5G Sandbox Project Documentation

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Contents

1. Current Testing Components of 5G Sandbox

UE	**RAN**	**Core**
• Quectel RM500Q • SIMCOM SIM8200 • Huawei Nova 7 SE • OAI UE (Virtual)	• OAI gNB. + RF Simulator • SRS RAN + USRP B210 • SRS RAN + USRP N310 • OAI gNB + USRP B210 • OAI gNB + USRP N310	• OAI 5G core network • Cumucore 5G core network • Open 5GS

2. Testing Setups and Status

2.1. 5G Simulation Setups

No.	UE	GNB	CN	Current Status
1	OAI UE with RF Simulator	OAI gNB with RF Simulator	OAI CN with SPGWU - UPF	End-to-End Connection Successful. 10Mbps Maximum Download Speed.
2	OAI UE with RF Simulator	OAI gNB with RF Simulator	OAI CN with VPP - UPF	End-to-End Connection Successful. 50Mbps Maximum Download Speed.

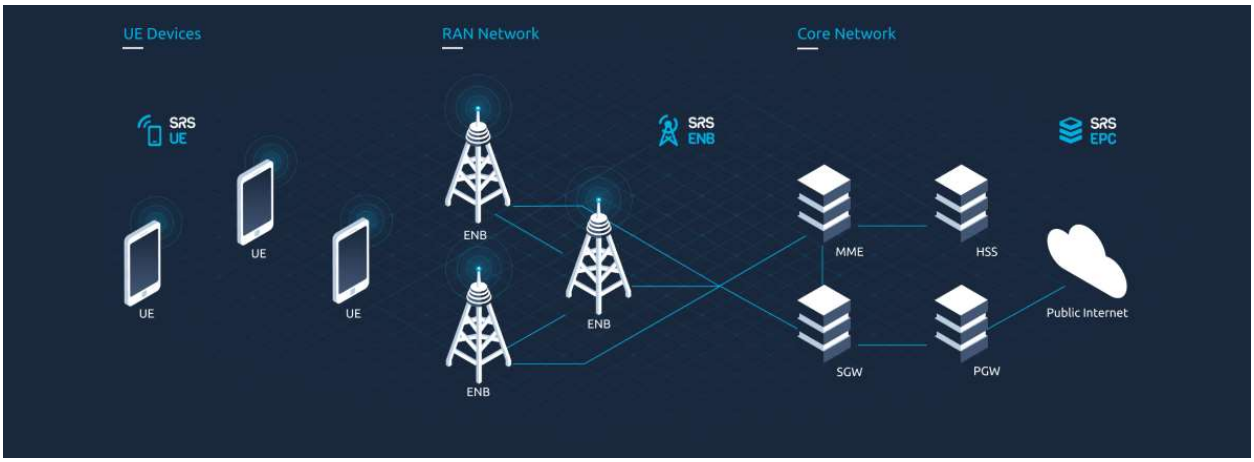
2.2. 5G Hardware Setups

No.	UE	GNB	CN	Current Status
1	Quectel RM500Q	OAI gNB with B210	OAI CN with SPGWU - UPF	End-to-End Connection Successful. 10Mbps Maximum Download Speed.
2	SIMCOM SIM8200	OAI gNB with B210	OAI CN with SPGWU - UPF	Connection to UE successful. UE is assigned an IP address. However, UE does not get internet access.
3	Quectel RM500Q	OAI gNB with N310	OAI CN with SPGWU - UPF	UE failed to Attach. Need to check with the latest OAI Updates.
4	SIMCOM SIM8200	OAI gNB with N310	OAI CN with SPGWU - UPF	UE failed to Attach. Need to check with the latest OAI Updates.
5	Quectel RM500Q	OAI gNB with B210	OAI CN with VPP - UPF	End-to-End Connection Successful. 23Mbps Average Download Speed, 57Mbps peak. Latency <20ms.
6	SIMCOM SIM8200	OAI gNB with B210	OAI CN with VPP - UPF	Need to check with the latest OAI Updates.
7	Quectel RM500Q	OAI gNB with N310	OAI CN with VPP - UPF	Connection okay. The network is not stable and download speeds are lower than 5)
8	SIMCOM SIM8200	OAI gNB with N310	OAI CN with VPP - UPF	Need to check with the latest OAI Updates.

