

Evaluating 5G/NextG Wireless

Overview

Goal: Research O-RAN and develop: (1) Open source 5G system implementation, and (2) Network management applications and framework for resilience, security, and spectrum management.

Implementation:

- Set up demo 5G network (OAI/Amarisoft)
- Develop Python rApp applications.
- Develop O-RAN SMO Framework Services for Topology and Visualization and Message Generation.

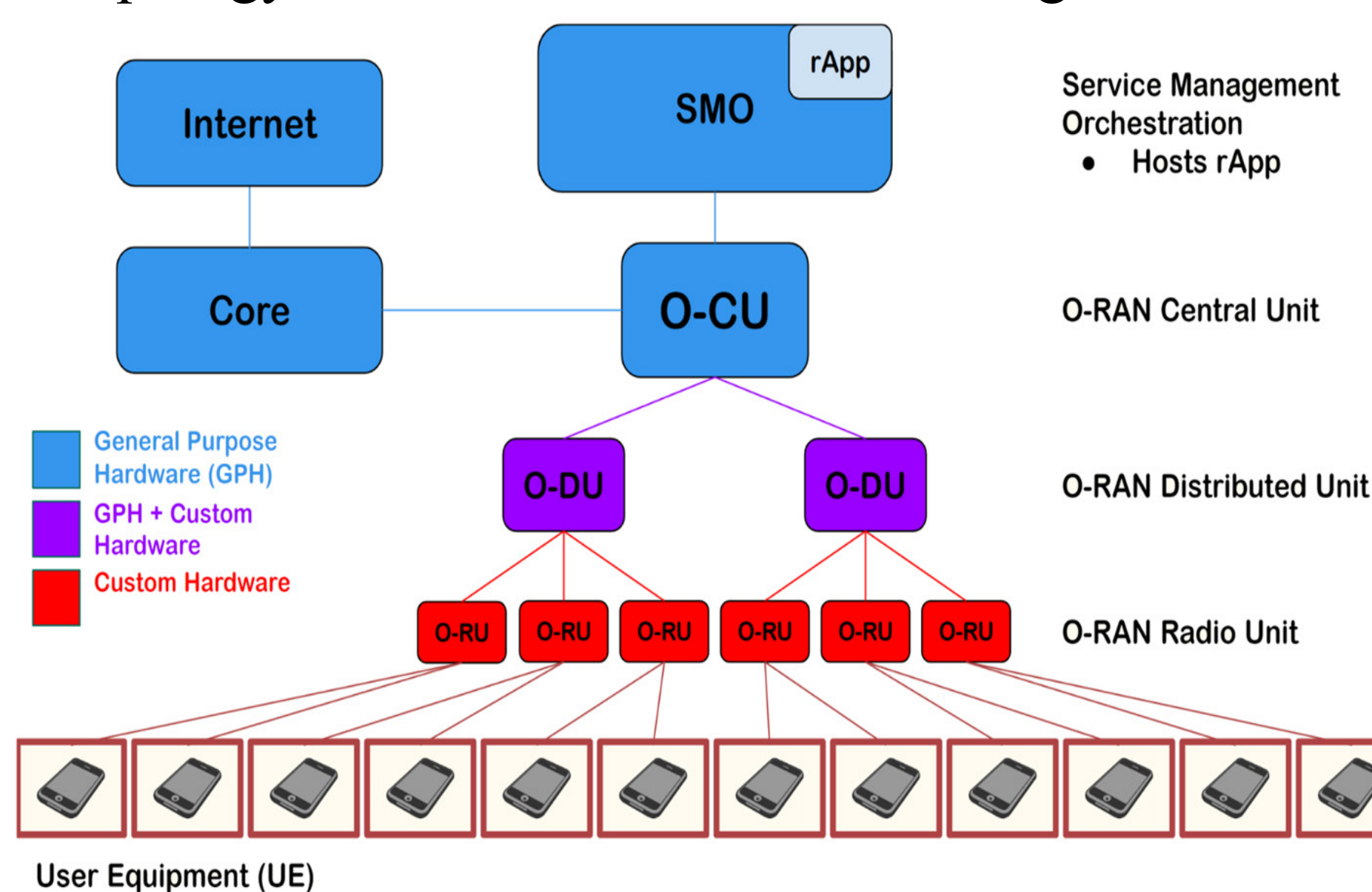


Figure 1: Block Diagram of O-RAN Hierarchy

rApp Framework/Methodology

Security: (1) Receives security related RAN alarms (2) Assesses severity of alarms and outputs commands (3) Isolates compromised components and their connections

