Open-source 5G RAN - srsRAN

Open 5G Forum - Fall 2021

17 November 2021

Software Radio Systems, Ltd
www.srs.io

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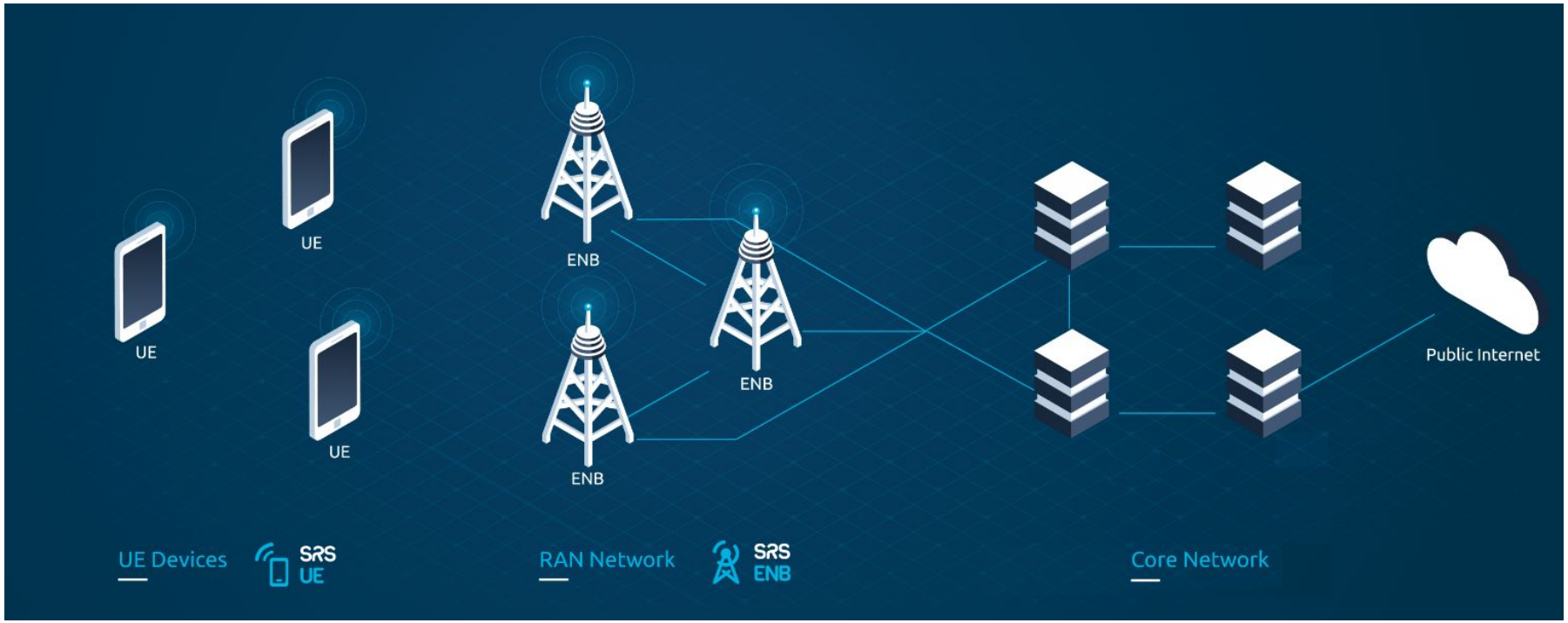
srsLTE



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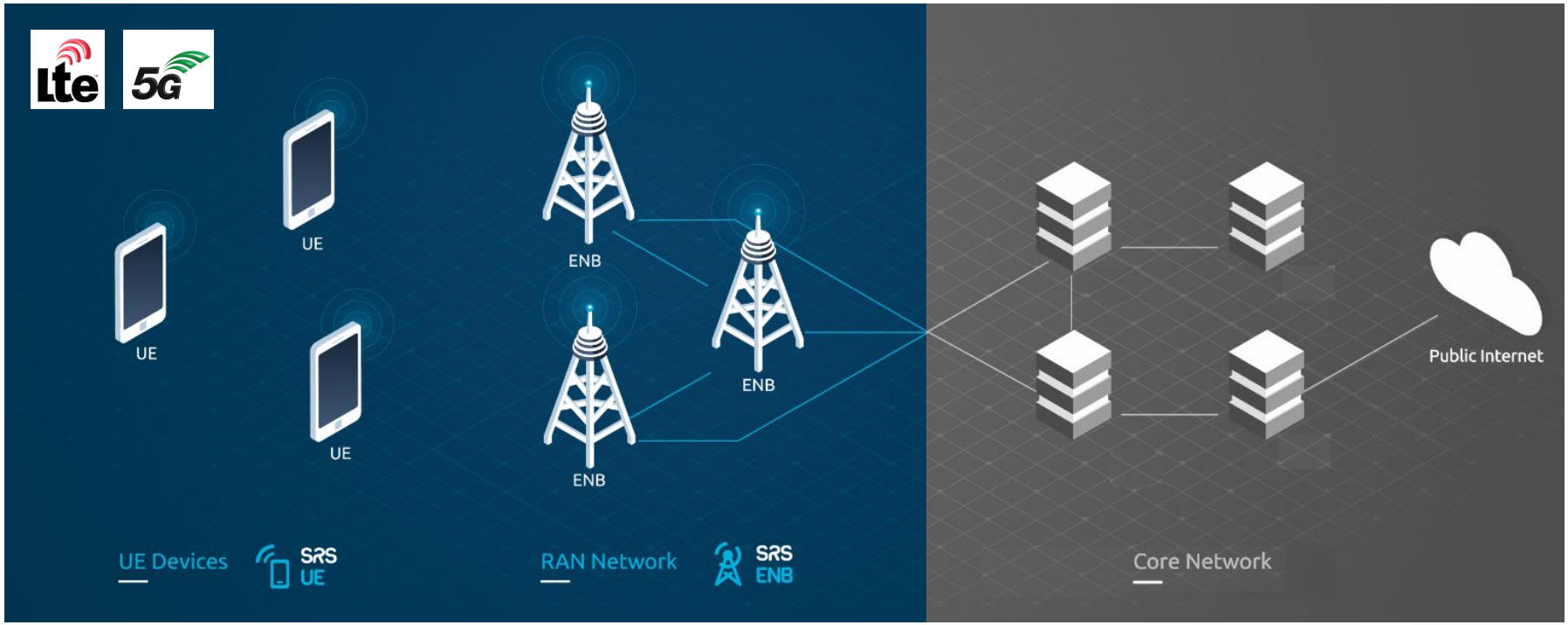
SRSRAN



