Dissertações para 2024/2025
1º Semestre

Secção de telecomunicações
Dept. Engenharia Electrotécnica e de Computadores
Faculdade de Ciências e Tecnologia
Universidade Nova de Lisboa

Julho 9, 2024
FCT NOVA, Portugal

Resumo

Resumo

1. Introdução

2. Apresentação das dissertações

3. Perguntas

- Introdução às áreas de investigação no grupo
- Apresentação das propostas de dissertação
- Perguntas

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Áreas de investigação

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➢ **Redes de Telecomunicações**

Desenho e arquitetura de redes; Protocolos de comunicação; Software de rede e aplicações; Operação e gestão de redes; etc.

➢ **Comunicação**

Comunicações sem fios; Comunicações com espalhamento de espectro; Sincronização, equalização, deteção e estimação de canal; Modulação e desenho de sinal; Teoria da codificação e aplicações; etc.

➢ **Antenas e Propagação**

Modelação de meios de propagação e antenas; Comunicação digital em ondas milimétricas (mmWave) e em Terahertz (THz). Desenho e análise de sistemas de múltiplas antenas.

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Áreas de investigação

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- **Redes de Telecomunicações**

Paulo Pinto, Luis Bernardo, Rodolfo Oliveira, Pedro Amaral

- **Comunicação**

Rui Dinis, Paulo Montezuma

- **Antenas e Propagação**

João Guerreiro

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DISSERTAÇÕES PROPOSTAS

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#1 Traffic scheduler for WiFi 6 (802.11ax)

Resumo

1. Introdução

2. **Apresentação das dissertações**

3. Perguntas

Main goal: Schedule polls, receive interests, and assign resources to stations

Workplan:

- ❑Understand the problem and the ns3 implementation
- ❑Either use the ns3 solution, or change it slightly
- ❑Run experiments based on real or artificial traffic

Supervisor: Paulo Pinto & Luis Bernardo

#1 Traffic scheduler for WiFi 6 (802.11ax)

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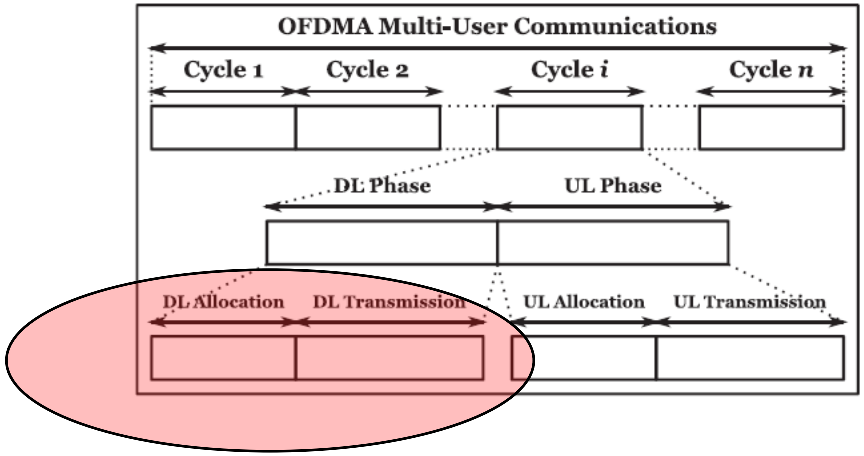

