Indian Institute of Information Technology Vadodara

UERAN Simulator Project Report

Under Guidance of

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Submitted by

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***Abstract*—This report presents the UERANSIM project, an open-source implementation of 5G User Equipment (UE) and Radio Access Network (RAN) simulations. Designed for testing 5G Core Networks and exploring 5G technologies, UERANSIM supports key functionalities like NAS signaling, PDU sessions, and gNodeB behavior while abstracting the physical layer. Written in C++, the project facilitates robust performance evaluation and protocol analysis. The report highlights the architecture, use cases, and contributions to advancing 5G network research and development, providing a foundational tool for academia and industry.**

I. Introduction

The UERANSIM (User Equipment and Radio Access Network Simulator) project is an open-source initiative aimed at replicating key functionalities of 5G networks, focusing on the User Equipment (UE) and gNodeB components of the 5G Radio Access Network (RAN). This simulation tool enables researchers, developers, and network engineers to test, validate, and analyze 5G Core Network operations without requiring physical hardware.

UERANSIM supports critical features like Non-Access Stratum (NAS) signaling, PDU session management, and interconnection with 5G Core Networks. It simplifies testing by abstracting the physical layer, allowing developers to concentrate on higher-layer protocol behaviors and network interactions.

Implemented in C++, UERANSIM adheres to 3GPP standards, ensuring compatibility and reliability in simulated environments. Its modular design and comprehensive documentation make it accessible to a wide range of users, from academic researchers studying network protocols to industry professionals optimizing 5G deployments.

This tool addresses the growing demand for efficient, cost-effective network testing solutions in the era of 5G, paving the way for innovations in mobile communications and telecommunications research.

II. Experimental Setup

The experimental setup for the UERANSIM and Open5GS project is designed to simulate 5G networks in a virtualized environment. The system is configured on Ubuntu 22.04 (Jammy) with SSD storage for optimal performance. Virtualization tools like VMware Workstation or Oracle VBox are not recommended for this setup.

Requirements

- **Open5GS:**
  - MongoDB for core database functionalities.
  - NodeJS for WebUI management.
- **UERANSIM:**
  - Dependencies: `make`, `gcc`, `g++`, `libsctp-dev`, `lksctp-tools`, `iproute2`, `git`.
  - `cmake` installed via Snap.

Installation Steps

1. Install Open5GS:

1) Update the package list:

```
sudo apt-get update
sudo apt-get install -y gnupg wget curl
```

2) Install MongoDB:

```
wget -qO - https://www.mongodb.org/static
/pgp/server-6.0.asc | sudo apt-key add -
echo "deb [ arch=amd64,arm64 ]
https://repo.mongodb.org/apt/ubuntu focal
/mongodb-org/6.0 multiverse" |
sudo tee /etc/apt/sources.list.d
/mongodb-org-6.0.list
sudo apt-get update
sudo apt install -y mongodb-org
```

Address dependency issues for `libssl1.1` as required for Ubuntu 22.04.

3) Enable MongoDB service:

```
systemctl start mongod
systemctl enable mongod
```

4) Install Node.js for WebUI:

```
curl -fsSL https://deb.nodesource.com/
setup_18.x | sudo -E bash -
sudo apt install nodejs
```

5) Install Open5GS and WebUI:

```
sudo add-apt-repository
ppa:open5gs/latest
sudo apt-get update &&
sudo apt install -y open5gs
curl -fsSL https://open5gs.org/open5gs
/assets/webui/install | sudo -E bash -
```

2. Install UERANSIM:

1) Install required packages:

```
sudo apt install make gcc g++
libsctp-dev lksctp-tools iproute2 git
sudo snap install cmake --classic
```

2) Clone and build UERANSIM:

```
git clone
https://github.com/aligungr/UERANSIM
cd ~/UERANSIM
make
```

This experimental setup establishes a simulated environment for evaluating 5G Core Network functionalities and interactions between UE and gNodeB using UERANSIM and Open5GS.