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Objectives

Most trusted open-source software for mobile wireless networks

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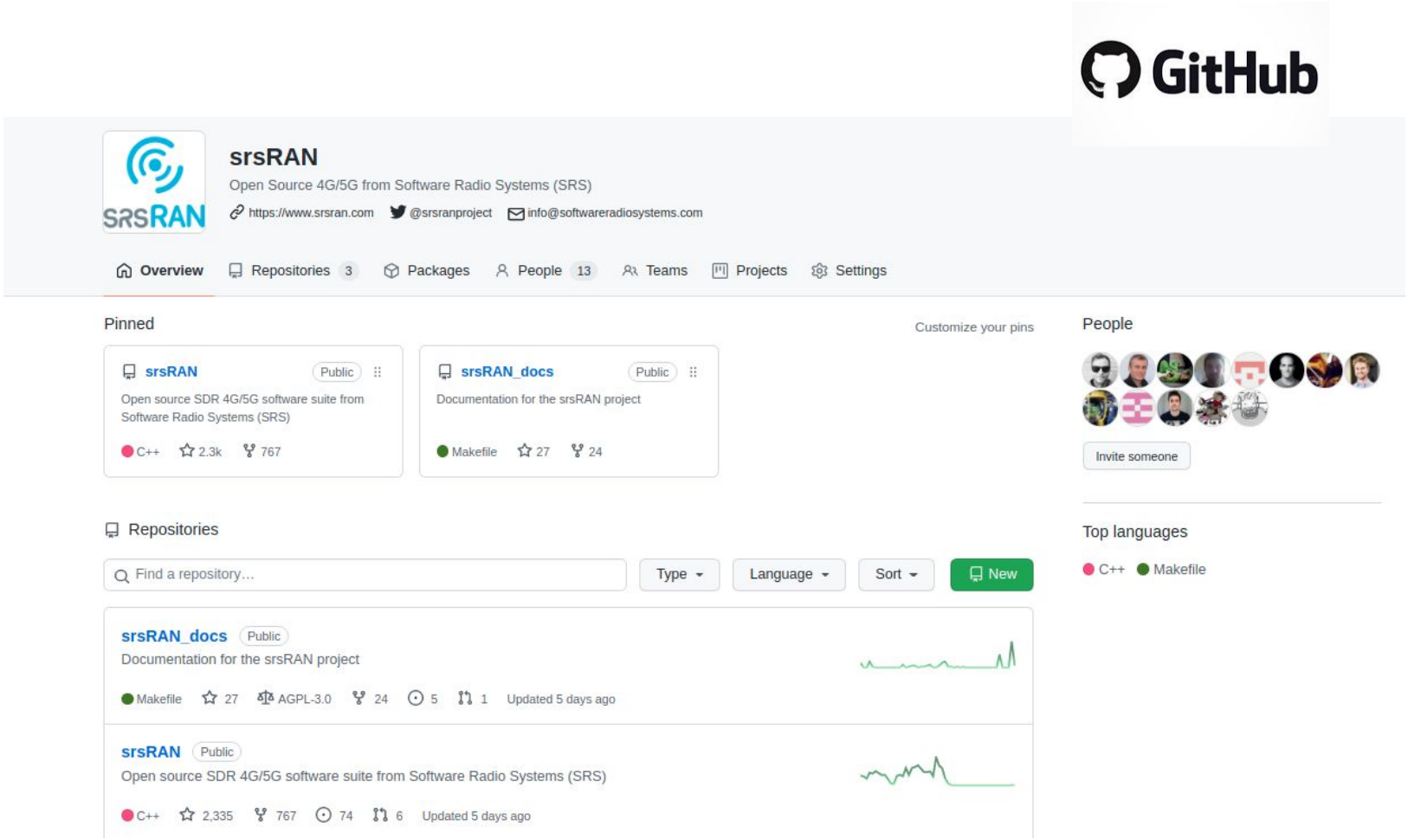
How to get it?



https://github.com/srsran

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How to use it?

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How to use it?

srsRAN

latest

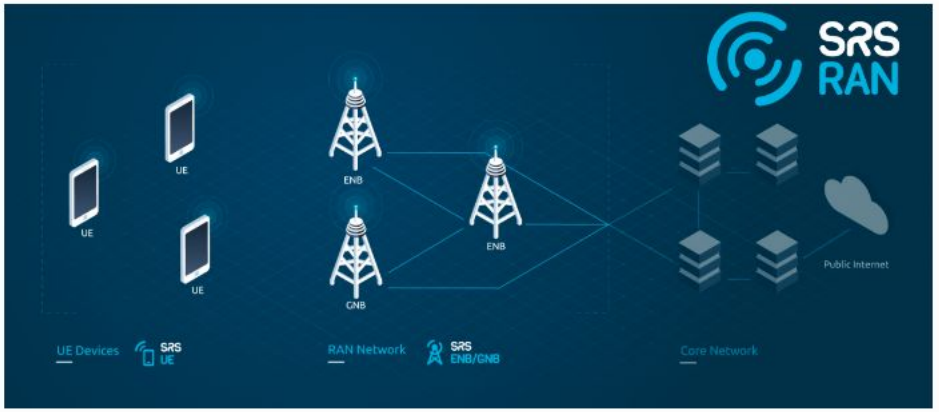
Search docs

- Getting Started
- General
- User Manuals
- srsRAN Application Notes

» srsRAN 21.04 Documentation

Edit on GitHub

srsRAN 21.04 Documentation



srsRAN is a free and open-source 4G and 5G software radio suite.