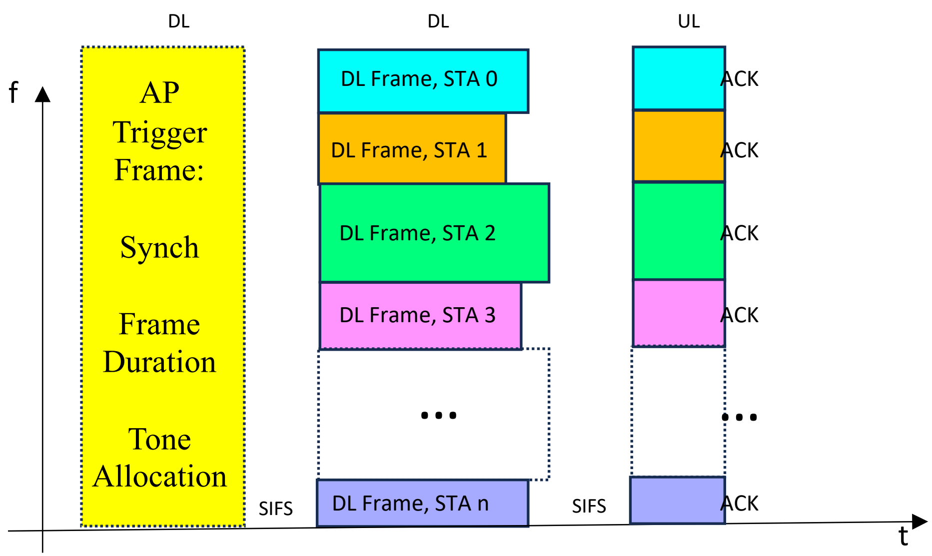

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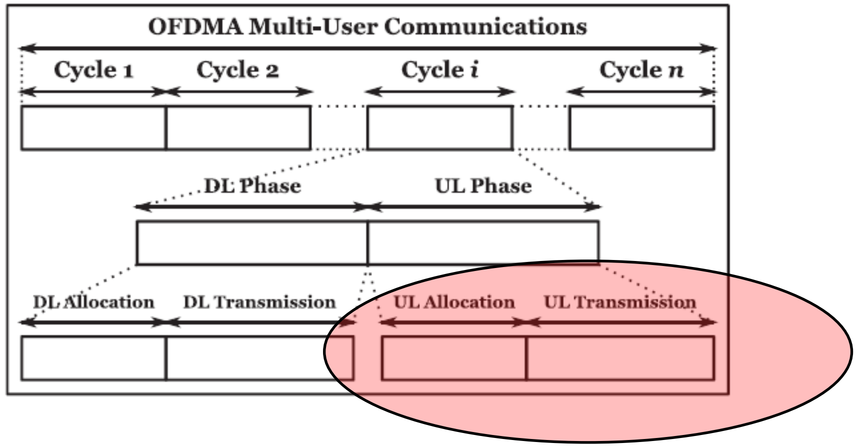

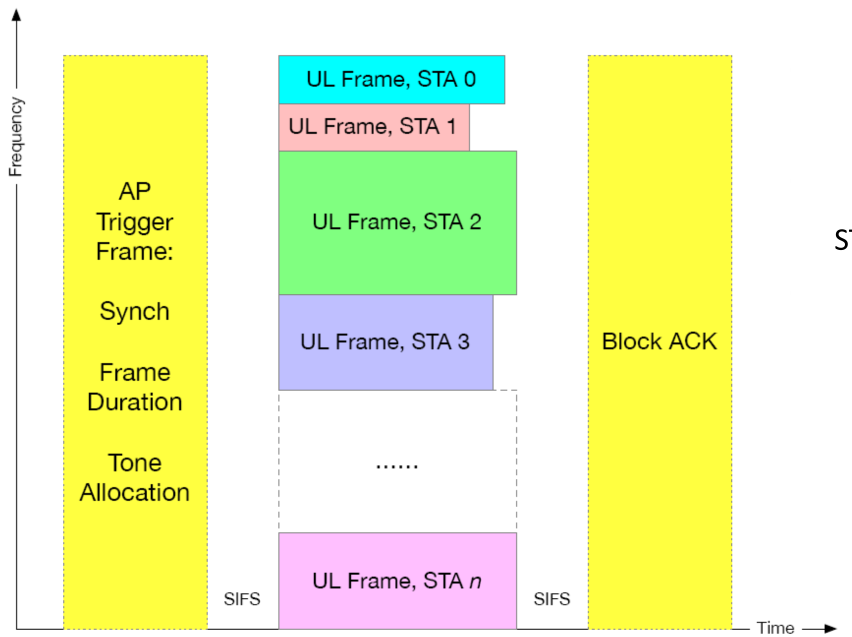

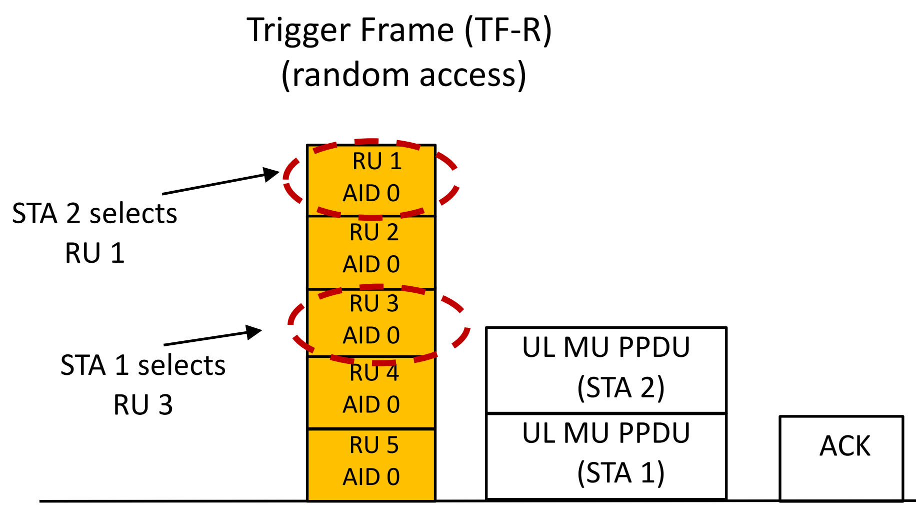

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#2 Radio Frequency Fingerprinting for Physical Layer Authentication on ZigBee networks

Resumo

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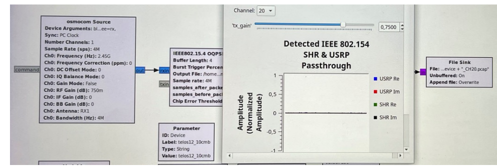
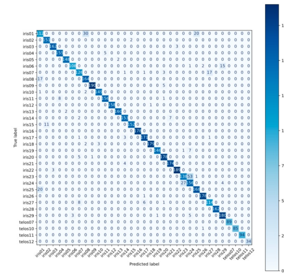
Main goal: Design and testing of machine learning generative algorithms for PHY layer authentication using Software Defined Radio.