Resilience: (1) Maintains updated topology (2) Calculates optimal distribution of data across multiple network paths (3) Ensures constant connectivity

Spectrum Management: (1) Analyzes frequency band occupancy (2) Allocates available frequency band to RUs

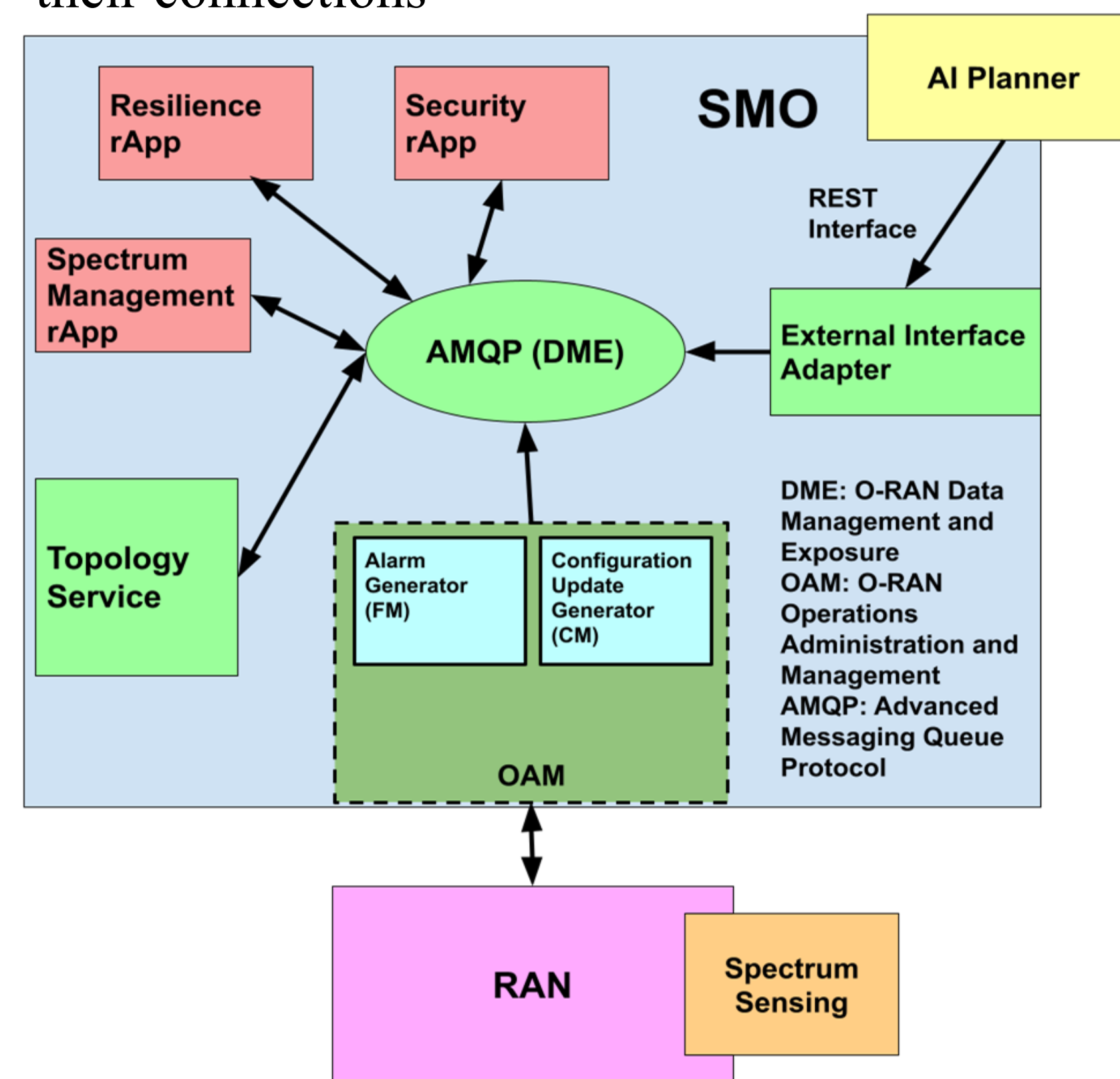


Figure 3: SMO Applications and Framework Services