III. Working

Steps

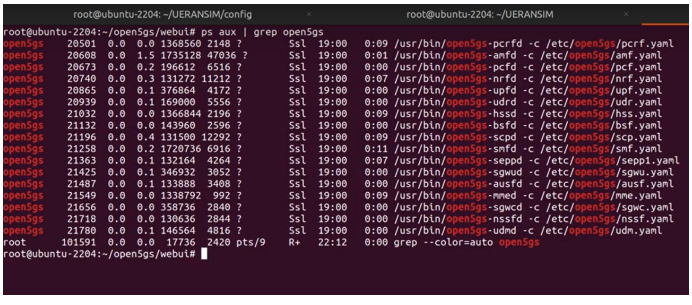

Fig. 1: Checking the open5gs service

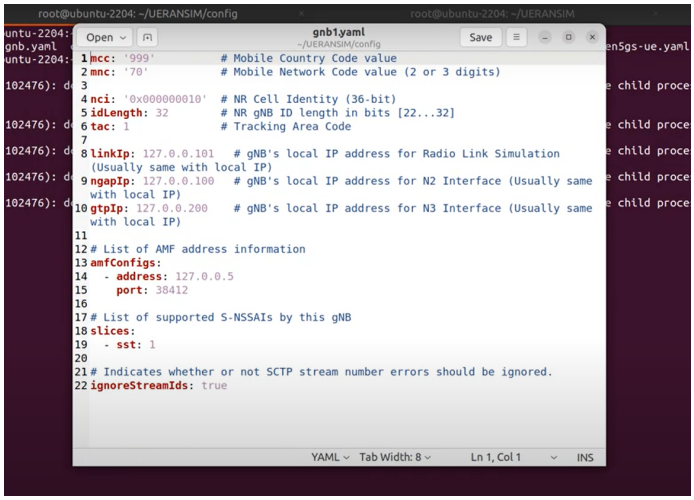

Fig. 2: Configuring ueransim gNodeB

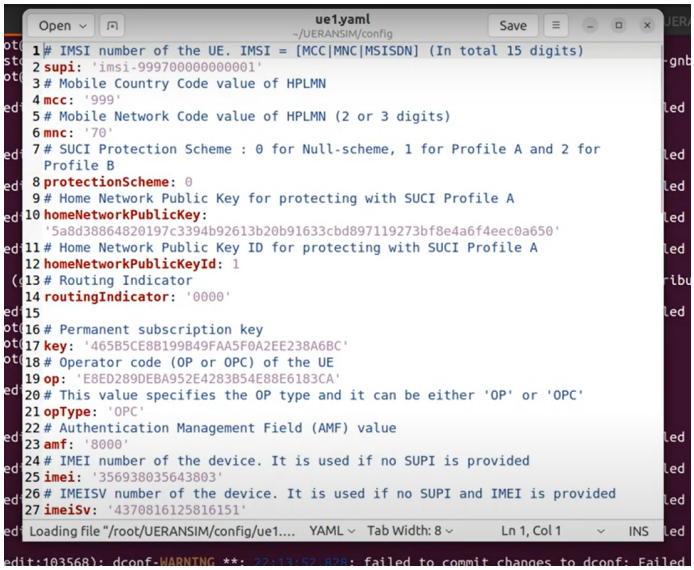

Fig. 3: Configuring ueransim User Equipment

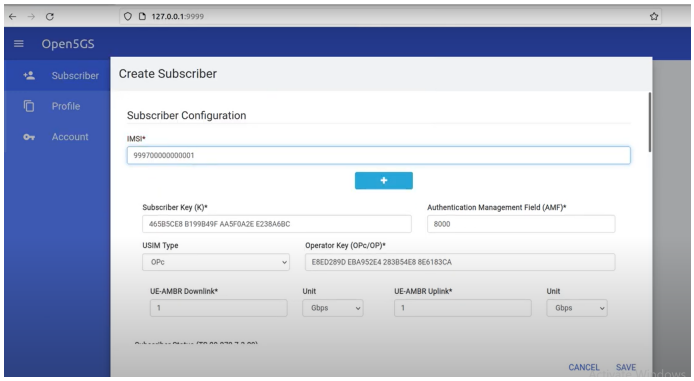

Fig. 4: Adding Subscriber to open5gs webui

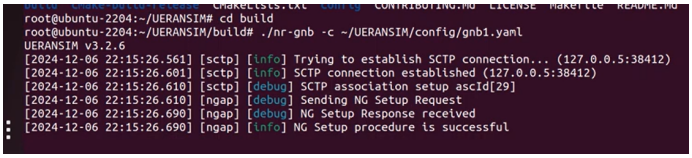

Fig. 5: Running gNodeB with logs

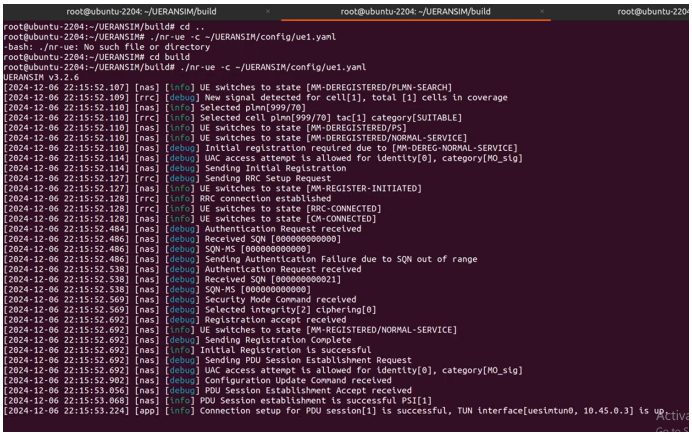

Fig. 6: Running UE with logs

IV. Contribution

The project was successfully completed with the collaborative efforts of the following team members, where tasks were distributed as per individual expertise and interests:

- **Implementation:** Ankur was responsible for the coding and technical implementation of the UERANSIM and Open5GS setup, ensuring compatibility and functionality of the system.
- **Research:** Satyam and Rohit conducted thorough research on 5G network protocols, simulation environments, and dependencies required for the project.
- **Report Creation:** Satyam took the lead in drafting and formatting the project report, ensuring a comprehensive and well-organized presentation of the work.

The seamless division of tasks and teamwork ensured the project's successful execution and documentation.

Conclusion

Finally, A Protocol Data Unit session is established.

The successful completion of this project highlights the collaborative effort of the team in simulating a 5G network environment using UERANSIM and Open5GS. By dividing responsibilities such as research, implementation, and report creation among the team members, the project was executed efficiently. The simulation setup provided a deeper understanding of 5G network protocols, dependencies, and interactions between User Equipment and the Radio Access Network. This work not only enhances practical knowledge but also serves as a foundation for future advancements in 5G technology.