Starting Point:

- Use existing GNU Radio software and Python classification software for the creation of a database of signals using 34 802.15.4 wireless sensors (IRIS/TelosB), NUAND SDR modules and existing GnuRadio software.
- Continuation of the thesis that won the 33º APDC award for the best thesis in telecommunications in 2024

Requirement:

- Availability to learn ML techniques and develop software in Python (Deep Learning) and C+ (GNU Radio)

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#2 Radio Frequency Fingerprinting for Physical Layer Authentication on ZigBee networks

Challenges:

- ML classifiers do not generalize well when the training signals are recorded in different conditions from the test (near/far or still/moving)
- How resilient the techniques are to spoofing attacks?

Workplan:

- Explore new ML algorithms more capable of creating signatures valid for different types of channels – e.g. generative adversarial networks, transformers and variational autoencoder networks
- Use two NUAND SDR to generate/receive signals and evaluate the capacity of the classification algorithms to identify generative signals.
- RFF performance evaluation
- Thesis writing

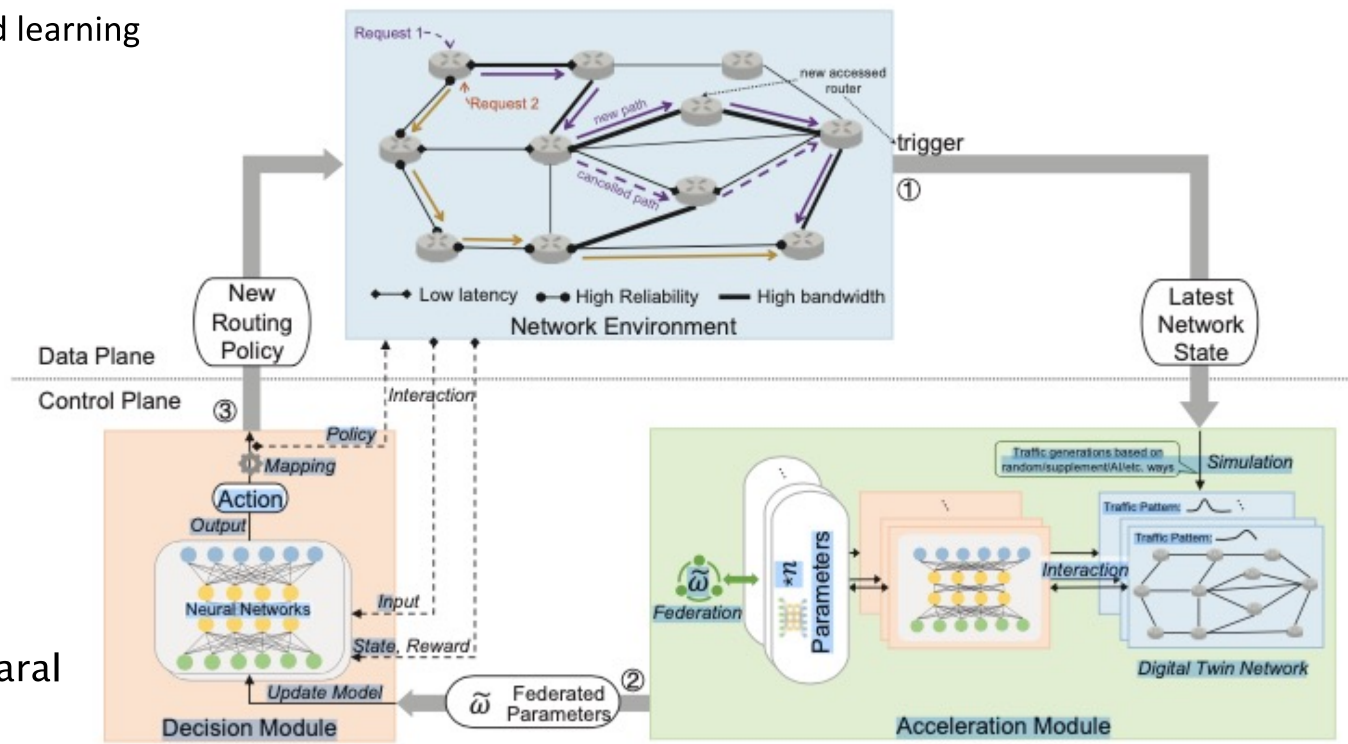
Supervisor: Luis Bernardo

#3 Fast Reconvergence in DRL based routing with topology changes.

Main goal: Use federated learning and alternative versions of the network topology to quickly learn how to route in the presence of failures and topology changes.

