

Comunicações Móveis

Projects

2022/2023

Main Topics

- 3x WLAN (to check available equipment)
- 2x Mobile Networks (5G) (SW; no limit)
- 1x IMS (SW; no limit)
- 3x LoRa (to check available equipment)
- 2x SDN (SW; no limit)

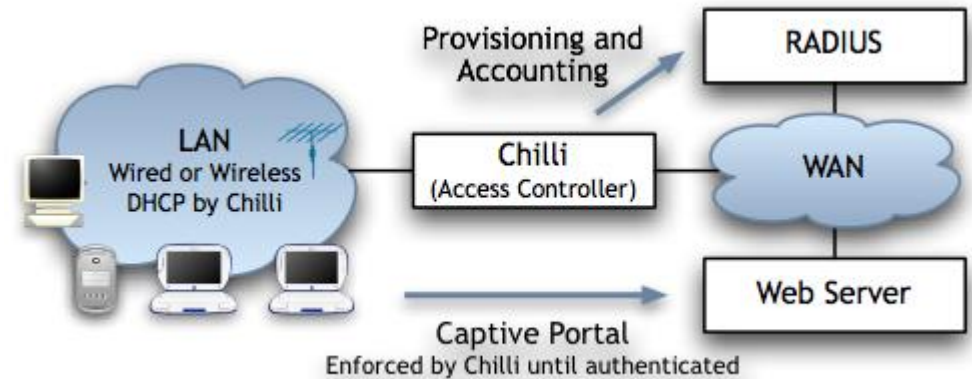
3 students per group

Indicate your ordered preferences (5 projects)

WLAN

WLAN, Project 1

- Objective
 - Implement a Internet access control solution via a public WLAN Hotspot
- Methodology
 - Configure access point with the correct WLAN parameters so that the terminals are authenticated and associated
 - Configure the *Captive Portal* with minimal features
 - Configure a RADIUS server with profiles and users
 - Experiment with additional features of the Captive Portal and the RADIUS profiles, changing diferente parameters (e.g., assign a fixed IP)



Suggestion

coova.org

WLAN, Project 2

- Objective
 - Test/verify functional and performance characteristics of the technology
- Methodology
 - Instantiate 802.11 network configurations that allow to verify the effect of:
 - Using the RTC/CTS mechanism
 - Fragmentation
 - Impact of coverage and performance configurations
 - Roaming between APs
 - Ad-hoc mode
 - Other features considered by the students

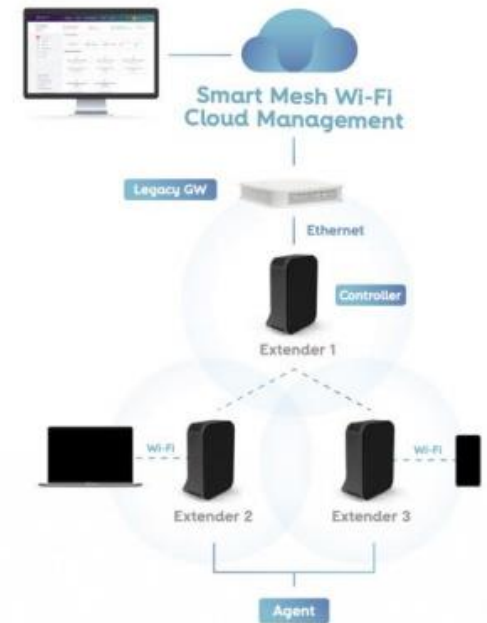
WLAN, Project 3

- Objective
 - Implement, understand and evaluate WiFi Mesh scenarios
- Methodology
 - Install and configure a home WLAN scenario based on a commercial PON access router and WiFi Extenders
 - Configure and evaluate several physical deployments, simulating different home environments

