Comunicações Móveis

Projets

2023/2024

Main Topics

- Your own proposal
- WLAN
- Mobile Networks
- IMS
- LoRa

Your own proposal

Your own proposal

- If you have an idea for a project proposal, you can discuss it with the professor
- You have to create a proposal, and send it by email to us TODAY
- Be prepared to defend your proposal via a remote meeting to be scheduled

WLAN

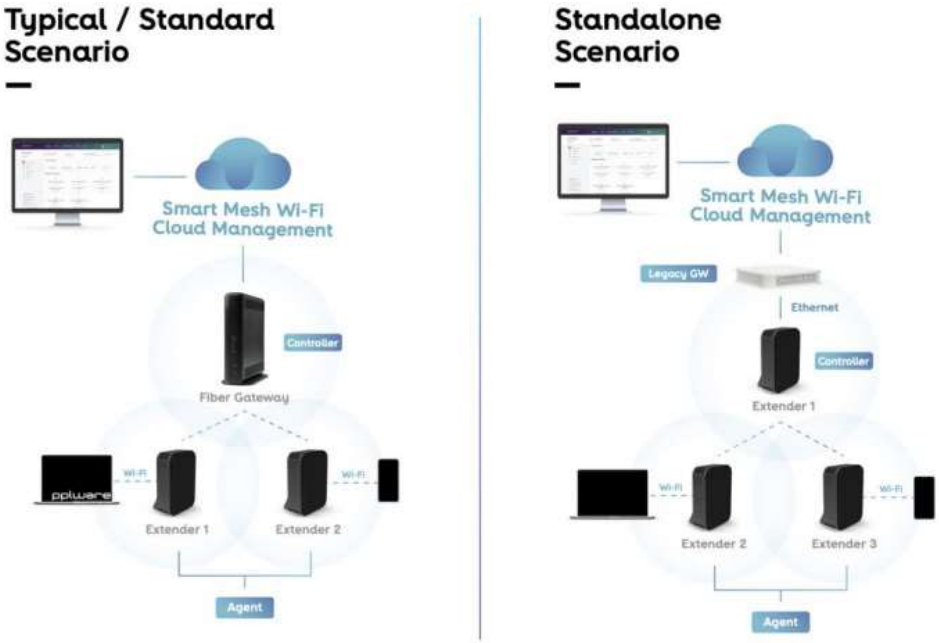
WLAN, Project 1

- Objetive
  - Explore the configuration capabilities of Cisco Access Points
- Methodology
  - Cisco APs used in class are professional ones, with many features
  - Learn, select, configure and deploy a selected choice of features made available by the Cisco APs
  - This project can be selected by different groups, but different features need to be selected by the groups
    - Or (at least) configured differently

WLAN, Project 2

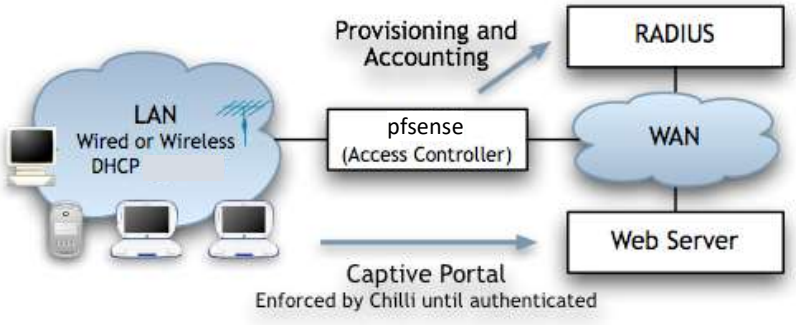
- Objetive
  - Test/verify functional and performance characteristics of the technology
- Methodology
  - Instantiate 802.11 network configurations that allow you to verify the effect of:
    - Using the RTC/CTS mechanism
    - Fragmentation
    - Impact of coverage and performance configurations
    - Roaming between APs
    - Ad-hoc mode
    - Other features considered by the students
    - Utilization of surveying tools:
      - https://www.wifisurveyors.com/free-wi-fi-stumbling-surveying-tool
    - Planning tools
      - https://support.huawei.com/enterprise/en/doc/EDOC1000113315/f67f8d8b/wlan-planning-example-using-an-online-tool
  - Different groups ⇔ Different assessments!