9	Quectel RM500Q	OAI gNB with B210	Cumucore	UE Authentication failed.
10	Quectel RM500Q	OAI gNB with N310	Cumucore	Need to be tested.
11	Quectel RM500Q	SRSRAN with B210	Open5GS	UE Discover the service but not attached.
12	Quectel RM500Q	SRSRAN with N310	Open5GS	Need to be tested

2.3. 4G Hardware Setup

4g hardware setup is deployed using SRSRAN 4G deployment and documentation can be found here.



Core Network: SRS EPC

RAN Network: SRS ENB

UE: All the UEs are supported in this network.

3. Installation and Deployment

3.1. OAI Simulation Setup

The tested end-to-end simulation setup documentation and all the other required files are included in this GitHub repo. And deployment instructions can be found in this ReadMe file.

3.2. OAI Hardware Setup

The tested end-to-end hardware setup documentation and all the other required files are included in this GitHub repo. And deployment instructions can be found in this ReadMe file.

GNB configuration files can be find the "5G_Sandbox/patch/" folder for different deployment cases such as connecting GNB with OAI core and CUMU Core.

3.3. Open5gs and SRSRAN

Currently this setup is not end to end finalized but SRSRAN 5G and Open5gs are installed in the computer. For further development try changing Open5gs configuration which located on "/etc /open5gs/" and SRSRAN configuration which on " ~/SRSRAN_Project/configs".

3.4. Cumu Core

All the related documentation can be found in the drive link.

3.5. SRSRAN 4G

Installation Instruction can be found here.

After installing SRSRAN 4G copy these config files to "~/.config/srsran"

To run the EPC:

```
cd ~/.config/srsran

sudo srsepc epc.conf
```

To run the ENB:

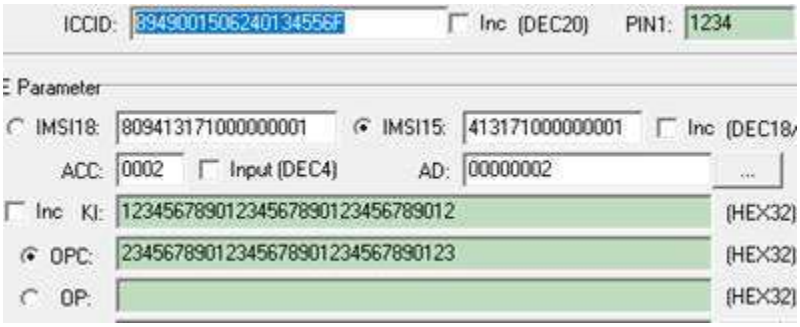
```
cd ~/.config/srsran

sudo srsenb enb.conf
```

After that UE should attached to 4G network. In any case UE cannot access Internet after attaching to the network run this script.

4. SIM Configurations

Card 1



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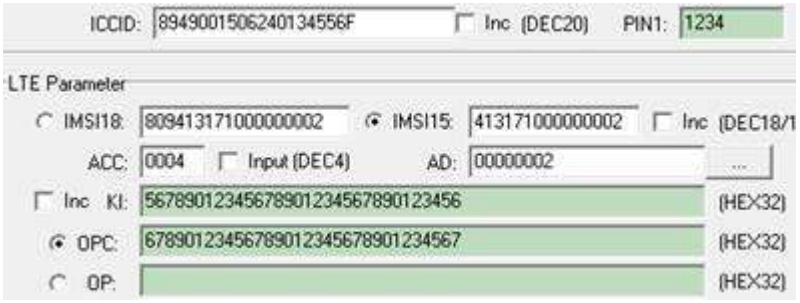