Featuring both UE and eNodeB/gNodeB applications, srsRAN can be used with third-party core network solutions to build complete end-to-end mobile wireless networks. For more information, see www.srsran.com.

The srsRAN suite currently includes:

- srsUE: a full-stack 4G and 5G NSA UE application **(5G SA coming 2022)**
- srsENB: a full-stack 4G eNodeB and 5G NSA gNodeB application
- srsGNB: a full-stack 5G SA gNodeB application **(coming 2022)**
- srsEPC: a light-weight 4G EPC implementation with MME, HSS and S/P-GW

All srsRAN software runs in linux with off-the-shelf compute and radio hardware.

https://docs.srsran.com/

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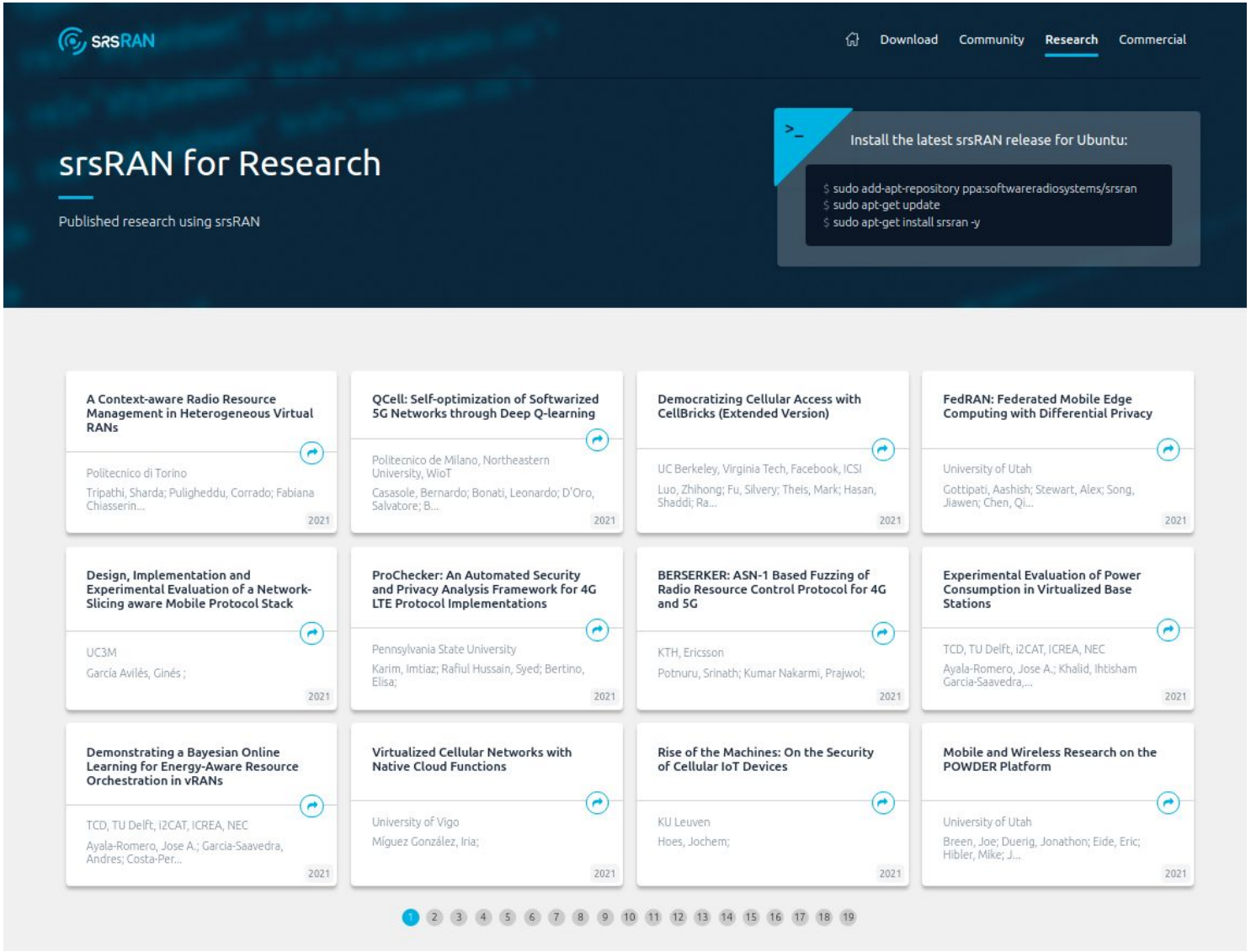
Is it any good?

Is it any good?

Is it any good?



https://www.srsran.com/research

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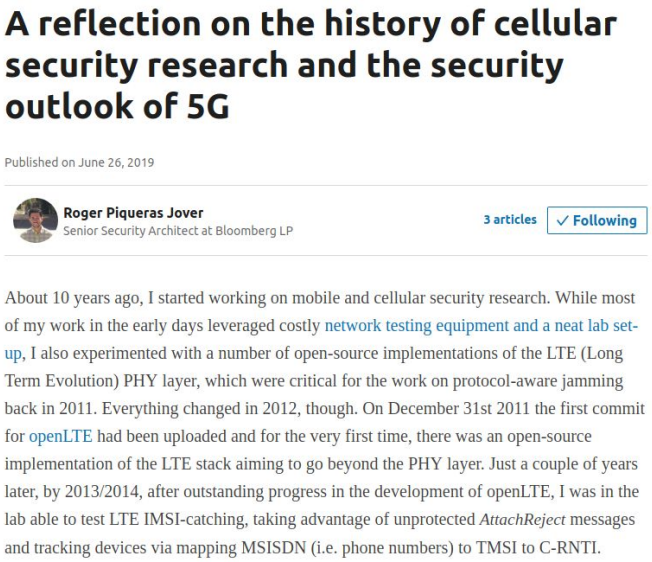
Is it any good?