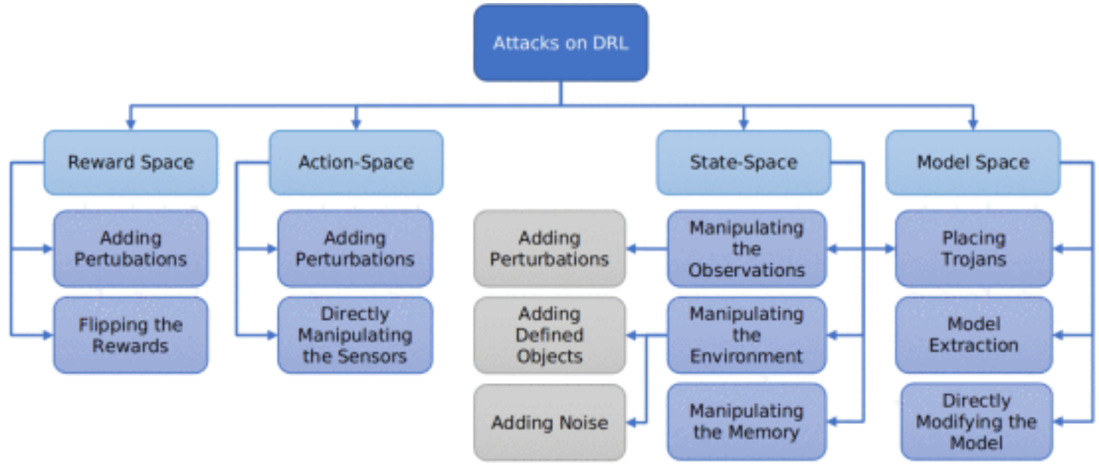
Workplan:

- Survey the state of the art on fast reconvergence in DRL based routing algorithms.
- Model definition (State, actions, reward, choice of DRL algorithm)
- Build twin alternative versions
- Implement the federated learning



Supervisors: Pedro Amaral

#4 Vulnerability identification in DRL based network Control – Model Extraction



Context: Deep Reinforcement Learning (DRL) is a promising framework for resource management in hard to model complex and dynamic environments. A DRL agent learns how to distribute resources to maximize reward. A control method based in DRL can be attacked using adversarial tactics. A particularly powerful attack is a model extraction attack, that can provide information on the inner workings of the DRL agent and increase the rates of success of adversarial attacks on the state-space.

Main goal: Study and experiment methods to perform model extraction of DRL algorithms

Workplan:

- ❑ Study the existing Deep Learning model extraction techniques and the few existing proposals for the DRL case.
- ❑ Design the model extraction to use.
- ❑ Use an existing DRL model and implement the model extraction technique.
- ❑ Evaluation (via simulation: Pythton using Mininet or ContainerNet): Training of the extraction model by observation of the DRL agent interaction with the environment. Comparison of the both the original and the extracted model to evaluate the accuracy.

#5 Moving target defence (Host address Mutation) based in DRL

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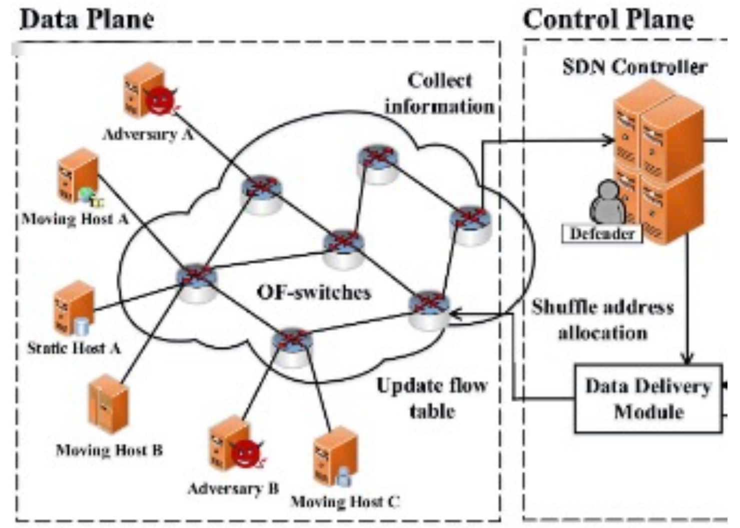
Context: A moving target defense technique called host address mutation (HAM) makes network reconnaissance (the first step of most attacks)more difficult to an attacker.

Challenges: Adaptability to adversarial strategies, maintaining existing connections, assuring unpredictability.

Main goal: Use DRL to perform the Address mutation in order to maximize the probability of avoiding network scanning.



Workplan:

- ❑ Study the existing HAM methods
- ❑ Model the problem as a MDP and design the DRL agent.
- ❑ Implement the DRL agent and a system simulator (this can be done with mininet and an SDN controller)
- ❑ Evaluation using known scanning techniques.

Supervisor: Pedro Amaral

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#6 Decentralized MAC Schemes for Grant-free Networks