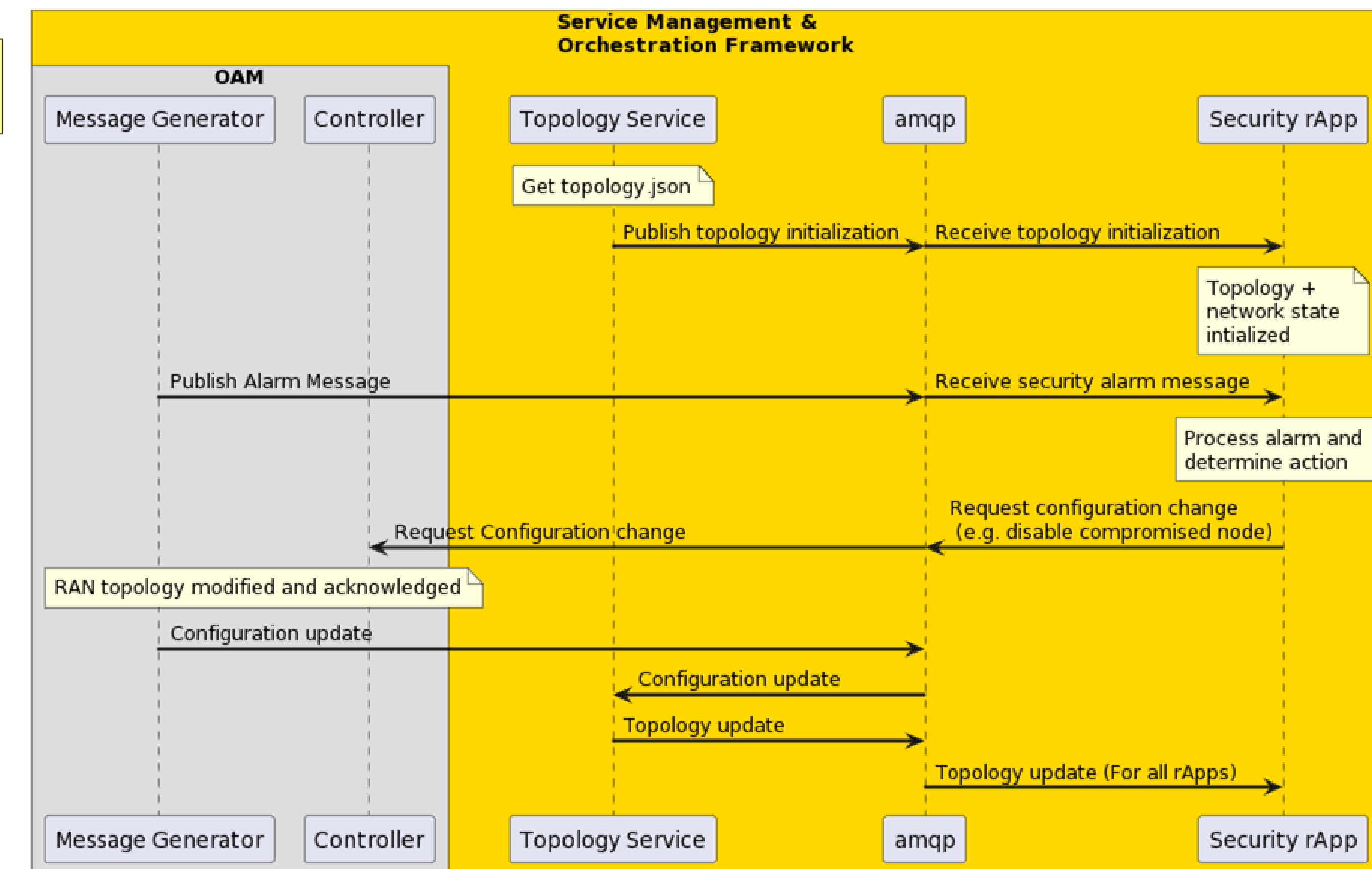


Figure 4: Sequence Diagram for Security rApp

OAI/Amarisoft Methodology

Components:

- 5G Network through Amarisoft and Open-Source Openairinterface (OAI) code.
- 5G CU/DU/RU through SDR (USRP B210) and 5G Core on Docker.

Accomplishment:

- End-to-End Connectivity from 2 nrUEs to the Internet.
- Demo 5G SA Monolithic Network for future testing.

