Comunicações Móveis

Projects

2022/2023

Main Topics

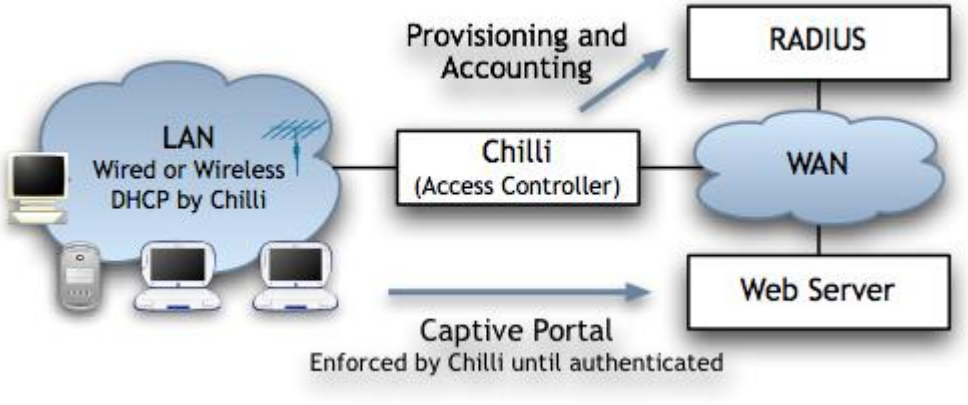
- 3x WLAN (to check available equipment)
- 2x Mobile Networks (5G) (SW; no limit)
- 1x IMS (SW; no limit)
- 3x LoRa (to check available equipment)
- 2x SDN (SW; no limit)