Resumo

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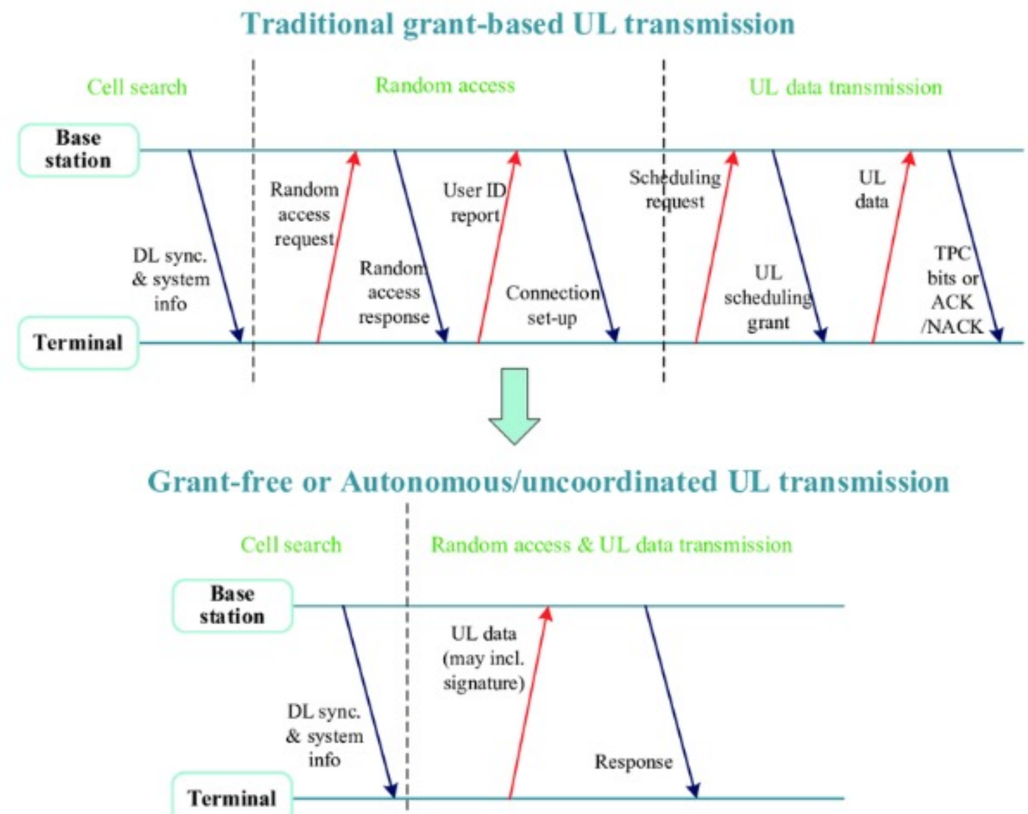
Motivation:

Part of future 6G systems are expected to work in a Grant-free way, i.e., the devices avoid sending a grant acquisition request to the BS and can randomly transmit a preamble without requiring an explicit grant from the BS

(in a contention-based manner using a common set of resources),

thus decreasing the channel access delay.

E.g., uplink for physical random access channel (PRACH) preamble transmission in 5G



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#6 Decentralized MAC Schemes for Grant-free Networks

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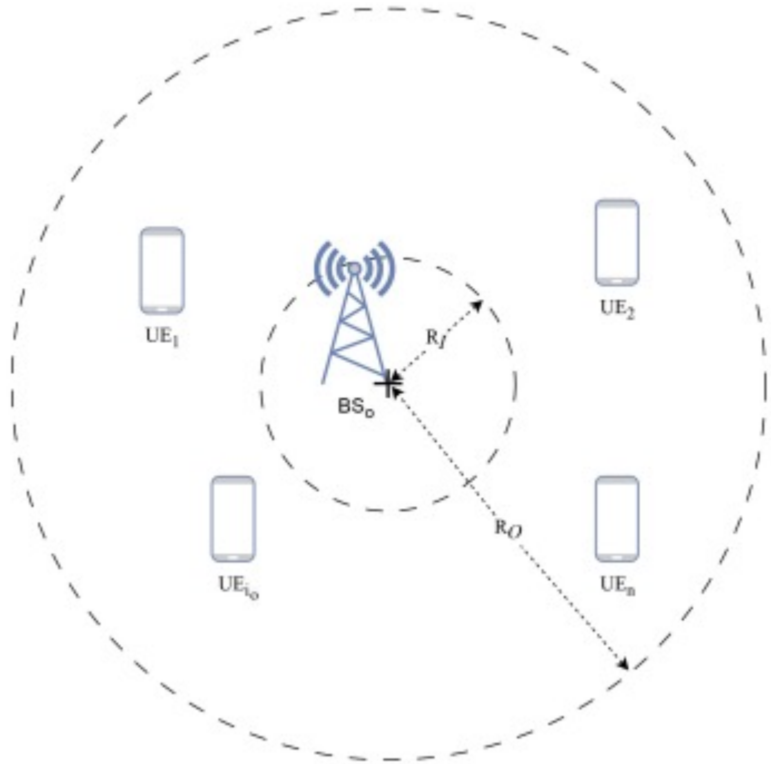
Motivation:

The BS can decode multiple preambles transmitted at the same time from multiple transiters



