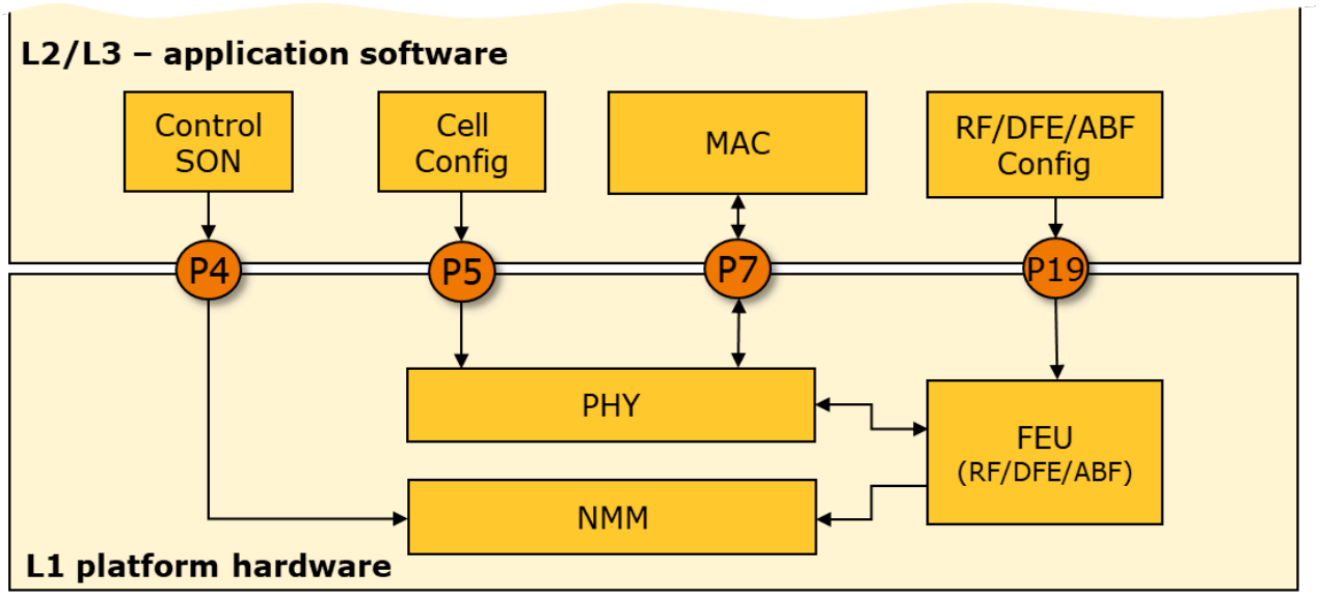
Study Plan

1. Introduction

Here I detailed research topic for Master's Degree at NTUST specifically at RTLab. In this document I would like to elaborate the research that I will do and hopefully can benefit for their project. The main research is for telecommunication technology (5G and beyond).

2. Topics

2.1 nFAPI



1. Introduction to PNF (Physical Network Function)

- **Understanding PNF**
  - Learn about the concept of Physical Network Function (PNF) in 5G networks.
  - Explore the role of the S-RU (physical radio unit) as a PNF, including its components like DFE (Digital Front-End) and RF chains.
  - Study how PNF differs from VNF (Virtual Network Function) and its importance in 5G infrastructure.

2. Detailed Study of PHY Instances

- **PHY Instance Overview**
  - Understand the definition and purpose of PHY instances within a PNF device.

    - Explore the Layer 1 (L1) functionality supported by each PHY instance, focusing on how it handles a single component carrier.
- **PHY Identifiers (PHY ID)**
    - Learn about PHY Identifiers (PHY ID) and their role in uniquely identifying each PHY instance within a PNF.
    - Study how multiple PHY instances are managed within a single PNF device.

3. nFAPI and Its Role in 5G RAN

- **Introduction to nFAPI**
    - Understand the Network Functional Application Platform Interface (nFAPI) and its application in 5G RAN (Radio Access Network).
    - Explore how nFAPI facilitates communication between the PNF (S-RU) and other network components.
- **nFAPI in Relation to PNF and PHY**
    - Investigate how nFAPI interacts with PNF devices and their PHY instances.
    - Study the role of nFAPI in managing and coordinating the PHY instances within the PNF

4. Practical Implementation and Simulatio

- **Simulating PNF and PHY Instances**
    - Set up a simulation or test environment to model the behavior of a PNF with multiple PHY instances.
    - Experiment with configuring and managing PHY instances within a PNF using nFAPI.
- **Case Studies and Examples**
    - Review real-world examples or case studies where PNF and PHY instances are implemented in a 5G network.
    - Analyze how nFAPI has been used to manage PNF devices and their PHY instances in these examples.