A reflection on the history of cellular security research and the security outlook of 5G

Published on June 26, 2019

Roger Piqueras Jover
Senior Security Architect at Bloomberg LP
3 articles ✓ Following

About 10 years ago, I started working on mobile and cellular security research. While most of my work in the early days leveraged costly network testing equipment and a neat lab set-up, I also experimented with a number of open-source implementations of the LTE (Long Term Evolution) PHY layer, which were critical for the work on protocol-aware jamming back in 2011. Everything changed in 2012, though. On December 31st 2011 the first commit for openLTE had been uploaded and for the very first time, there was an open-source implementation of the LTE stack aiming to go beyond the PHY layer. Just a couple of years later, by 2013/2014, after outstanding progress in the development of openLTE, I was in the lab able to test LTE IMSI-catching, taking advantage of unprotected *AttachReject* messages and tracking devices via mapping MSISDN (i.e. phone numbers) to TMSI to C-RNTI.

"Currently srsLTE is by far the best and most widely used – both in academia and industry – tool for LTE security research"

Is it any good?

Security

› Home › GSMA Coordinated Vulnerability Disclosure (CVD) Programme

GSMA Coordinated Vulnerability Disclosure (CVD) Programme

GSMA Mobile Security Hall of Fame

CVD-2017	0007	Altaf Shaik	Technical University of Berlin and Kaitiaki Labs https://www.isti.tu-berlin.de/security_in_telecommunications
CVD-2017	0007	Ravishankar Borgaonkar	SINTEF Digital and Kaitiaki Labs https://www.sintef.no/en/cyber-security/#/
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CVD-2018	00011	Loic Ferreira	Orange Labs / IRISA http://crypto.rd.francetelecom.com/people/Ferreira
CVD-2018	00011	Gildas Avoine	INSA Rennes / IRISA http://avoine.net
CVD-2018	0012	David Basin Jannik Dreier Lucca Hirschi Saša Radomirovic Ralf Sasse Vincent Stettler	ETH Zurich, Université de Lorraine CNRS, Inria, University of Dundee https://arxiv.org/abs/1806.10360
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CVD-2019	0026	Cathal Mc Daid	AdaptiveMobile Security https://www.adaptivemobile.com
CVD-2019	0029	Syed Rafiul Hussain Mitziu Echeverria Imtiaz Karim Omar Chowdhury Elisa Bertino	Purdue University University of Iowa Purdue University University of Iowa Purdue University
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Is it any good?

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Who maintains it?

- Private company founded in 2012
- Office locations in Ireland and Spain
- Global customer base
- 22 Full-Time Employees
- 100% SDR Engineering
- 100% Organic growth

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How is it funded?

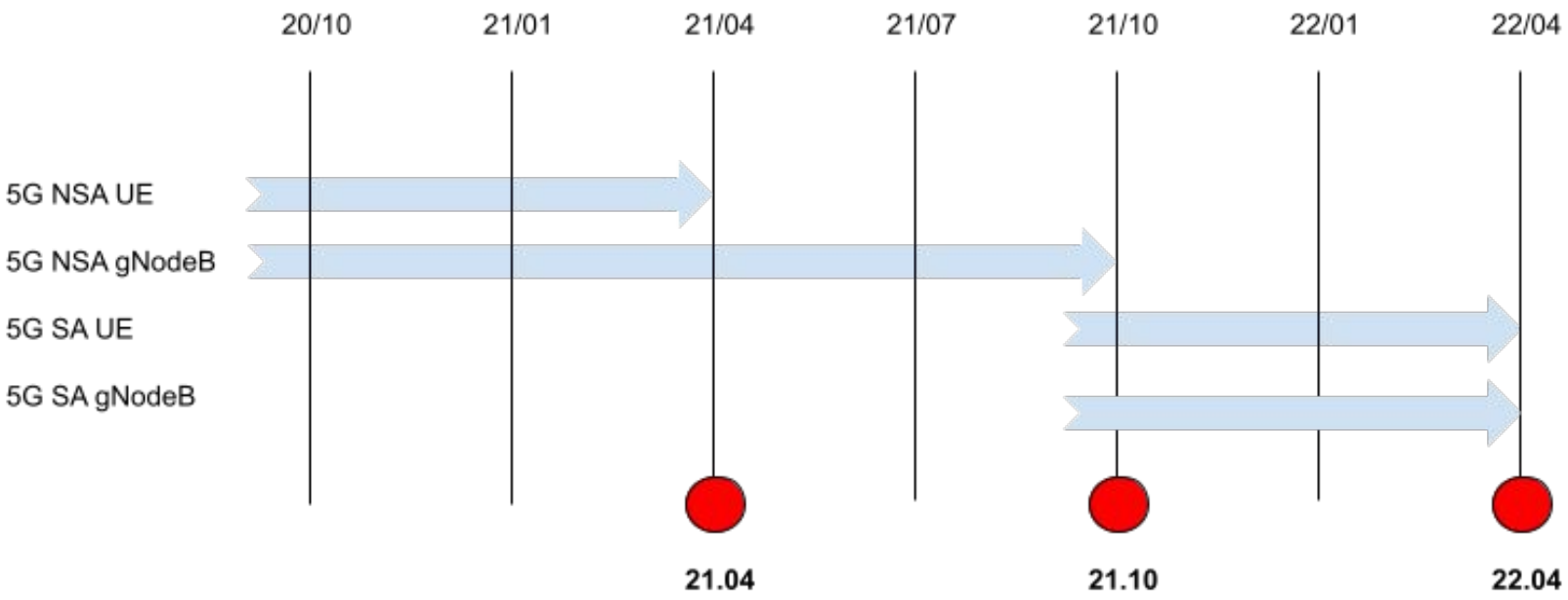
- Open-source under AGPL

OR

- Commercial source-code license

How is it funded?

Roadmap?