#6 Decentralized MAC Schemes for Grant-free Networks

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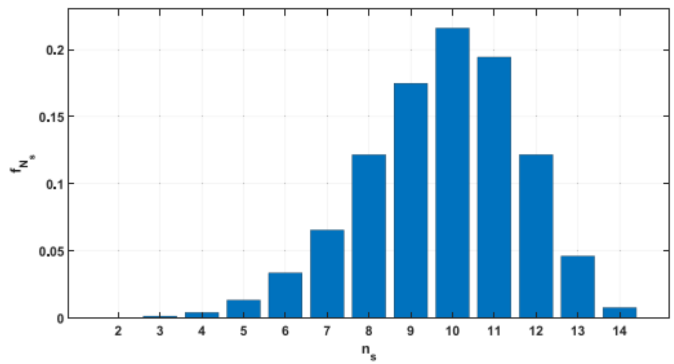
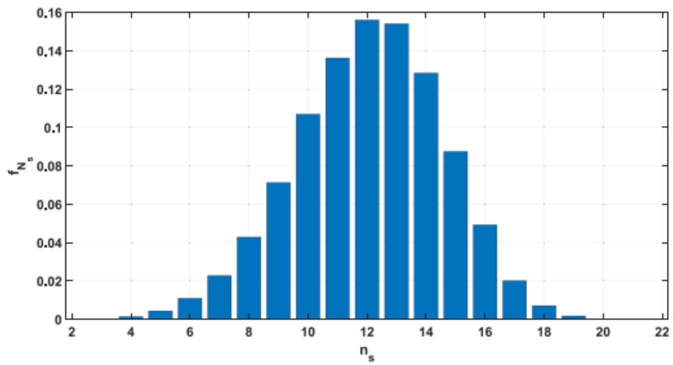
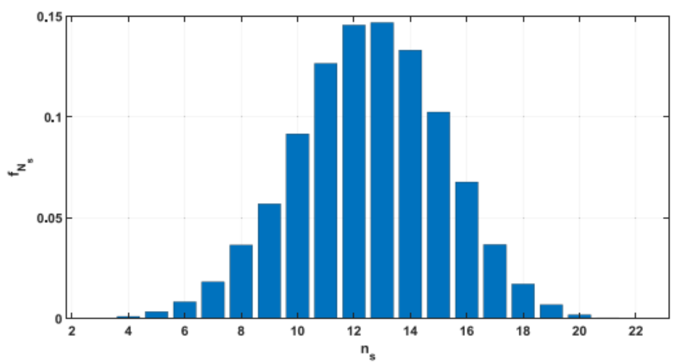


14 transmitting nodes and
9.7 successfully received



22 transmitting nodes and
12 successfully received



25 transmitting nodes and
12.5 successfully received

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#6 Decentralized MAC Schemes for Grant-free Networks

Goal:

Design innovative access schemes that take advantage of the statistics of the receiver by adopting advanced machine and deep learning tools

Methodology:

1. **Definition of the communication network scenarios**
2. **Simulation of the performance**
3. **Design of the Access Scheme**
4. **Optimization based on Deep Learning (how to regulate the access to increase the the number of decoded packets)**
5. **Performance Evaluation**
6. **Thesis Writing**

Supervisor:

Rodolfo Oliveira

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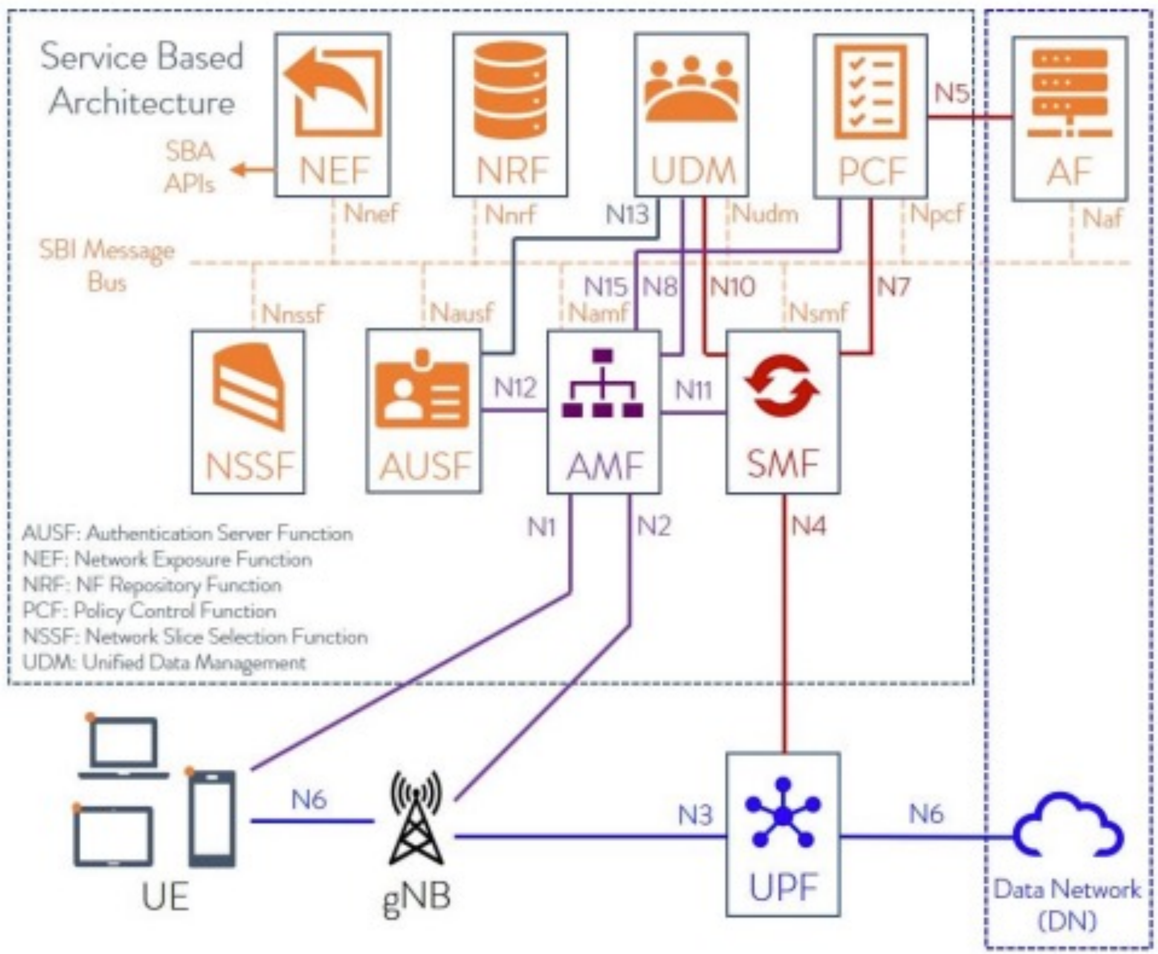
#7 Implementation of Services in 5G Networks