5. Advanced Concepts and Review

- **Optimization of PNF and PHY Instances**
    - Study advanced methods for optimizing the performance of PHY instances within a PNF.
    - Explore strategies for improving the efficiency and scalability of nFAPI in managing PNF devices.
- **Documentation and Review**

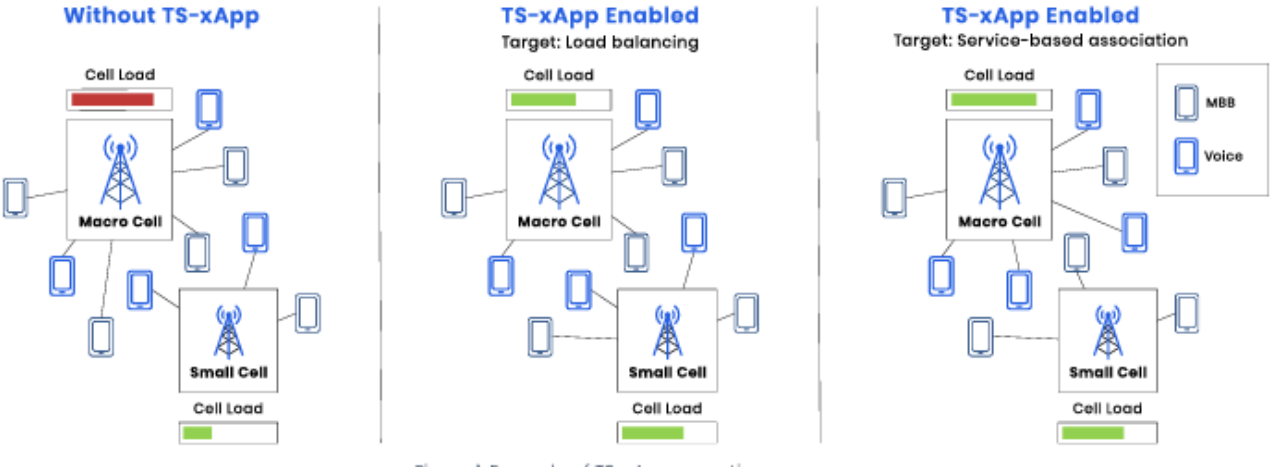
- Document your findings, including the behavior and management of PNF and PHY instances.
- Prepare a summary or report that outlines the key concepts and practical insights gained from your study.

2.2 RIC

1. Introduction to RIC and 5G Traffic Steering

- **RIC Architecture**
  - Understand RIC's role in 5G, including Near-RT and Non-RT RIC.
  - Study RIC's interaction with gNB, CU, DU, and other 5G components.
- **NR Xn-C Interface**
  - Learn about the Xn interface between gNBs and its role in handovers.
  - Focus on Xn-C (Control Plane) procedures in NR (New Radio) and its signaling processes.
- **F1-C Interface**
  - Study the F1-C protocol between DU and CU.
  - Understand traffic flow and decision-making within the DU-CU architecture.

2. eBPF and Traffic Steering



- **Introduction to eBPF**
  - Explore the fundamentals of eBPF and its use in networking.
  - Learn how eBPF can bypass the kernel for efficient decision-making.
- **eBPF in Traffic Steering**
  - Investigate the use of eBPF in real-time data collection for traffic steering between gNBs.
  - Study examples or case studies where eBPF is applied to traffic management.

- **Implementing eBPF with RIC**
  - Experiment with using eBPF to enhance RIC decision-making for handovers.
  - Develop a proof-of-concept showcasing eBPF-based decision-making in traffic steering.

3. Load Balancing in 5G RAN

- **F1 Load Balancing**
  - Understand load balancing within the F1 interface.
  - Explore strategies for selecting the best CU based on availability or capability.
- **nFAPI Load Balancing**
  - Learn about nFAPI's role in 5G RAN and its load-balancing mechanisms.
  - Investigate approaches to manage load distribution within nFAPI.
- **Practical Implementation**
  - Simulate or set up scenarios to demonstrate load balancing using RIC.
  - Experiment with different strategies and evaluate their performance.

4. Advanced Topics and Review

- **Optimization Techniques**
  - Explore advanced methods for optimizing traffic steering and load balancing.
  - Consider machine learning or algorithmic approaches to enhance decision-making.
- **Integration and Testing**
  - Integrate RIC, eBPF, Traffic Steering, and Load Balancing into a cohesive system.
  - Test the system under various scenarios and conditions.
- **Documentation and Review**
  - Document your implementation, challenges, and results.
  - Compile a report or presentation on your findings and identify areas for future work.

3 References

- SCF225_5G_nFAPI_specification-JULY-22
- O-RAN.WG5.O-CU-O1.0-R003-v07.00
- https://opennetworking.org/wp-content/uploads/2022/10/ORAN-TS-xApp-TechSpec-Marcin-Dryjanski.pdf