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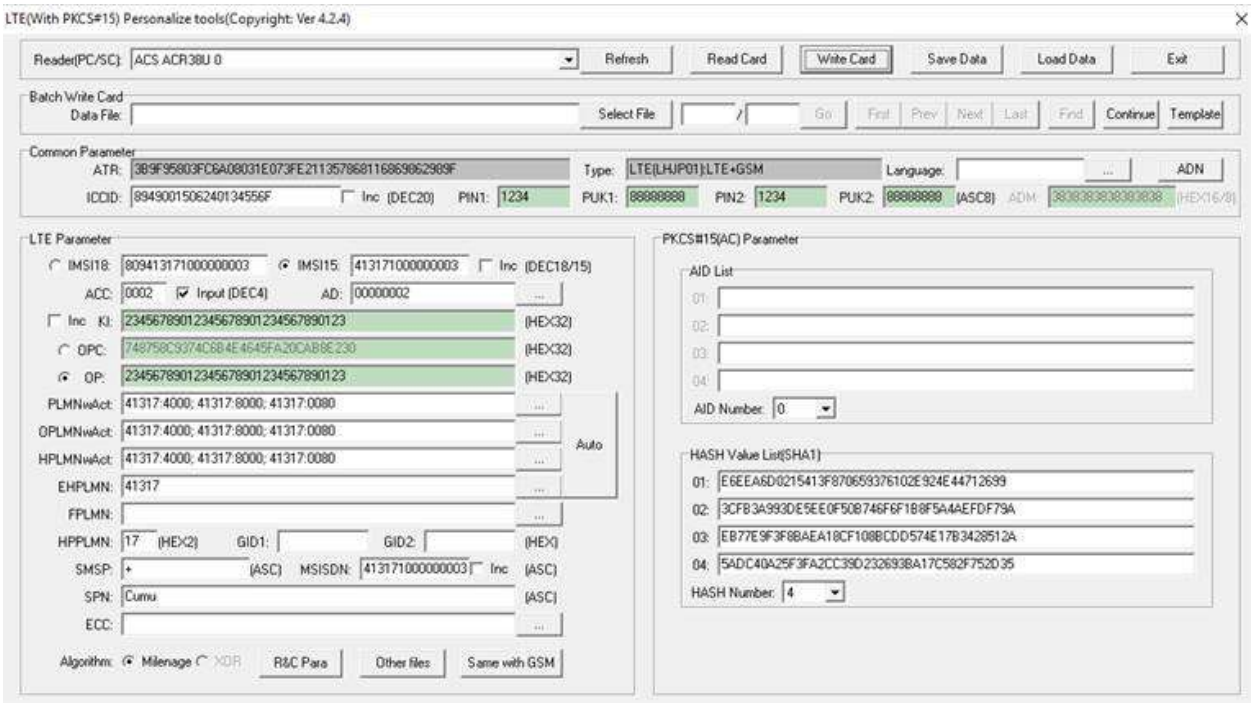

