits/s)	Packet size	Receiver Bandwidth (Mbits/s)	Packet Loss (%)
6	32		
	64		
	128		
	256		
	512		
	1024		
12	32		
	64		
	128		
	256		
	512		
	1024		
65	32		
	64		
	128		
	256		
	512		
	1024		

Table 1: Measurements

that the **hy435** network uses **Channel 13** at 2472 MHz and a transmission power of 7 dBm.

2. **Station1** should join the **hy435** network automatically. Make sure that their transmission power is also **7 dBm**.

3. At the **AP2** there should be an SSID with the name **i_love_talking_over_you**. This will be your interference source. Browsing the settings, make sure that you assign the network to the **Channel 13** and **transmission power 7 dBm**.

4. **Station2** should join the **i_love_talking_over_you** network. Make sure that their transmission power is also **7 dBm**.

5. Run an *iperf3* server on the **PC1** and another on **PC4**.

6. Obtain a baseline measurement by running a UDP stream for 20 seconds from **PC2** to **PC1** at 65 Mbits, with a packet size of 1024 bytes. During this experiment the interference network should be powered off, to avoid interference from the AP beacons.

7. For the rest of the experiments use a UDP stream for 20 seconds from **PC2** to **PC1** at 65 Mbits, with a packet size of 1024 bytes. At the same time run use also a UDP stream for 20 seconds from **PC3** to **PC4** and fill the Table 2. Try to carefully

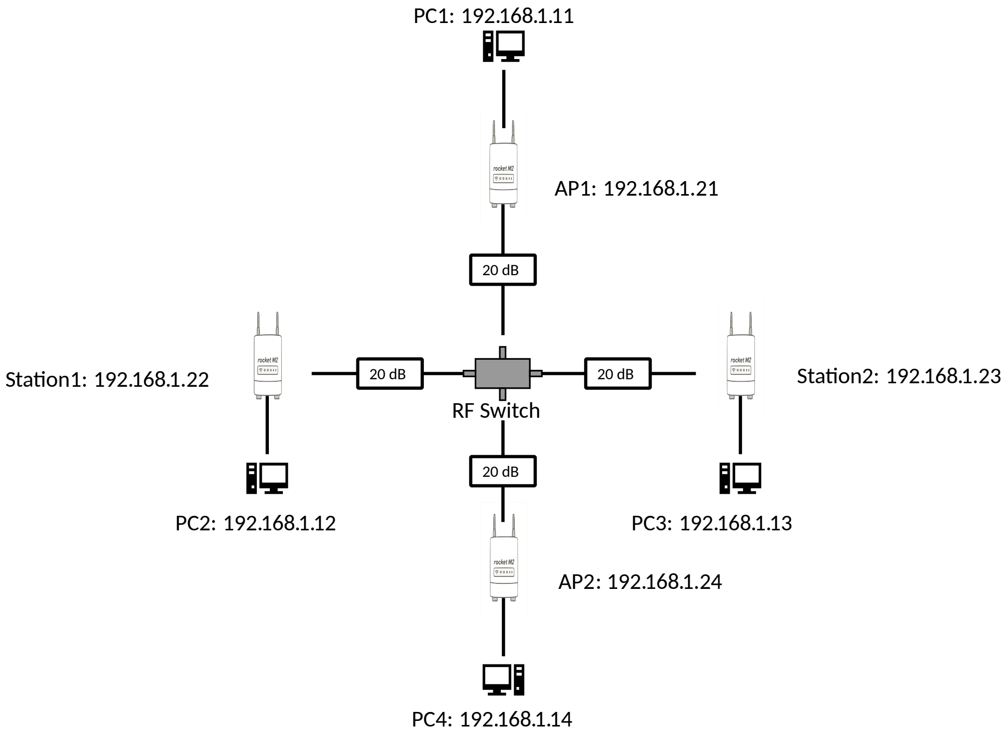

Figure 2: Experiment setup

explain the observed values. How does the interferer affects the performance of the network?

Report and submission

The submission deadline is 30/05/2025 23:59 via turnin
Have fun!

Interferer Channel	**Interferer Bandwidth (Mbits/s)**	**Receiver Bandwidth (Mbits/s)**	**Packet Loss (%)**
9	0.5		
	1		
	8		
	24		
	65		
10	0.5		
	1		
	8		
	24		
	65		
11	0.5		
	1		
	8		
	24		
	65		
12	0.5		
	1		
	8		
	24		
	65		
13	0.5		
	1		
	8		
	24		
	65		

Table 2: Interference measurements