20/10
21/01
21/04
21/07
21/10
22/01
22/04
5G NSA UE
5G NSA gNodeB
5G SA UE
5G SA gNodeB
21.04
21.10
22.04

21.04 - 5G NSA UE

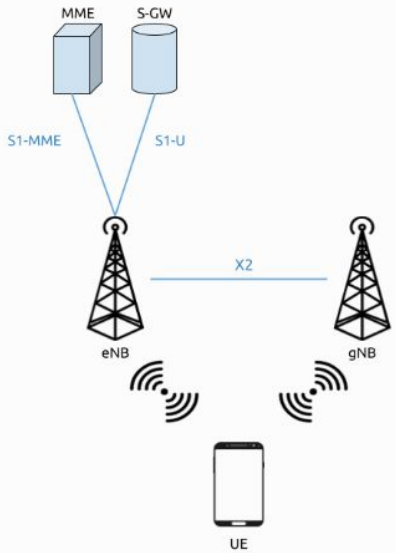
21.04 - 5G NSA UE

5G NSA srsUE

Introduction

The 21.04 release of srsRAN brought 5G NSA (Non-Standalone) support to srsUE. This application note shows how the UE can be used with a third-party 5G NSA network. In this example, we use the Amari Callbox Classic from Amarisoft to provide the network.

5G NSA: What you need to know



5G NSA Mode 3

https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_amari/source/index.html

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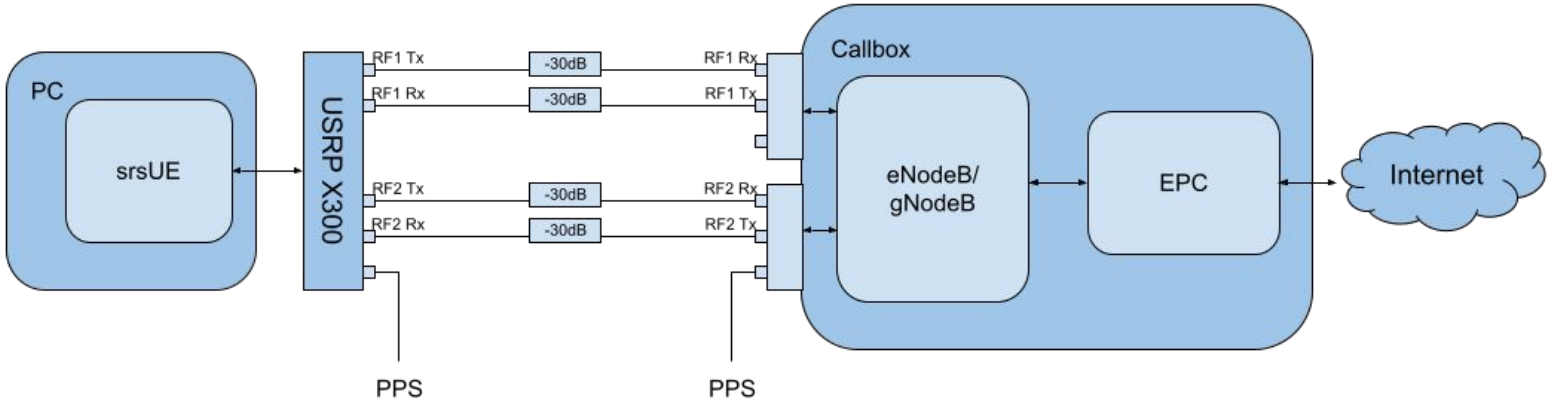
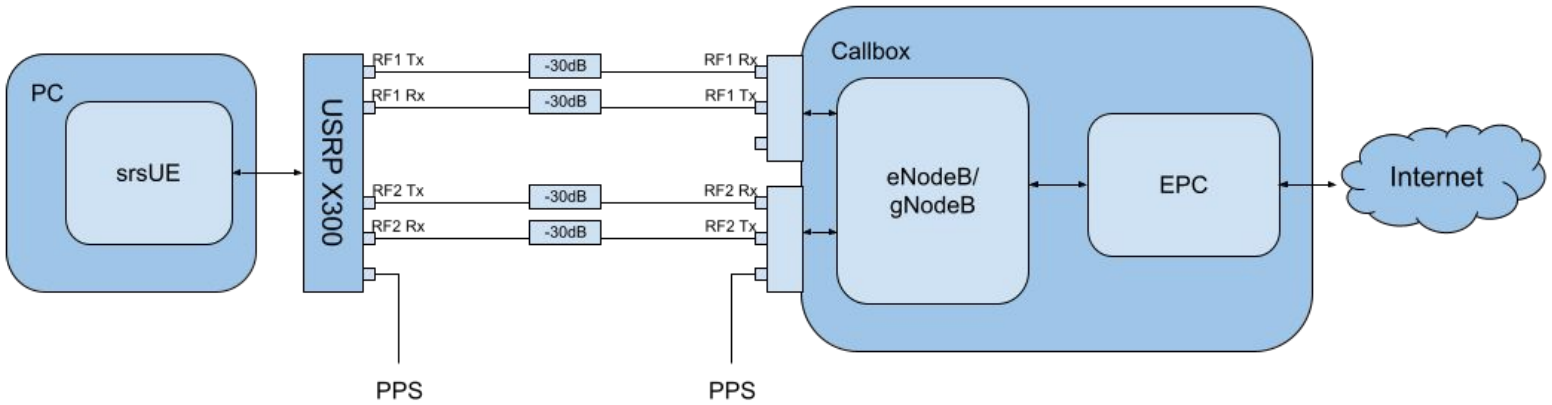
21.04 - 5G NSA UE



https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_amari/source/index.html