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

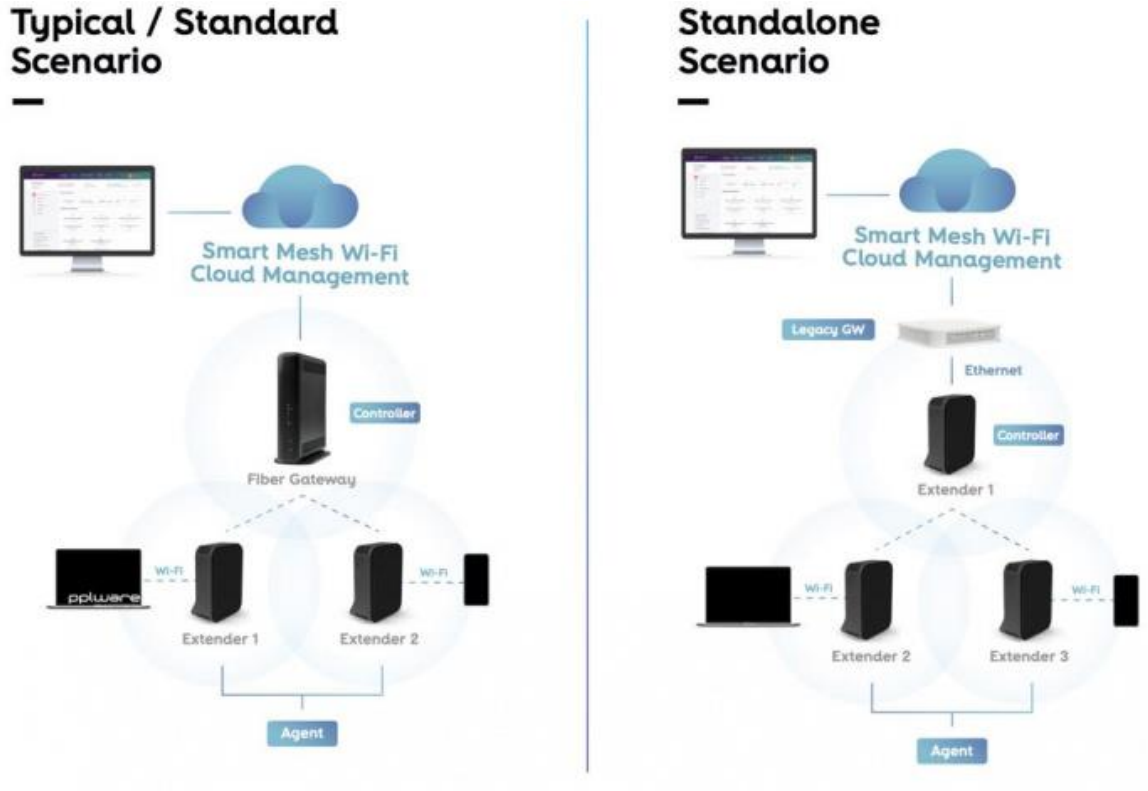
coova.org

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

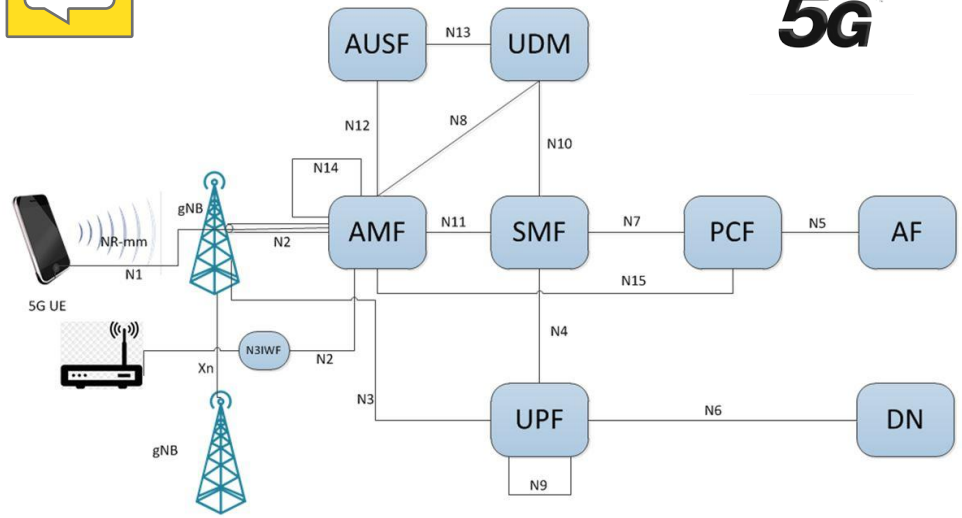
WLAN, Project 3



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

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
  - Installl the 5G acess (using UERANSIM)
  - 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**

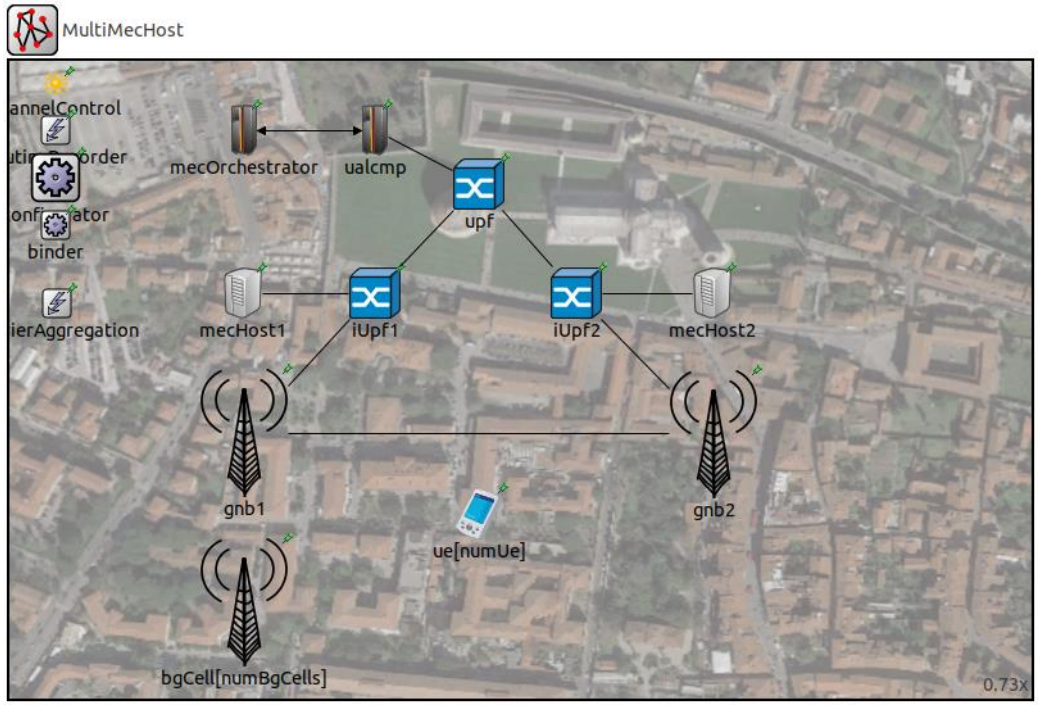
https://open5gs.org/open5gs/docs/guide/01-quickstart/