WLAN, Project 3



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

WLAN, Project 4



- Objetive
  - 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)

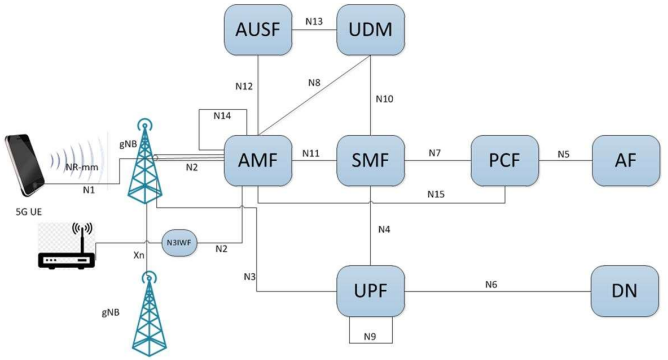
Suggestion

https://www.pfsense.org/

Mobile Networks

5G, Project 1, Open5GS + UERANSIM

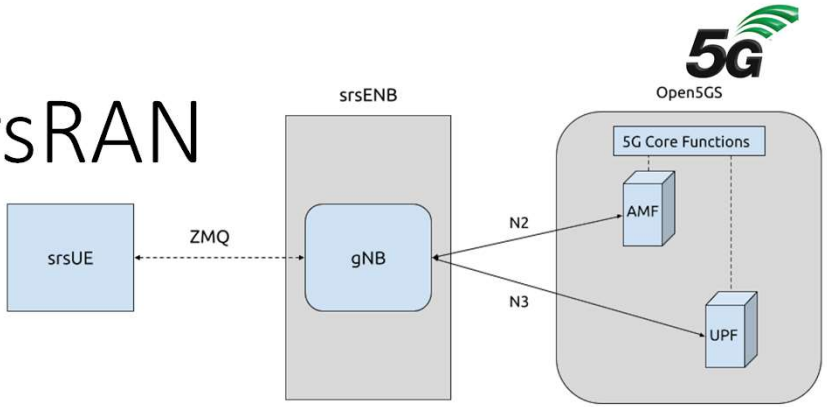
- Objetive
  - Instantiate and exercise a complete 5G network
- Methodology
  - Instantiate Open5GC as a Core 5G solution, following a tutorial
  - Installl the 5G acess (using UERANSIM) according to the provided instructions
  - Verify the configuratin files of Core 5G, gNB and UE
  - Instantiate the 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 2, Open5GS + srsRAN



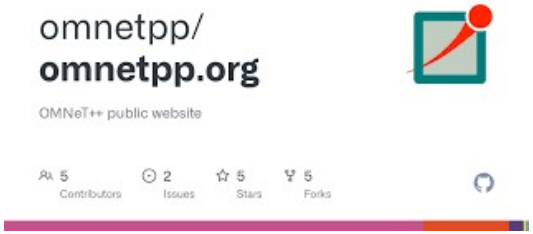
- Objetive
  - Instantiate and exercise a complete 5G network
- Methodology
  - Instantiate Open5GC as a Core 5G solution, following a tutorial (or, alternatively, Free5GCore)
  - Installl the 5G acess (using srsRAN) according to the provided instructions, and srsUE for the UE
  - Verify the configuratin 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

[5G SA Lab Setup using srsRAN-open5GS (hashnode.dev)]

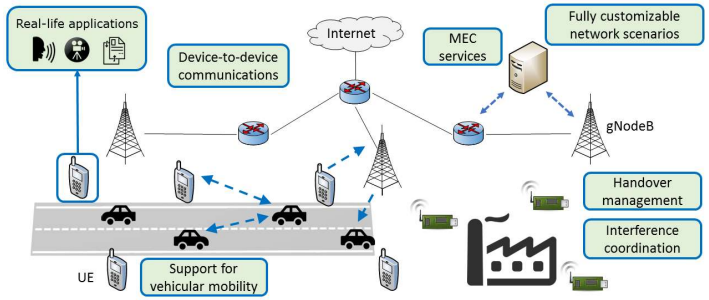
5G, Project 2, Real 5G assessment

- Objetive
  - Do performance tests using real networks
- Methodology
  - Use available tools to gain insight on the operation and performance of real 5G networks
  - Caution: since the work needs to use closed applications and real networks, the students need to be very proactive in how they get, analyze and presents results
  - https://play.google.com/store/apps/details?id=com.wilysis.cellinfolite&hl=en&gl=US
  - http://www.mobileinsight.net/index.html
    - Requires a rooted phone, with Qualcomm chipset
  - https://www.opensignal.com/apps
  - https://github.com/telekom/5g-trace-visualizer