21.04 - 5G NSA UE




```
Found Cell:  Mode=FDD, PCI=1, PRB=50, Ports=1, CFO=0.1 KHz
Found PLMN:  Id=00101, TAC=7
Random Access Transmission: seq=17, tti=8494, ra-rnti=0x5
RRC Connected
Random Access Complete.     c-rnti=0x3d, ta=3
Network attach successful. IP: 192.168.4.2
Amarisoft Network (Amarisoft) 20/4/2021 23:32:40 TZ:105
RRC NR reconfiguration successful.
Random Access Transmission: prach_occasion=0, preamble_index=0, ra-rnti=0x7f, tti=8979
Random Access Complete.     c-rnti=0x4601, ta=23
---------Signal----------|-----------------DL-----------------|-----------UL-----------
rat  pci  rsrp  pl   cfo | mcs  snr  iter  brate  bler  ta_us | mcs   buff  brate  bler
lte    1   -52  13    12 |  19   40   0.5    15k    0%    7.3 |  16    0.0    10k    4%
 nr  500     4   0  881m |   2   31   1.0    0.0    0%    0.0 |  17    0.0   6.0k    0%
lte    1   -49   7  -4.8 |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     3   0  -5.9 |  27   35   1.0   1.3k    0%    0.0 |  28    0.0   148k    0%
lte    1   -58  16  -3.7 |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     3   0  -7.7 |  27   35   1.0   1.3k    0%    0.0 |  28    0.0   148k    0%
lte    1   -61  19  428m |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     4   0   2.2 |  27   30   1.4    67k    0%    0.0 |  28     28   143k    0%
lte    1   -61  19 -507m |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     4   0  924m |  27   24   1.9    18M    0%    0.0 |  28    0.0   3.7k    0%
lte    1   -61  19   3.8 |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     4   0   3.5 |  27   24   1.9    18M    0%    0.0 |   0    0.0    0.0    0%
lte    1   -61  19   3.8 |  28   40   0.5   1.4k    0%    7.3 |   0    0.0    0.0    0%
 nr  500     4   0   3.1 |  27   24   1.9    18M    0%    0.0 |   0    0.0    0.0    0%
```

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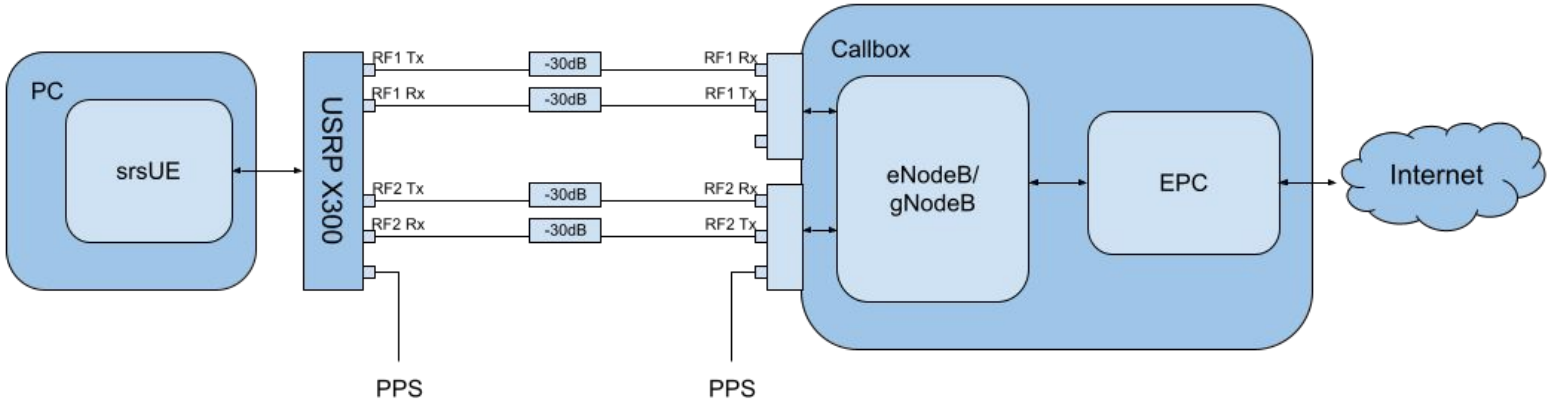
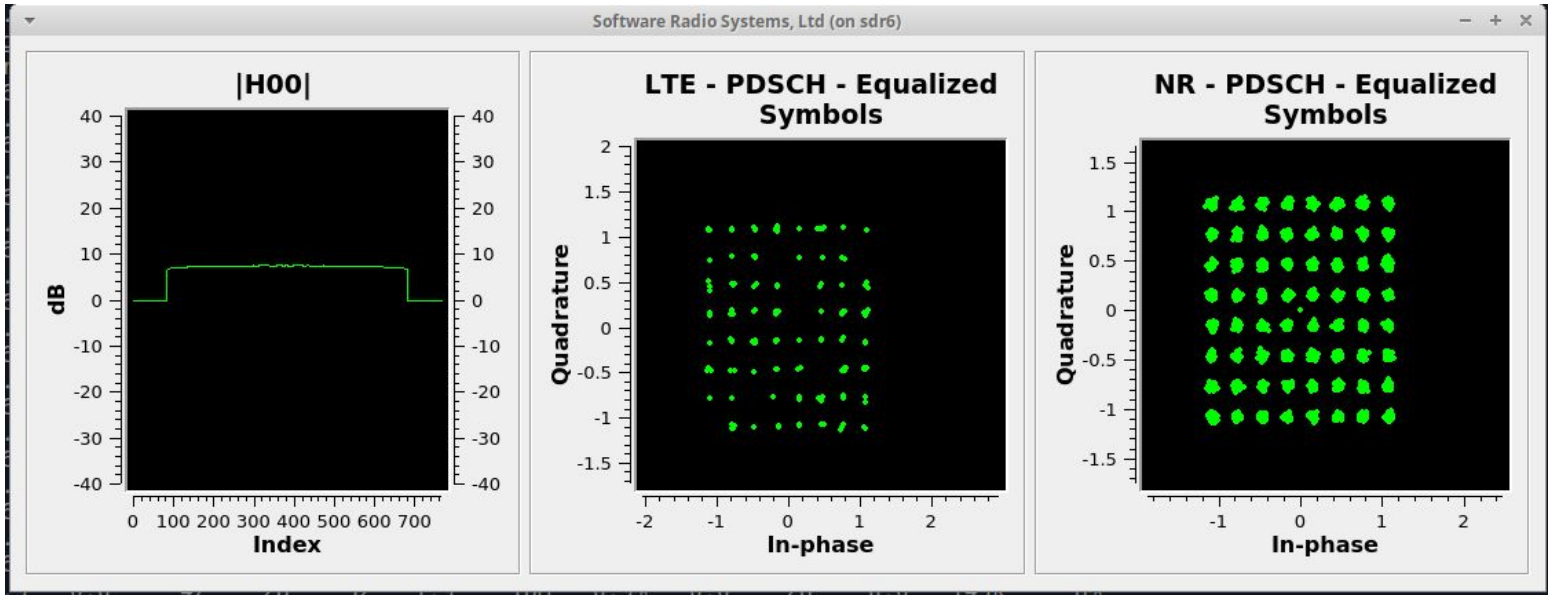
21.04 - 5G NSA UE





https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_amari/source/index.html