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#7 Implementation of Services in 5G Networks

Goal:

Develop a testbed environment of a 5G core network.

Methodology:

1. Literature Review: Conduct a comprehensive review of current research and technical standards related to 5G core network services.
2. Testbed Development: Set up a test environment using industry-standard 5G core network simulation tools (e.g., Open5GS, free5GC).
3. Performance Testing: Design test scenarios for each service (network slicing, edge computing, security) and perform detailed performance evaluations.
4. Data Analysis: Use statistical methods to analyze test data, identifying trends, performance issues, and reliability concerns.
5. Reporting

Supervisor:

Rodolfo Oliveira

#8 RF-based Context-awareness Demonstrator

Goals:

1. Designing a system architecture that leverages RF signals for context sensing.
2. Implementing the hardware and software components necessary for real-time operation.
3. Demonstrating the system's capabilities through practical use case scenarios.

Methodology:

1. Literature Review: Conduct a comprehensive review of current research on RF-based sensing and context-awareness.
2. Testbed Development: Set up a test environment using active RF sensing and evaluate different context-awareness algorithms.
3. Performance Testing: Evaluate the performance of the algorithms proposed in task 2.
4. Demonstrator implementation: Develop an application with a friendly GUI to serve as a demonstrator.
5. Reporting

Supervisor:

Rodolfo Oliveira

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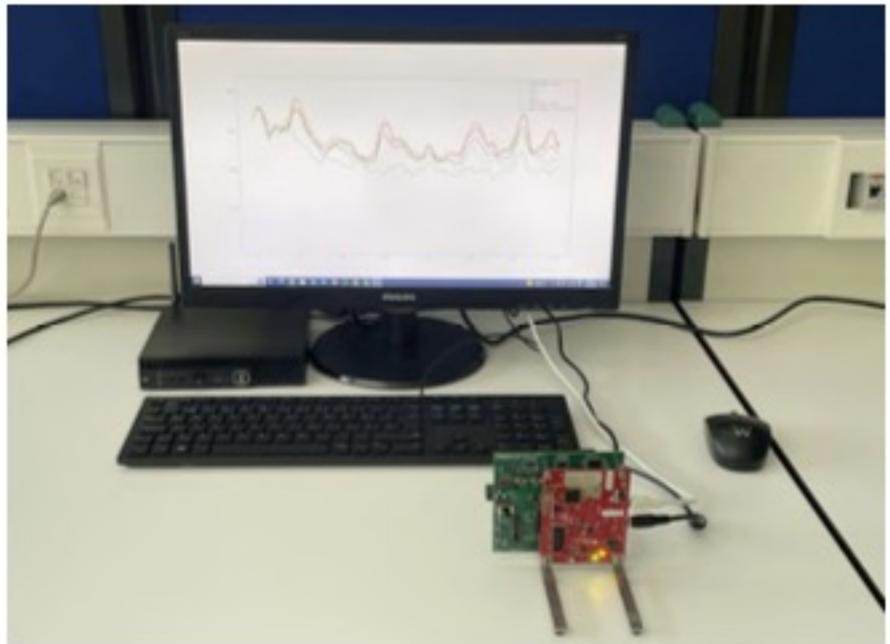
#8 RF-based Context-awareness Demonstrator