Typical / Standard Scenario



Standalone Scenario



Mobile Networks

5G, Project 1, Open5GS

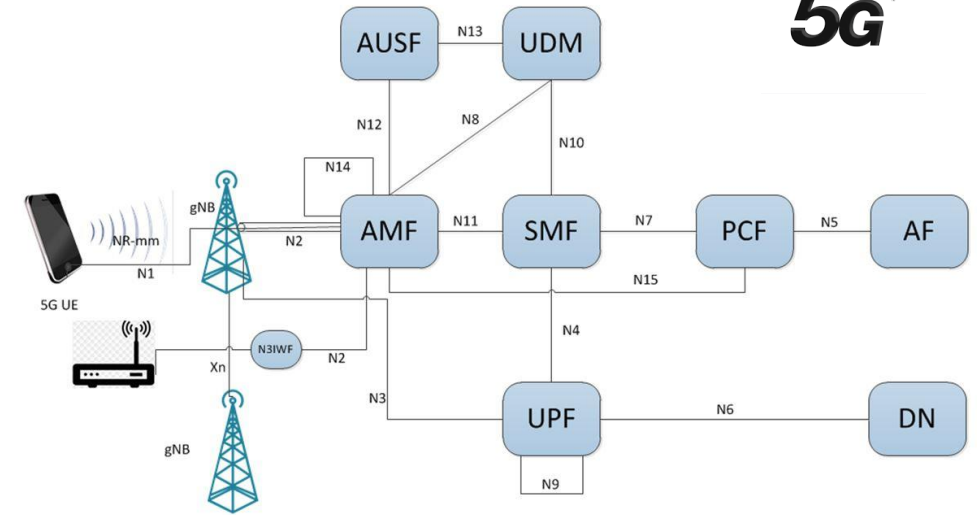


- Objective

- Instantiate and exercise a complete 5G network, going beyond Lab3 activities

- Methodology

- Instantiate Open5GC as a Core 5G solution
- Install the 5G access (using UERANSIM)
- Verify the configuration files of Core 5G, gNB and UE
- Instantiate the gNB(s) and the UE(s)
- Use Wireshark to observe the procedures used by the network
- **Change parameters and instantiate more complex topologies**



<https://open5gs.org/open5gs/docs/guide/01-quickstart/>

<https://github.com/aligungr/UERANSIM/wiki>

5G, Project 1, Simu5G and MEC

- Objective
 - Understand and use the simulator to study the performance of several 5G aspects with a focus on Edge Computing
- Methodology
 - Download and install the Simu5G VM
 - Understand the MEC environments built on Simu5G, for instance the 'singleMECHost' and 'multiMECHost'
 - Extract and analyse results



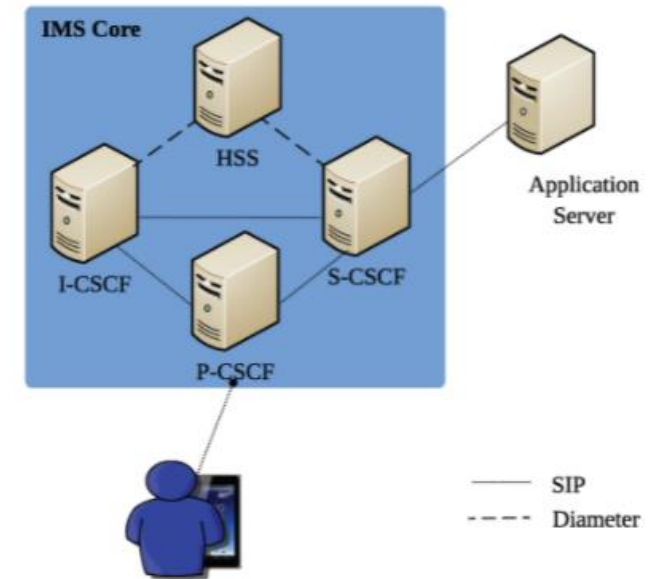
<https://github.com/Unipisa/Simu5G>

<http://www.simu5g.org/MEC.html>

IMS

IMS

- Objective
 - Instantiate a complete IMS ecosystem and exercise it with multimedia services
- Methodology
 - Select and install an IMS system
 - Configure a simple scenario with a P, I, S-CSCF and HSS
 - Configure clients and make SIP call / Session
 - Configure the IMS platform with additional topologies and configurations (e.g. security, transport protocols)
 - Add other elements such as Application Servers and/or Session Border Controllers (e.g. for calls between IPv4 and IPv6)