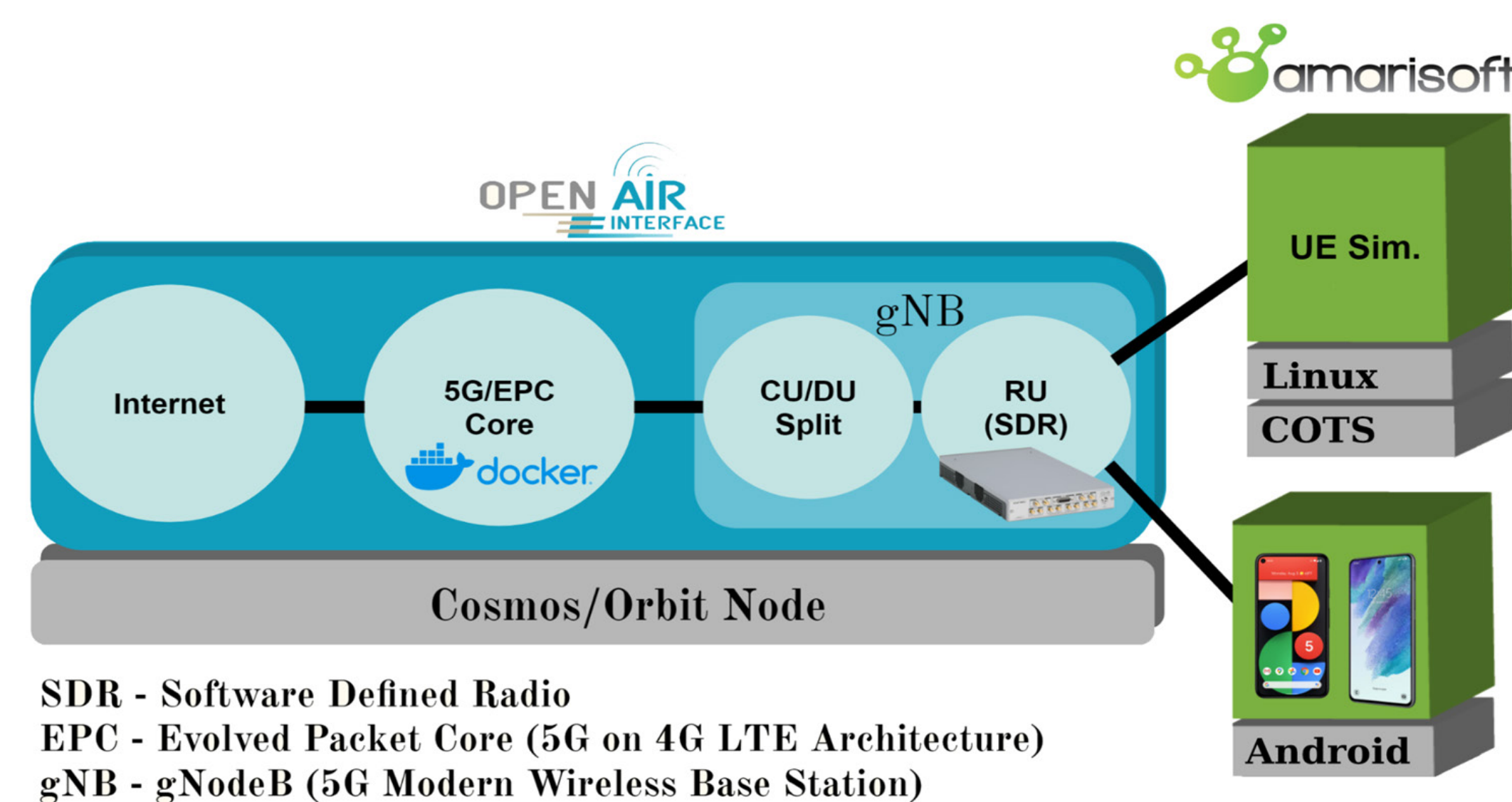


Figure 2: OAI/Amarisoft Architecture

Implementations

```
Client connecting to 12.1.1.4, UDP port 5001
Sending 1470 byte datagrams, IPG target: 149.54 us
UDP buffer size: 208 KByte (default)

[ ID] Interval      Transfer    Bandwidth
[ 3] 0.0- 1.0 sec  9.38 MBytes 78.7 Mbits/sec
[ 3] 1.0- 2.0 sec  9.37 MBytes 78.6 Mbits/sec
[ 3] 2.0- 3.0 sec  9.37 MBytes 78.6 Mbits/sec
...
[ 3] 19.0-20.0 sec 9.44 MBytes 79.2 Mbits/sec
[ 3] 0.0-20.0 sec 188 MBytes 78.6 Mbits/sec
[ 3] Sent 133747 datagrams
[ 3] Server Report: 0.131 ms 56594/133747 (42%)
[ 3] 0.0-21.0 sec 108 MBytes 43.2 Mbits/sec
[ 3] 0.0000-20.9929 sec 1 datagrams received out-of-order
```

