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DEPARTAMENTO DE ELECTRÓNICA, TELECOMUNICAÇÕES E INFORMÁTICA
MESTRADO EM ENG. DE COMPUTADORES E TELEMÁTICA
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REDES E SISTEMAS AUTÓNOMOS

AUTONOMOUS NETWORKS AND SYSTEMS

PRACTICAL GUIDE 2 – B.A.T.M.A.N.

Objectives

- Set up B.A.T.M.A.N. ad-hoc network
- Validate the multi-hop ad-hoc network with simple tests
- Observe the status of the network
- Try new topologies of the ad-hoc network to force different paths
- Analyse metrics of the network

Duration

2 weeks

1st week

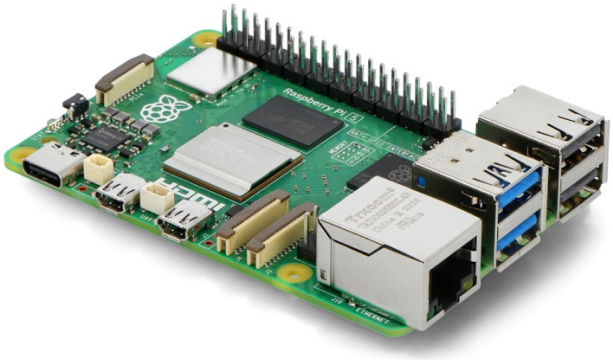
Introduction

The Better Approach to Mobile Ad-hoc Networking (B.A.T.M.A.N.) is a protocol for multi-hop mobile **ad hoc networks**. The official documentation is available here.

In this practical guide, we will learn how to deploy a Wi-Fi ad-hoc network with support for multi-hop. Supporting more than one hop means the network will behave like a mesh network, where the nodes can reach other nodes that are directly or indirectly connected, if they are part of the same batman group and Wi-Fi channel.

Environment

The setup we will be mounting for the experience uses Raspberry Pi (RPi) 5 4GB, and there is **one available per student**:



Raspberry Pi 5 4GB Dev Kit

Each RPi is identified with a sticker, example "NAP 7**06**". For this example, the **id** of the device is **6**.

Every RPi is already flashed with the official Raspbian and it has already some pre-configuration (the batman binary is installed).

In terms of networking and authentication, the board is configured with the following:

- Hostname: raspberrypi-7**id**
- Ethernet interface: 192.168.3.**id** (it also accepts DHCP)
- SSH login
    - Username: nap
    - Password: openlab

The internal WiFi chipset of the RPi will be used for the batman setup. The important thing about this chipset is that it allows the configuration of the Wi-Fi interface in **IBSS mode** which is required for the configuration of ad-hoc networks.

Form groups of 4 people to perform this guide.

1. Connecting your PC to the RPi board

1.1. Configure **your PC** with an IP in the **same LAN** of the RPi Ethernet interface (192.168.3.0/24) and connect an Ethernet cable between your PC and RPi.

Example: 192.168.3.1/24 (**no** gateway needed)

1.2. Use **ssh** to connect to the RPi, using the IP and authentication described in the previous page. In Windows use Putty or ssh through WSL. In Linux use ssh directly.

2. Configure the Wi-Fi interface in preparation for the batman network.

2.1. Run the following commands, so the wpa_supplicant service doesn't interfere with the configuration we will do for batman:

```
sudo service wpa_supplicant stop
sudo systemctl mask wpa_supplicant.service
sudo killall wpa_supplicant
```

2.2. Change the Wi-Fi interface mode to IBSS

(check the Wi-Fi interface name (`ip a`), and use it to **replace** with the right name in the following commands)

```
sudo ip link set wlanX down

sudo iw wlanX set type ibss

sudo ifconfig wlanX mtu 1500
```

2.3. Select the right Wi-Fi channel. Every group with 4 boards will create a separated ad-hoc network. Select channels among the following list [3, 5, 7, 9, 11]

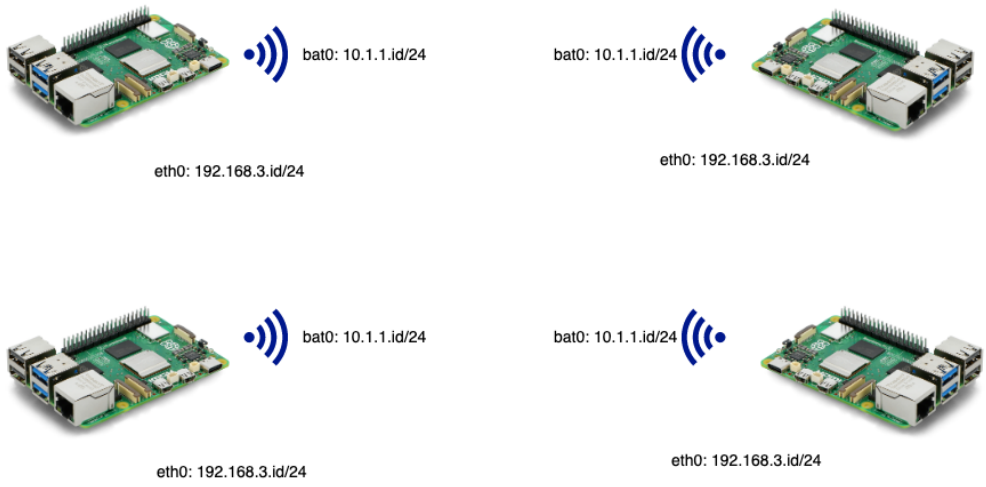
```
sudo iwconfig wlanX channel Y

sudo ip link set wlanX up
```

2.4. Confirm if the Wi-Fi interface is in the correct mode (**ibss**), with the following command:

```
sudo iw dev
```

3. First batman network configuration

3.1. The network of every group will look like the following figure:



3.2. Find out (**search online**) what is the frequency (**f0**), **in MHz**, for the Wi-Fi **channel** selected in the configuration of exercise **2.3**.

3.3. Then, invent a **network name** for your batman network.

3.4. On your RPi, run the following command, according to the frequency and the chosen ad-hoc network name:

```
sudo iw wlanX ibss join network_name f0
```

3.5. Finalize the batman configuration with the following:

```
sudo modprobe batman-adv
```

```
sudo batctl if add wlanX
```

```
sudo ip link set up dev wlanX
```

```
sudo ip link set up dev bat0
```

```
sudo ifconfig bat0 10.1.1.id/24
```

(Configure the IP for the batman LAN, according to the **id** of your board)

4. Testing the batman network for the first time

4.1. Together with the colleagues from the other groups, test the wireless connection to their RPis, using the ping command. Validate that you can reach every node of the ad-hoc network.

```
sudo batctl ping 10.1.1.X
```

```
ping 10.1.1.X
```

4.2. Use the following to check the neighbors table. The command `watch` is to keep observing in real time:

```
watch -n 0.1 batctl n
```

Example of output:

```
Every 0.1s: batctl n
raspberrypi-706: Thu Mar 16 19:52:03 2023[B.A.T.M.A.N. adv
2021.3…
IF             Neighbor              last-seen
   wlan0     24:ec:99:b4:0f:a6    0.444s
   wlan0     24:ec:99:8b:e7:08    0.128s
```

Important note: For every time you boot the RPi, you need to setup batman again. However, there are ways to put the configuration automatic at the boot.