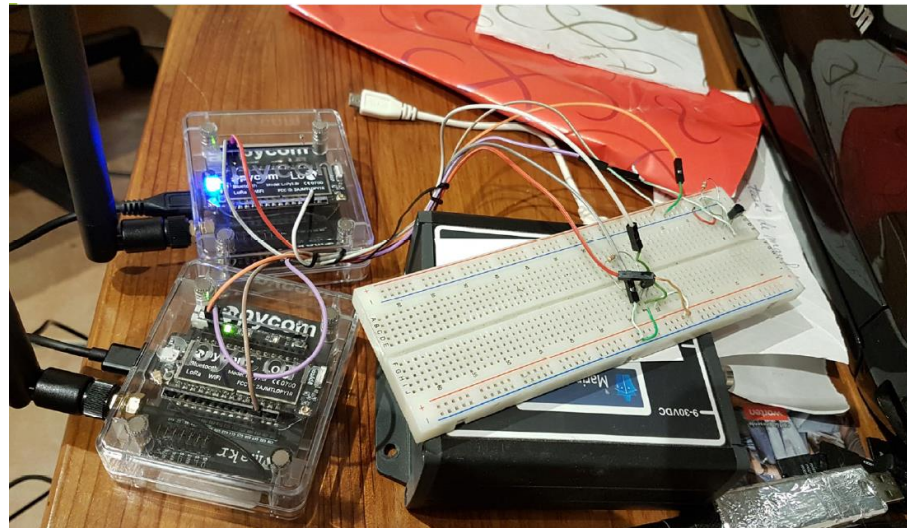
Sugestão:

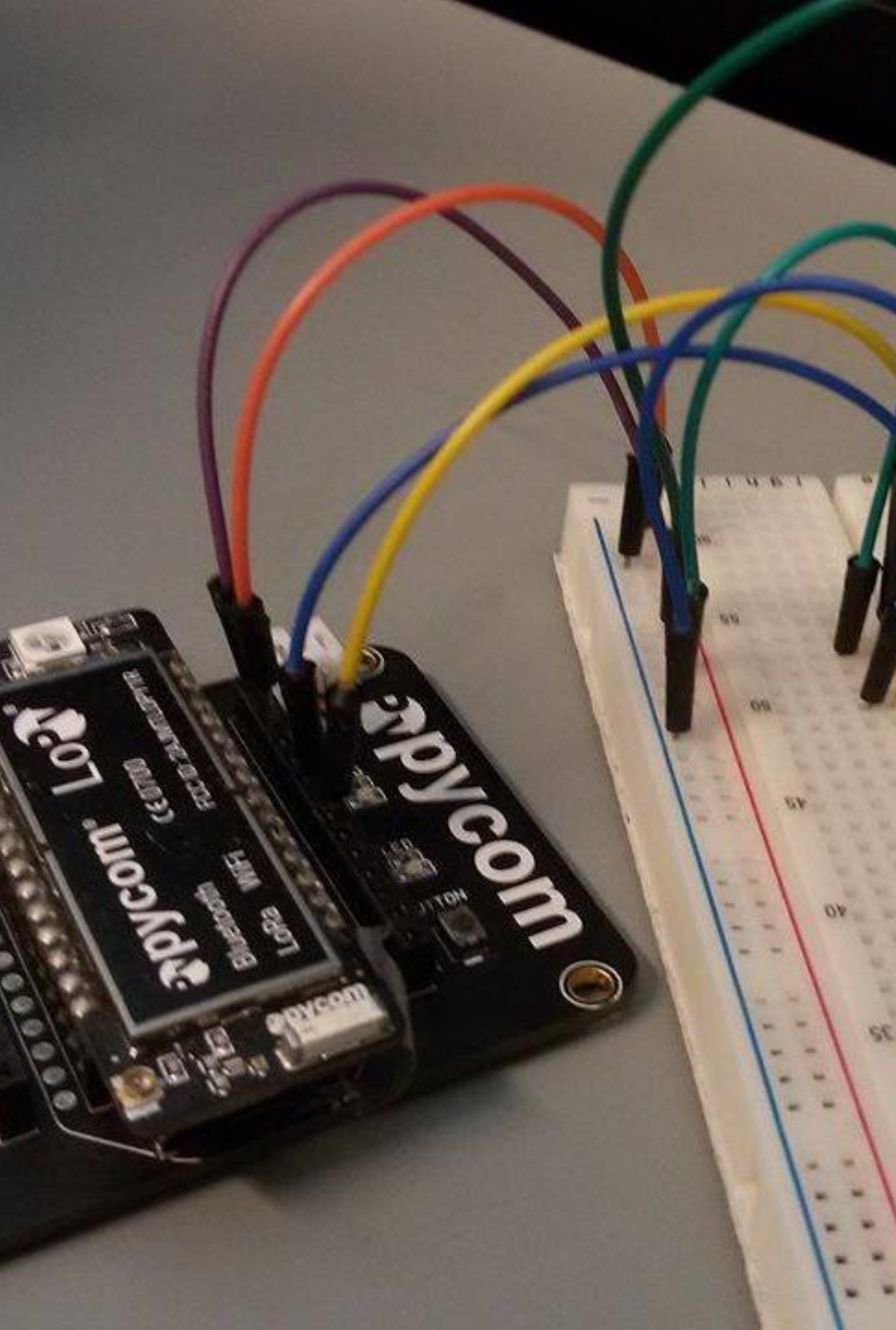


LoRa

LoRa

- Objective
 - Study one of the possible connection variants in LoRa/LoRaWAN environments, to exchange information
- Methodology
 - Programming development boards that have LoRa interfaces and test them





LoRa

- Methodology (cont.)
 - Programming the boards allows to develop small programs to collect, send and receive information using the LoRa interface
 - Python, using a specific IDE
 - Research and analysis of tutorials to implement programs
 - The information will be simple in the beginning (i.e., ping)
 - More advanced scenarios will need other IoT elements
 - Connecting sensors and other devices through GPIO pins

LoRa – Project variations

- Project 1 – Lopy2Lopy

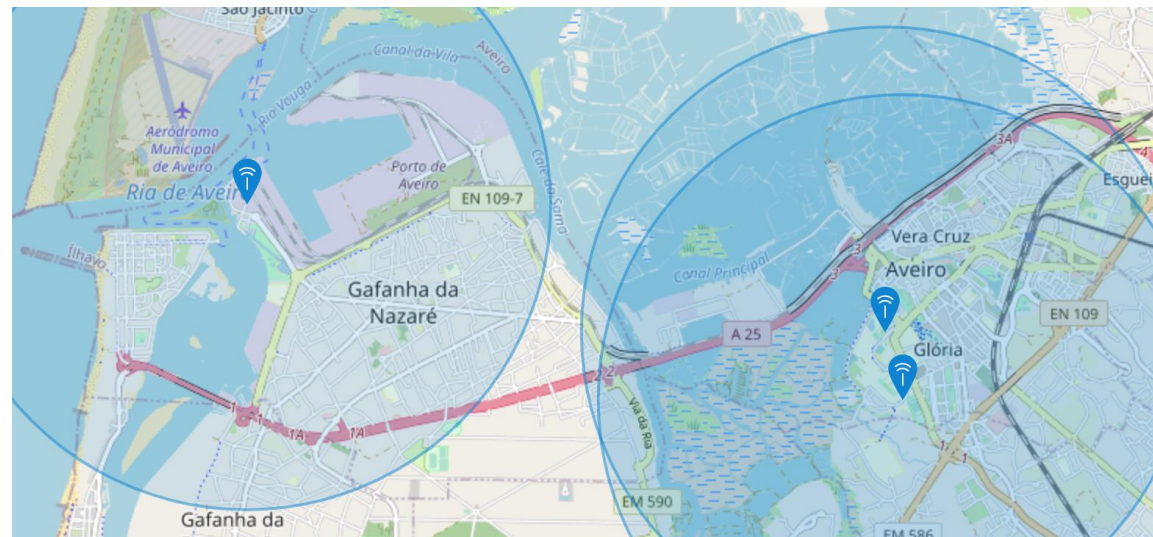
- Direct connection between two devices using LoRa frequencies
- Bilateral communication:
 - Device 1 starts Communications sending information to Device 2
 - Device 2 receives that information and answers by sending new information towards Device 1

- Complexity/challenge

1. Besides the official “Lopy to Lopy” tutotial at pycom.io, the project guide provides a alternative where information about the status of a LED is exchanged
 1. Natural progression towards a project that involved GPIO integration
2. This is the simplest LoRa project. Therefore students need to expand the work with more complex features, researching and exploring diferente scenarions