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21.10 - 5G NSA eNodeB

21.10 - 5G NSA eNodeB

5G NSA COTS UE

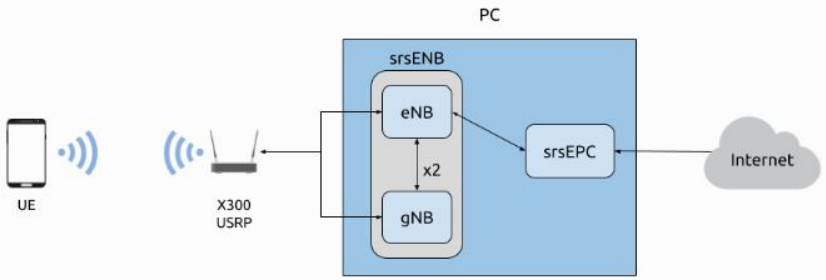
Tip

Operating a private 5G NSA network on cellular frequency bands may be tightly regulated in your jurisdiction. Seek the approval of your telecommunications regulator before doing so.

Introduction

This application note shows how to create your own 5G NSA network using srsENB, srsEPC and a 5G capable COTS UE. There are two options for network setup when connecting a COTS UE: The network can be left as is, and the UE can communicate locally within the network, or the EPC can be connected to the internet through the P-GW, allowing the UE to access the internet for web-browsing, email etc.

Network & Hardware Overview



Simplified network architecture

Setting up a 5G NSA network and connecting a 5G COTS UE requires the following:

- PC with a Linux based OS, with srsRAN installed and built
- A dual channel RF-frontend with independent RF chains
- A 5G NSA-capable UE
- USIM/ SIM card (This must be a test card or a programmable card, with known keys)

https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_cots/source/index.html

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21.10 - 5G NSA eNodeB

srsENB

If a successful connection is made, a `RACH` message should be seen followed by a `USER <ID> connected` message where "<ID>" is the RNTI assigned to the UE:

```
==== eNodeB started ===
Type <t> to view trace
Setting frequency: DL=806.0 Mhz, UL=847.0 MHz for cc_idx=0 nof_prb=50
Setting frequency: DL=1842.5 Mhz, UL=1747.5 MHz for cc_idx=1 nof_prb=52
User 0x46 connected
RACH:  slot=7691, cc=0, preamble=41, offset=1, temp_crnti=0x4602

          ----------------DL----------------|------------------------UL----------------------
lte   46   12   0    5   2.5k    4    0   0% |  25.7    9.4   23   23    17k    4    0   0%
 nr 4601  n/a   0    0      0    0    0   0% |   n/a    n/a    0    0    38k    4    0   0%
lte   46   13   0    0      0    0    0   0% |   n/a    6.2    0    0      0    0    0   0%
 nr 4601  n/a   0    0      0    0    0   0% |   n/a    n/a    0    0      0    0    0   0%
lte   46   13   0    0      0    0    0   0% |   n/a    6.2    0    0      0    0    0   0%
```

https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_cots/source/index.html

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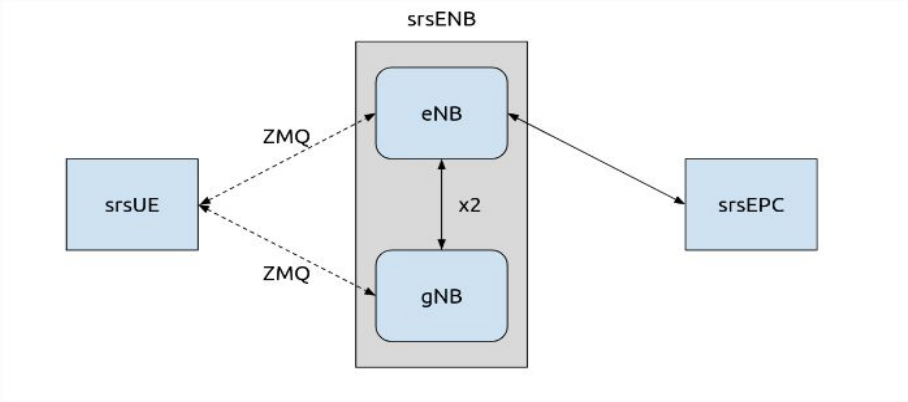
21.10 - End-to-end with virtual radio

21.10 - End-to-end with virtual radio

Network & Hardware Overview

For this application note we will be using ZeroMQ in place of physical RF hardware. A detailed outline of how to install and use ZMQ with srsRAN can be found here. This app note will assume prior knowledge of use of ZMQ with srsRAN.