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

5G, Project 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



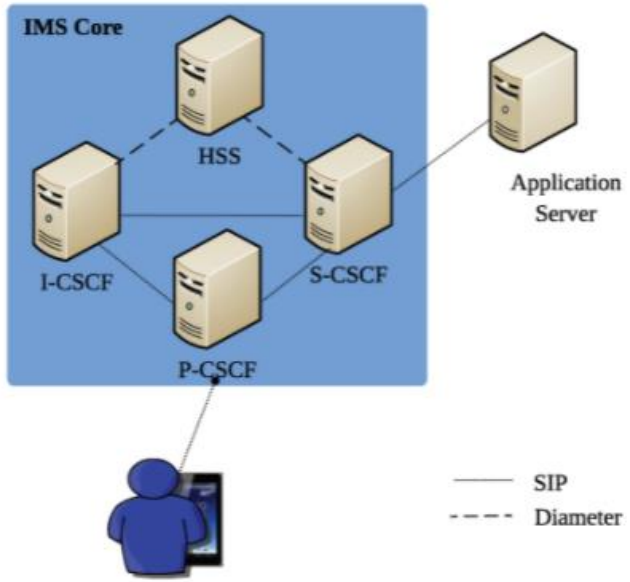
https://github.com/Unipisa/Simu5G

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)



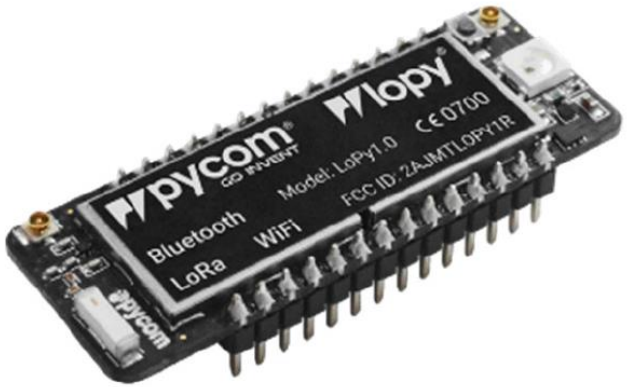
Sugestão:

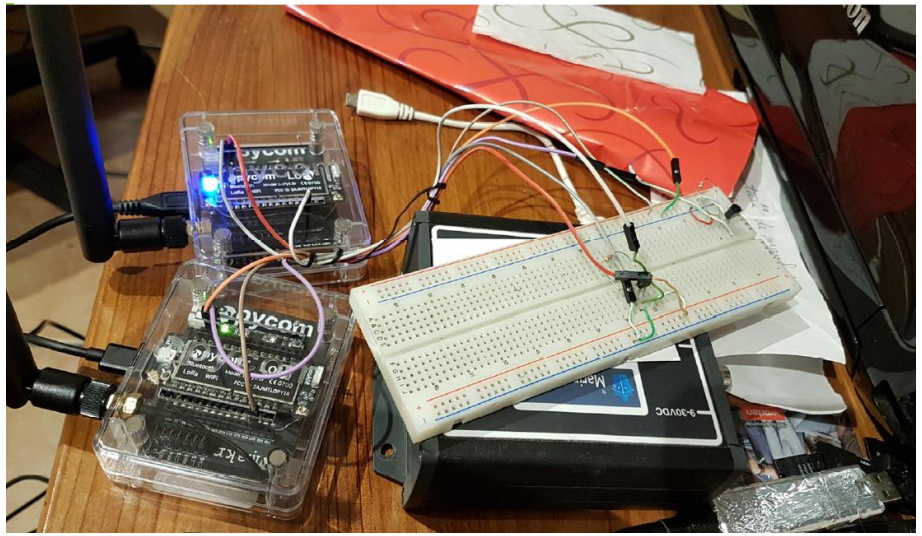
KAMAILIO

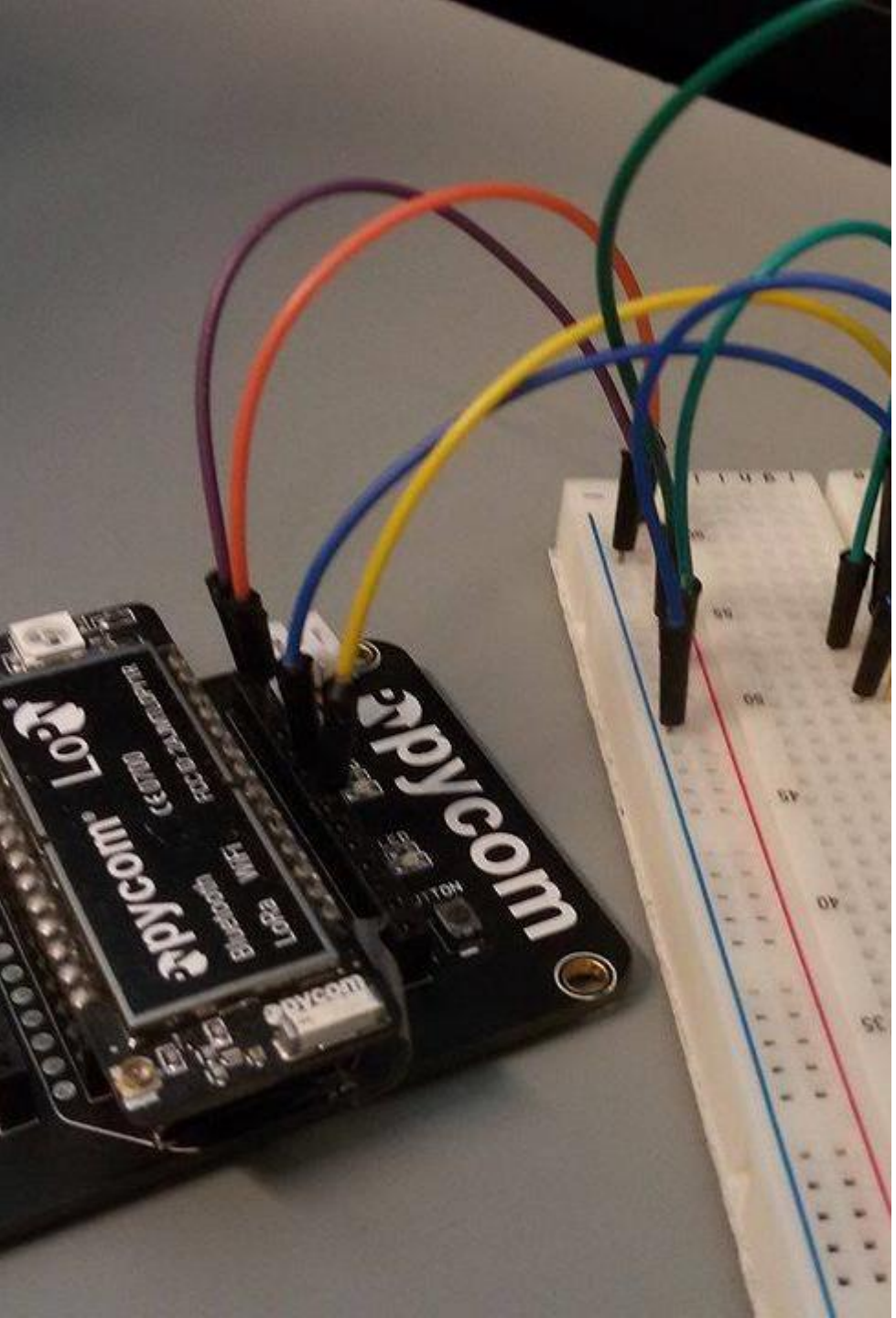
LoRa

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

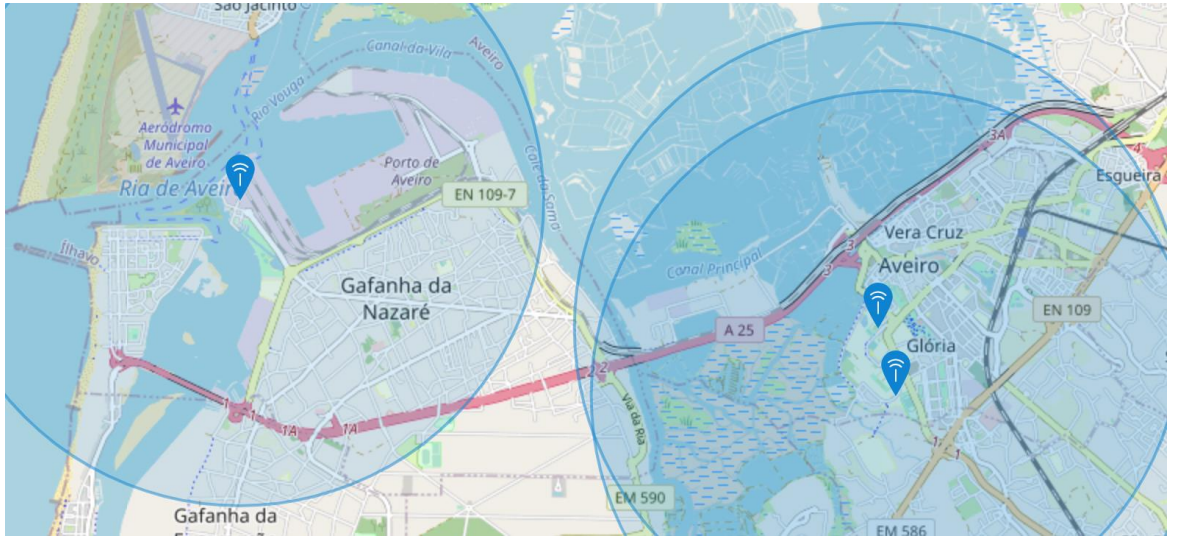
- Methdology (cont.)
  - Programming the boards allows to develop small programs to collect, send and receive information using the LoRa interface
    - Python, using a specific IDE
    - Research and analysis of tutorials to implemente programs
  - The information will be simple in the beginning (i.e.,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

LoRa – Project variations

- Project 1 – Lopy2Lopy
  - 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 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 – 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

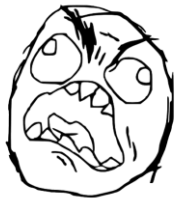
SDN – Project 1