LoRa – Project variations

- Project 2 – LoRaWAN with gateway connection
 - Connecting a LoRa device and a gateway associated to a LoRaWAN network
 - The Things Network
 - Requires registration and configuration at the portal <https://www.thethingsnetwork.org/>
 - This is a real LoRaWAN Communications scenario, using public gateways existing in Aveiro



LoRa – Project variations

- Project 2 – LoRaWAN with gateway connection
 - Sending IoT information through the node to the TTN network, through LoRaWAN, and exposing the information
 - Complexity/Challenge
 - Besides the official “LoRaWAN OTAA” tutorial from pycom.io, the guide provides an exemple on how information about a sensor connected to a node is configured and exposed at the TTN
 - Usage of GPIO
 - More configuration and programming steps are needed (i.e., some javascript too), and involves interaction with a external system (web app), configured to operate through standardised protocols

LoRa – Project variations

- Project 3 – LoRa Raw Gateway
 - Connection between a node device and a gateway device, (both programmed by the students) using LoRa frequencies
 - The LoRa-MAC mode is explored, which ignores the LoRaWAN layer, and directly uses the radio layer
 - A device sends information to the gateway and waits for the acknowledgement
 - Complexity/challenge
 - There's only the official pycom tutorial
 - Students should search more information independently

LoRa – Generic information for all projects

- Besides achieving LoRa Communications, students should/can explore
 - Impact of the distance between nodes
 - Indoor, outdoor, movement, etc.
 - (i.e., collect SNR and RSSI values using the “`lora.stats()`” function in the code)
 - Solution Performance
 - Time between sending the information and receiving the ack

SDN

SDN – Project 1

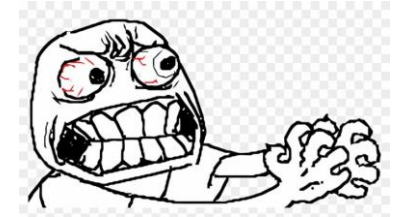
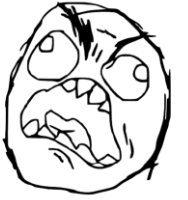
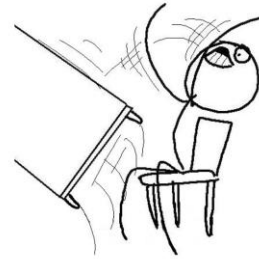
- Open vSwitch and Faucet SDN controller
- Verify, in practice, how SDN can be used to dynamically configure networks
- Interesting scenarios
 - Simple interaction with OVS and Faucet
 - Using OVS for IPSec
 - VLANs and other advanced features
 - Connection Tracking
- Overall objective: analyse SDN interactions and impact in the network
- Good news: all of these scenarios are available as tutorials in the OVS website: <https://doc.openvswitch.org/en/latest/tutorials/index.html>

SDN – Project 1 (cont)

- Challenging news
 - You still need to do the work
 - Heavy Linux-based work
 - Requires (some) virtualisation
 - Virtualbox will be fine, and you can combine it with GNS3 topologies
 - Alternatively, Support other solutions: i.e., QEMU
- Since the practical steps are available as tutorial, students will have:
 - To demonstrate mastery of the learned procedures
 - Go beyond the tutorials: create more complex topologies and scenarios

SDN – Project 2

- !!! WARNING !!! THIS PROJECT IS H-A-R-D!
- YOU HAVE BEEN WARNED!
- NOT FOR THE FAINT OF HEART!



WARNING!
T-VIRUS INFECTED AREA



SDN – Project 2

- Deploy a TeraFlow SDN Controller instantiation
- Challenges
 - The software is still under development
 - You will need to setup your own kubernetes environment
 - Separate tutorial!
 - Separate knowledge acquisition!
 - Of you can use their virtual machine :D
 - You will exercise extensive Linux knowledge
 - Scripting
 - Networking

SDN – Project 2



- After it is deployed, you will be able to:
 - Use a built-in WebUI
 - Explore some functional tests
- What will you learn
 - A major step in acquisition of DevNet skillset
 - Kubernetes and Docker (containers, virtualization)
 - Deployment automation (python scripts)
 - Advanced network monitoring (Grafana Dashboards)
 - See a micro-services telecommunications network tool in action
 - Debugging problems
 - For hours