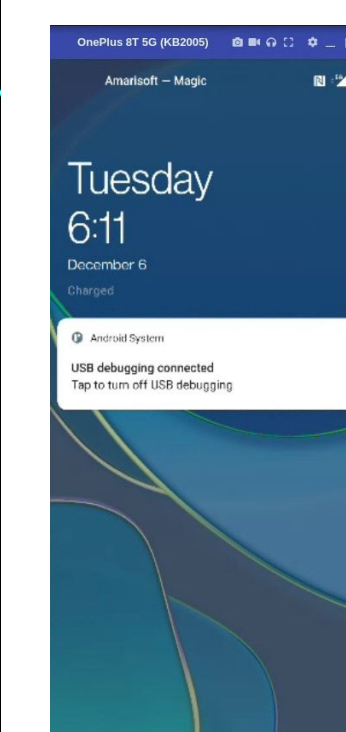


Figure 5: OAI iperf test with OAI nrUE + gNB, COTS UE

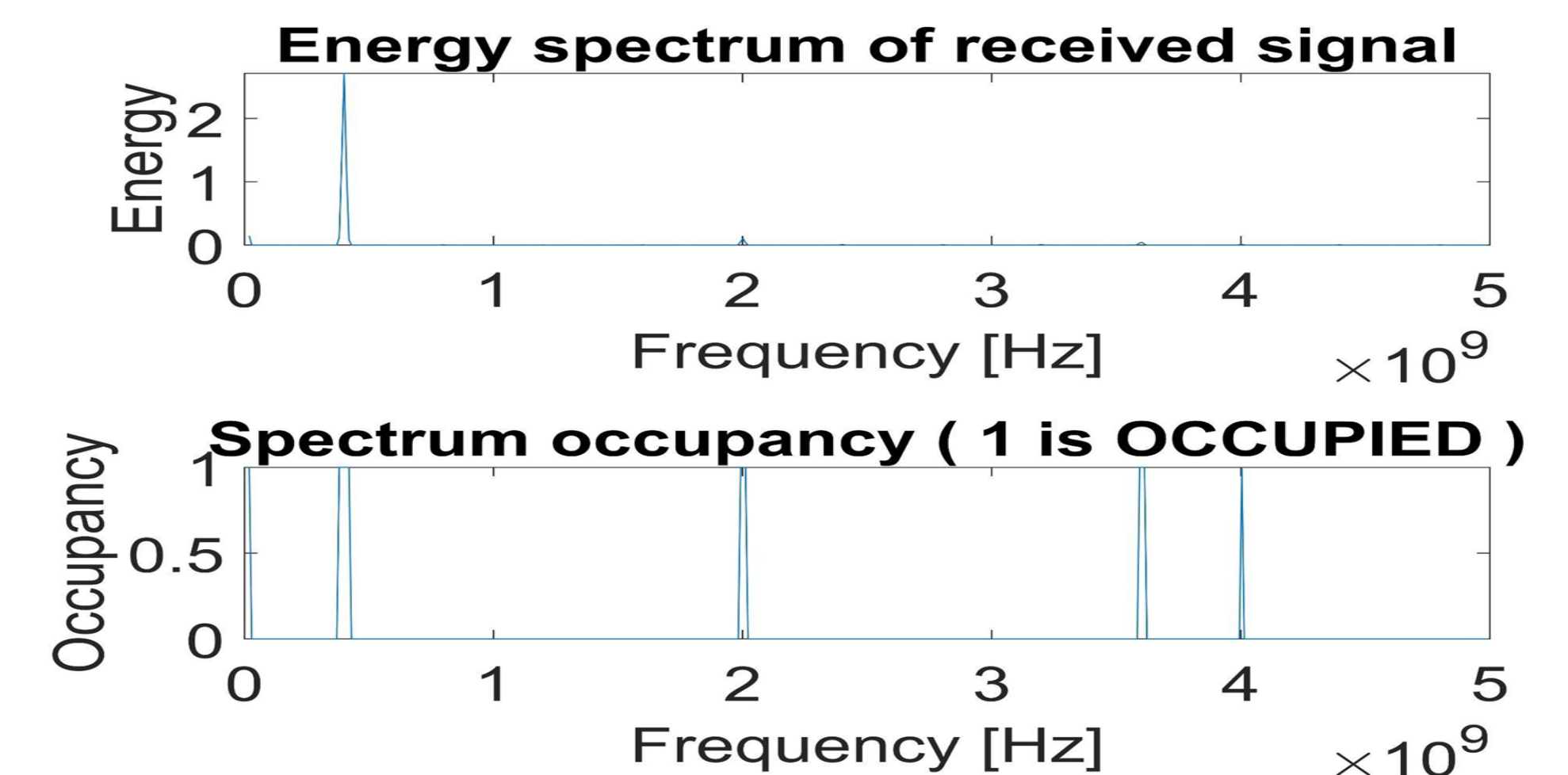


Figure 7: Spectrum Energy and Occupancy

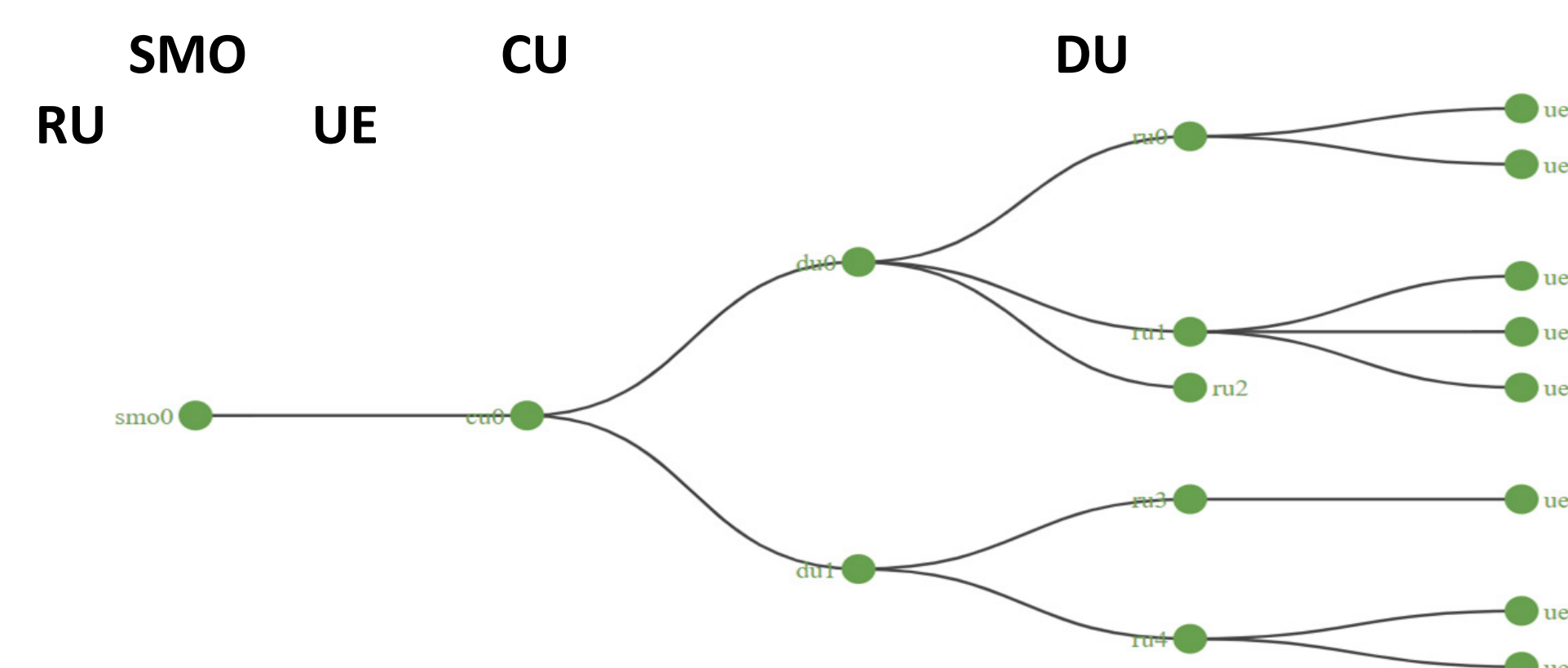


Figure 6: Topology Visualization

Future Work

- Integration onto SDRs and physical hardware
- Test/refine applications design and daily performance

Acknowledgements

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