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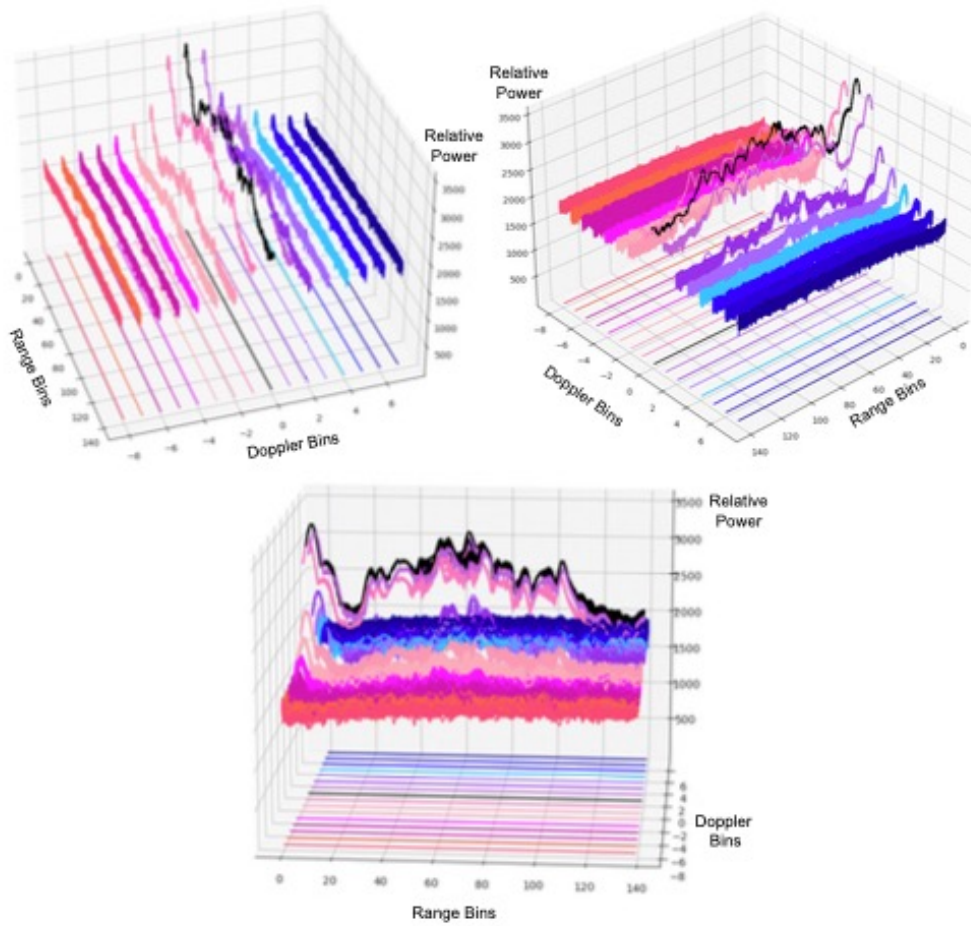
#8 RF-based Context-awareness Demonstrator



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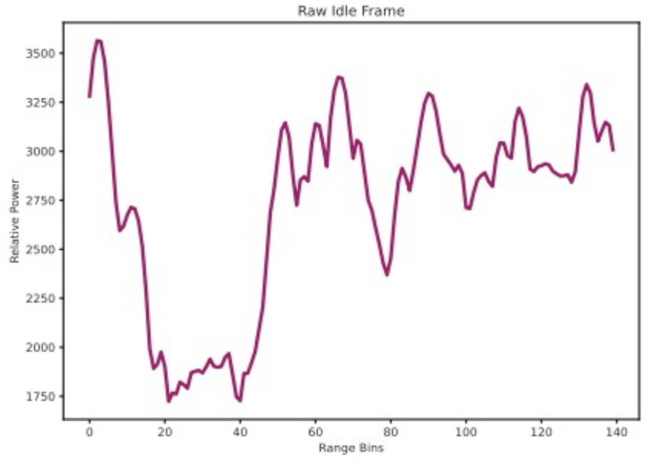

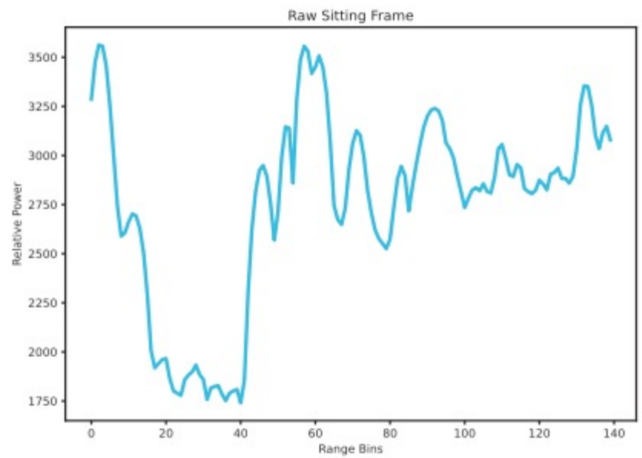

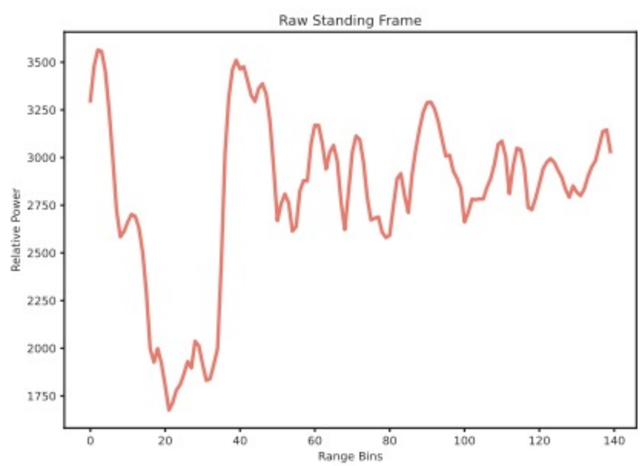

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