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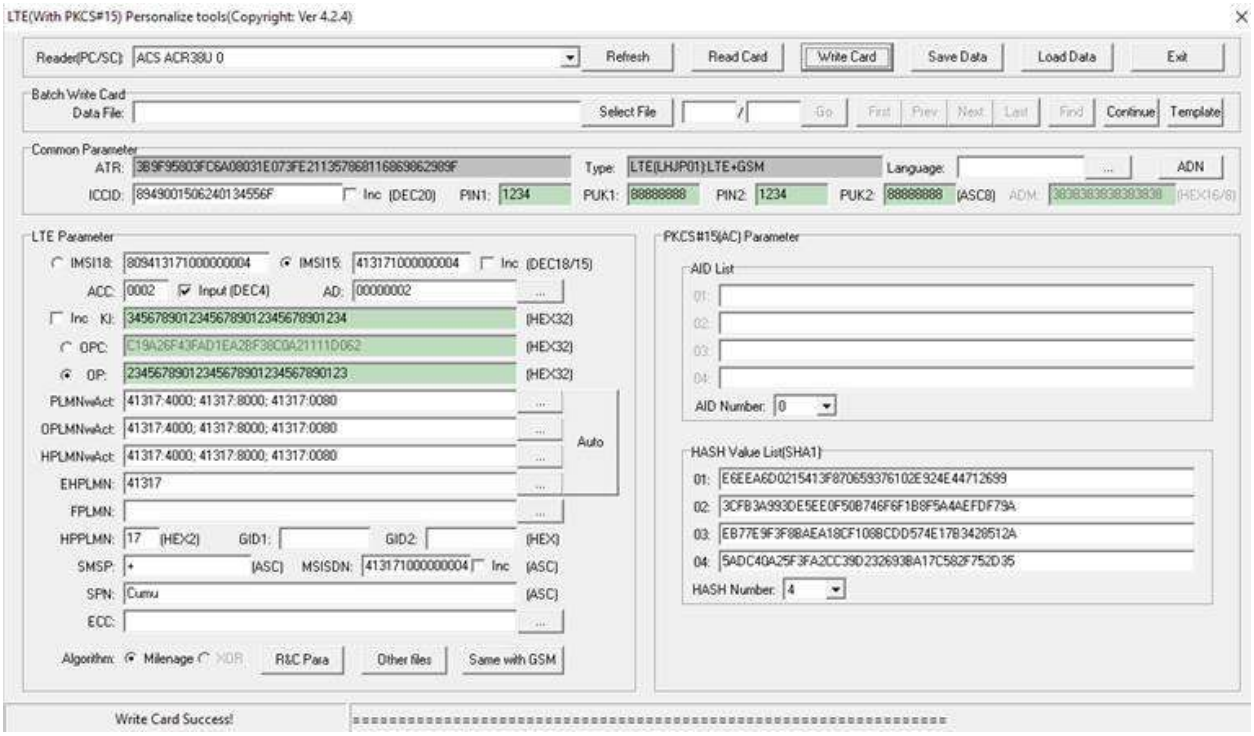
LTE(With PKCS#15) Personalize tools(Copyright: Ver 4.2.4)
Reader(PC/SC): ACS ACR38U 0
Refresh
Read Card
Write Card
Save Data
Load Data
Exit
Batch Write Card
Data File:
Select File
Go
First
Prev
Next
Last
Find
Continue
Template
Common Parameter
ATR: 3B9F95803FC6A08031E073FE211357868116869862989F
Type: LTE(LHJP01):LTE+GSM
Language:
ADN
ICCID: 89490015062401345 56F
Inc (DEC20)
PIN1: 1234
PUK1: 88888888
PIN2: 1234
PUK2: 88888888 (ASC8)
ADM:
LTE Parameter
IMSI18: 809413171000000004
IMSI15: 413171000000004
Inc (DEC18/15)
ACC: 0002
Input (DEC4)
AD: 00000002
Inc KI: 34567890123456789012345678901234 (HEX32)
OPC: C19A26F43FAD1EA28F38C0A21111D062 (HEX32)
OP: 23456789012345678901234567890123 (HEX32)
PLMNwAct: 41317:4000; 41317:8000; 41317:0080
OPLMNwAct: 41317:4000; 41317:8000; 41317:0080
HPLMNwAct: 41317:4000; 41317:8000; 41317:0080
Auto
EHPLMN: 41317
FPLMN:
HPPLMN: 17 (HEX2)
GID1:
GID2: (HEX)
SMSP: + (ASC)
MSISDN: 413171000000004
Inc (ASC)
SPN: Cumu (ASC)
ECC:
Algorithm: Milenage XOR
R&C Para
Other files
Same with GSM
PKCS#15(AC) Parameter
AID List
01:
02:
03:
04:
AID Number: 0
HASH Value List(SHA1)
01: E6EEA6D0215413F870659376102E924E44712699
02: 3CFB3A993DE5EE0F50B746F6F1B8F5A4AEFDF79A
03: EB77E9F3F88AEA18CF108BCDD574E17B3428512A
04: 5ADC40A25F3FA2CC39D232693BA17C582F752D35
HASH Number: 4
Write Card Success!