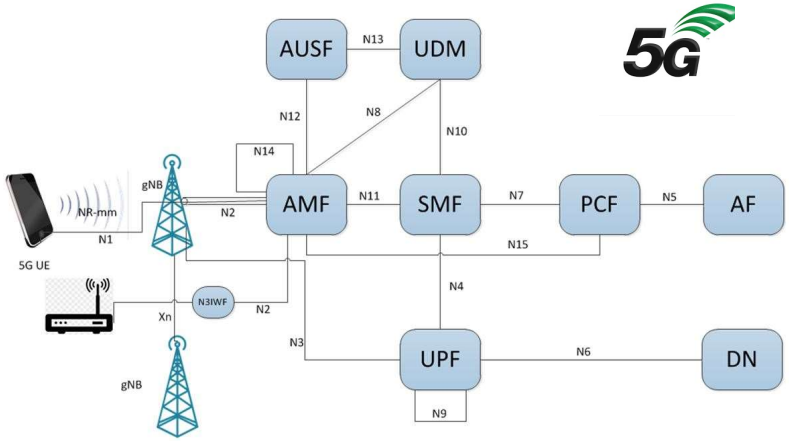
5G, Project 3, 5G simulation



- Objetive
  - Use and modify a 5G simulation
- Methodology
  - Learn and use a graphical simulator with a 5G model
  - Learn how the 5G functions were implemented in the simulator (i.e., C++ code)
  - Create new scenarios and/or features, placing them in the simulator and obtaining new results
  - https://simu5g.org



5G, Project 4, Simu5G



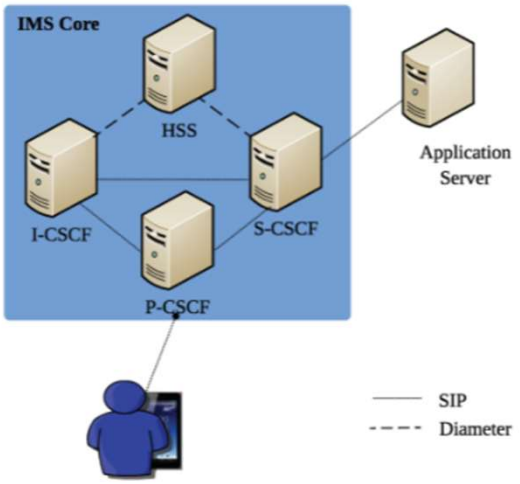
- Objetive
  - Instantiate and exercise a complete 5G network
- Methodology
  - Instantiate Simu5GC as a Core 5G solution, following a tutorial
  - Installl the 5G acess (using UERANSIM) according to the provided instructions
  - Verify the configuratin files of Core 5G, gNB and UE
  - Instantiate the gNB(s) and the UE(s)
  - Use Wireshark to observe the procedures used by the network
  - Change parameters and instantiate more complex topologies

https://github.com/Unipisa/Simu5G

http://simu5g.org/

IMS

IMS



- Objetivo
  - Instanciar um ecossistema IMS completo e exercita-lo com serviços multimédia
- Metodologia
  - Seleccionar e instalar um sistema IMS
  - Configurar um cenário simples com um P, I, S-CSCF e HSS
  - Configurar clientes e efectuar chamada / Sessão SIP
  - Configure a plataforma IMS com topologias e configurações adicionais (p.ex. segurança, protocolos de transporte)
  - Adicionar outros elementos como Application Servers e/ou Session Border Controllers (p.ex. para chamadas entre IPv4 e IPv6)

Sugestão:

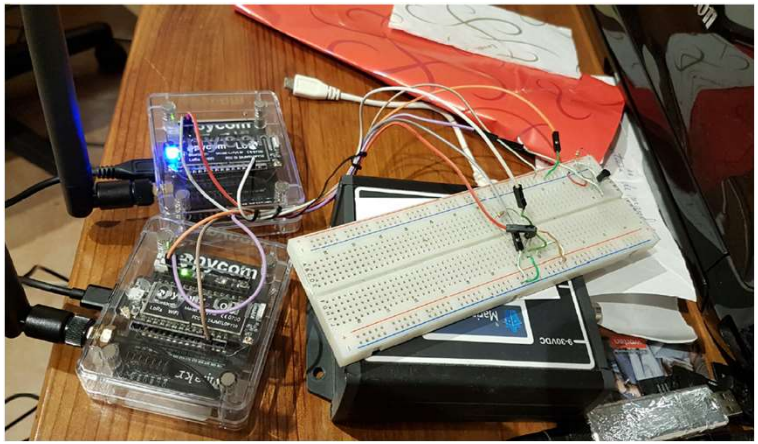
KAMAILIO

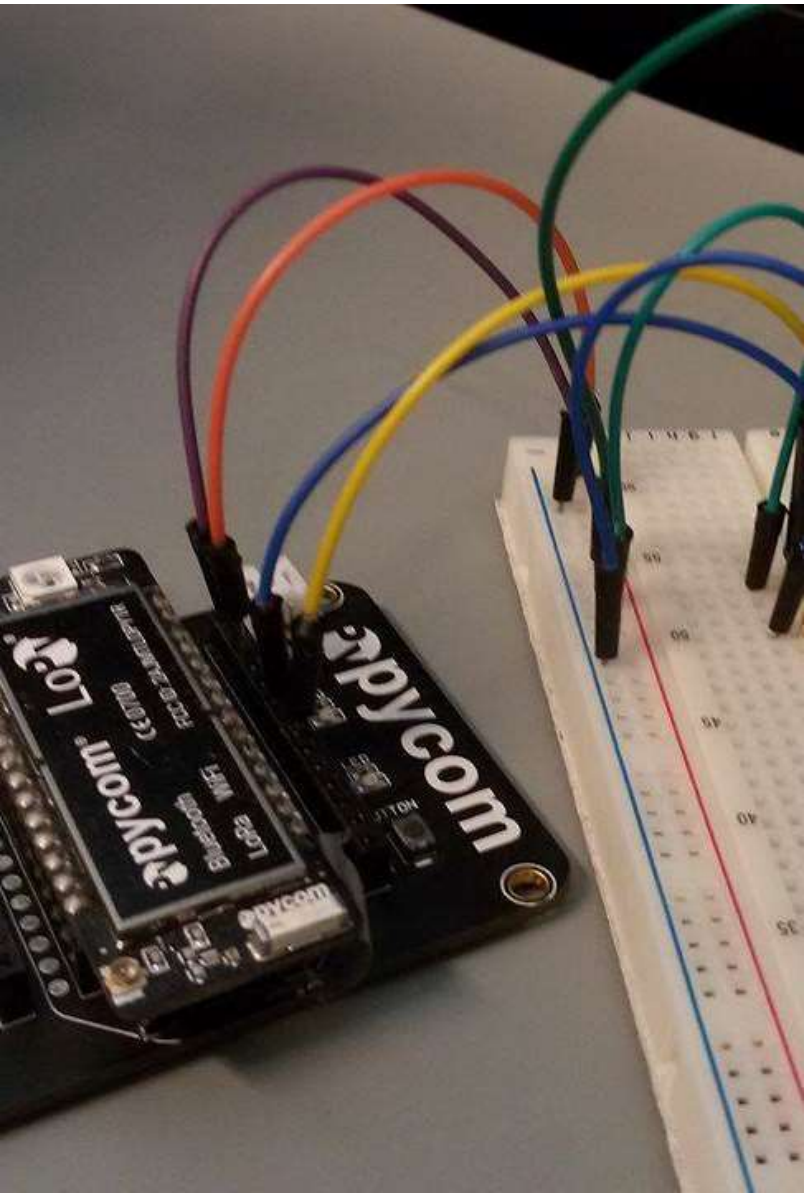
https://www.kamailio.org/w/
https://jblazquez.es/deploy-kamailio-solution-with-rtpengine-in-dooker-compose-automation/

LoRa

LoRa

- Objetive
  - 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

- Methdology (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 implemente 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

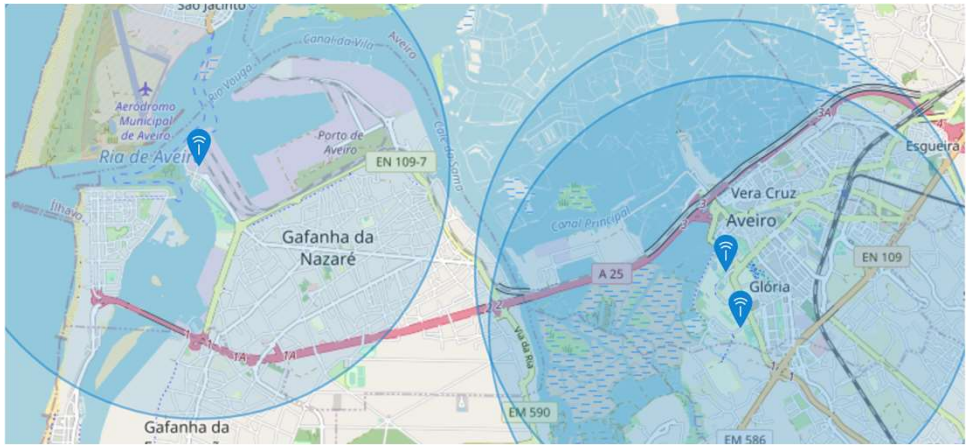
- Project 1 – Lopy2Lopy and Lopy2GW
  - 1st part - Direct connection between two devices using LoRa frequencies
  - Bilateral communication:
    - Device 1 starts Communications sending information to Device 2
    - Device 2 receives that information and answers by sending new information towards Device 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 simpliest LoRa project. Therefore students need to expand the work with more complex features, researching and exploring diferente scenarions

LoRa – Project variations

- Project 1 – Lopy2Lopy and Lopy2GW (cont)
  - 2nd part - 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 – 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 envolves interaction with a external system (web app), configured to operate through standardised protocols

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 – 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
- Overal 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