Implementing and Evaluating 5G Roaming Scenarios in an Open Source Testbed

Oliver Zeidler and Julian Sturm

1 Overview

5G is the newest generation of mobile networks, allowing for higher data rates, lower latency and many new features like network slicing. Its central element is the 5G Core, which is a network of specialised Network Functions (NFs). One of these NFs is responsible for roaming connections. Roaming allows subscribers to connect to the internet via other network operators’ networks if they have a roaming agreement. Between two Public Land Mobile Networks (PLMNs), there are two standardised Roaming modes: Local Break Out and Home Routed Roaming. For Local Break Out Roaming, only the home network’s control plane is accessed from the visited network, while the user data is directly transmitted to the Data Network (DN). For Home Routed Roaming, the user data is routed through the home network to the DN. This thesis aims to implement both Roaming versions in an open-source core network and compare them regarding chosen KPIs, e.g., latency or throughput. Open5GS would be the primary choice for the open-source core network, as it already supports Local Break Out Roaming. Home Routed Roaming is not yet supported.

A major part of 5G roaming is the Security Edge Protection Proxy (SEPP), a 5G NF designed to establish and maintain a secure control plane connection between two PLMNs. Implementing it, or extending the existing implementation of Open5GS, will be an important part of this work. The SEPP is connected to other NFs in the same PLMN via Service Based Interfaces (SBIs) and to other PLMN’s SEPPs via the N32 interface.

The biggest difference between the two roaming scenarios lies in the data plane routing, so implementing the connection between two User Plane Functions (UPFs), the N9 interface, is necessary to connect two PLMNs. The newly introduced Inter PLMN User Plane Security (IPUPS) used for additional security on this connection is initially considered out-of-scope for this work but may be added later.

A security analysis regarding control and user plane for both roaming modes finishes this work’s contributions. One potential focal point is the control capabilities of the home PLMN operator in Local Break Out compared to Home Routed Roaming.

2 Objectives

1. Check roaming functionalities of Open5GS
2. Implement missing Roaming functionalities into Open5GS
3. Run tests to investigate the differences between Home Routed and Local Break Out Roaming considering chosen KPIs
4. Investigate the security capabilities of both options

3 Prerequisites

- Basic understanding of 5G networks advantageous; especially of the 5G core network
  - interest and motivation to learn the system are sufficient
- Programming knowledge in C useful (for Open5GS)
- Interest in roaming functionalities
- Interest in security