- 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
- 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

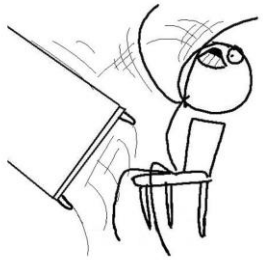
SDN – Project 1 (cont)

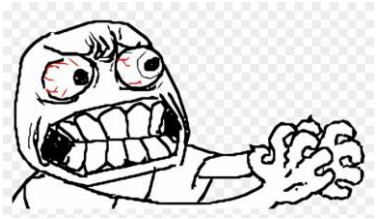
- Challenging news
  - You still need to do the work
  - Heavy Linux-based work
  - Requires (some) virtualisation
    - Virtualbox will be fine, and you can combine it with GNS3 topologies
    - Alternatively, Support other solutions: i.e., QEMU
- Since the practical steps are available as tutorial,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

SDN – Project 2



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

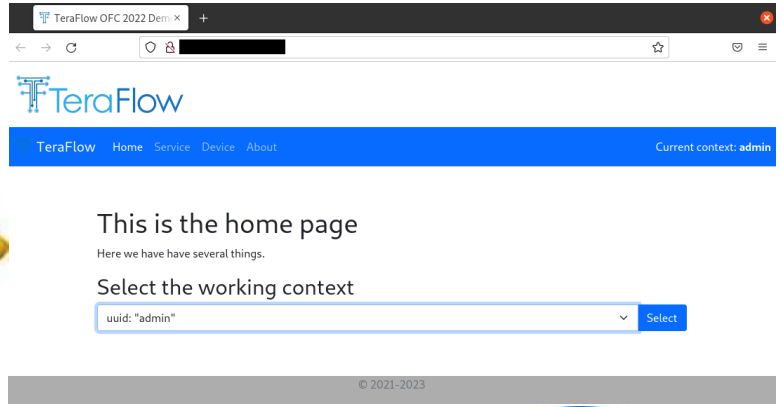




SDN – Project 2

- 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 acquisiton of DevNet skillset
    - Kubernettes 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