Simplified overview of the network architecture

This set up requires the following:

- srsUE running in a seperate network namespace
- srsENB configured so that both an LTE eNB, and an NSA gNB cell are created at run time
- srsEPC with the UE included in the list of subscribers

https://docs.srsran.com/en/latest/app_notes/source/5g_nsa_zmq/source/index.html

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21.10 - CoreScope

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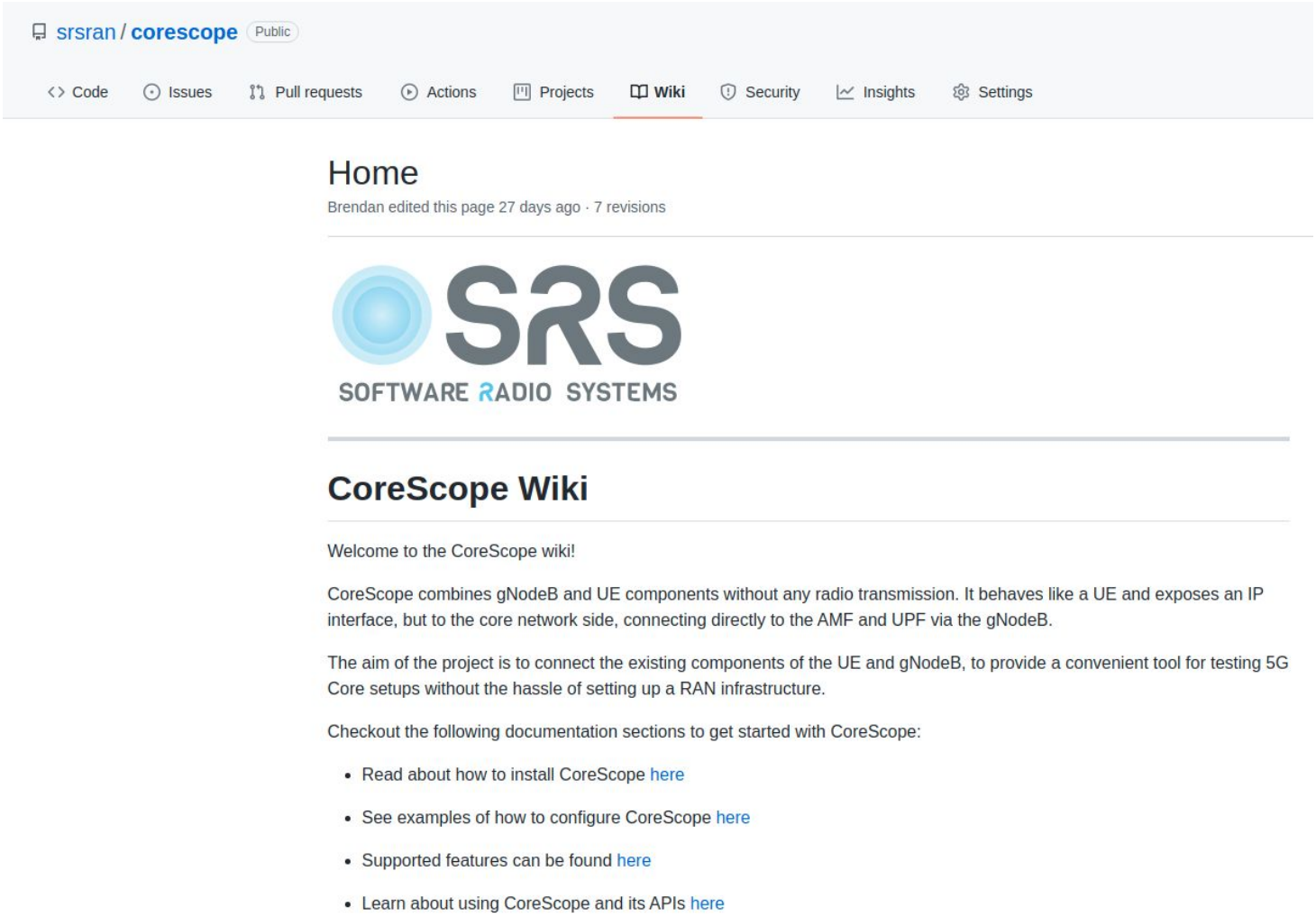
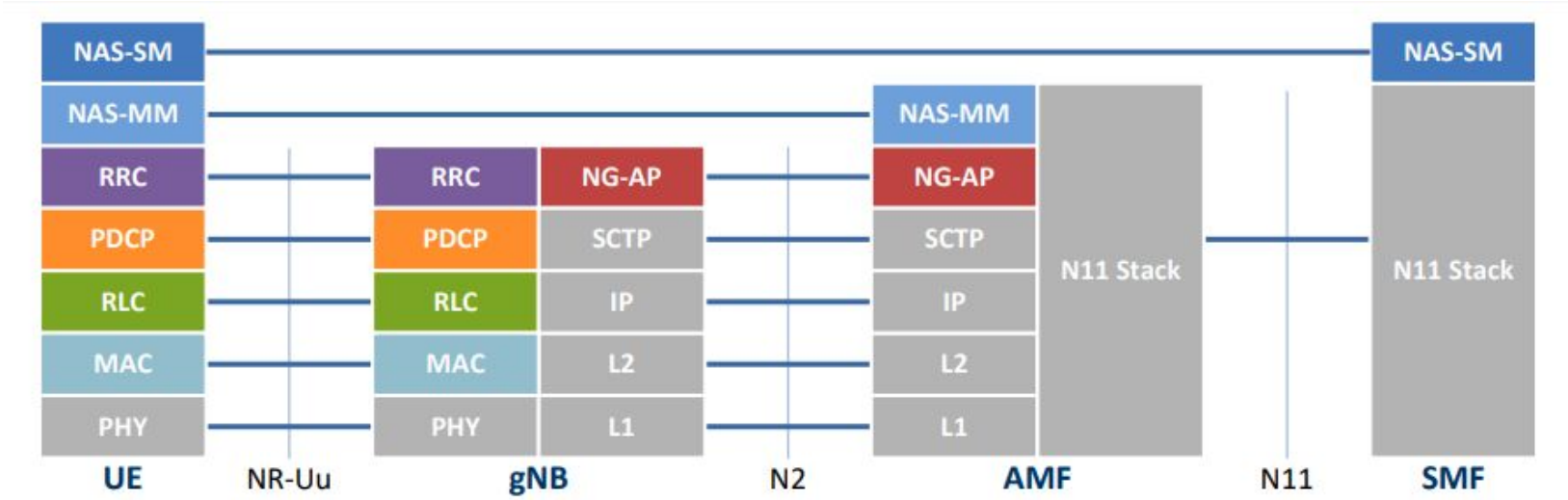


https://github.com/srsran/corescope/wiki

21.10 - CoreScope

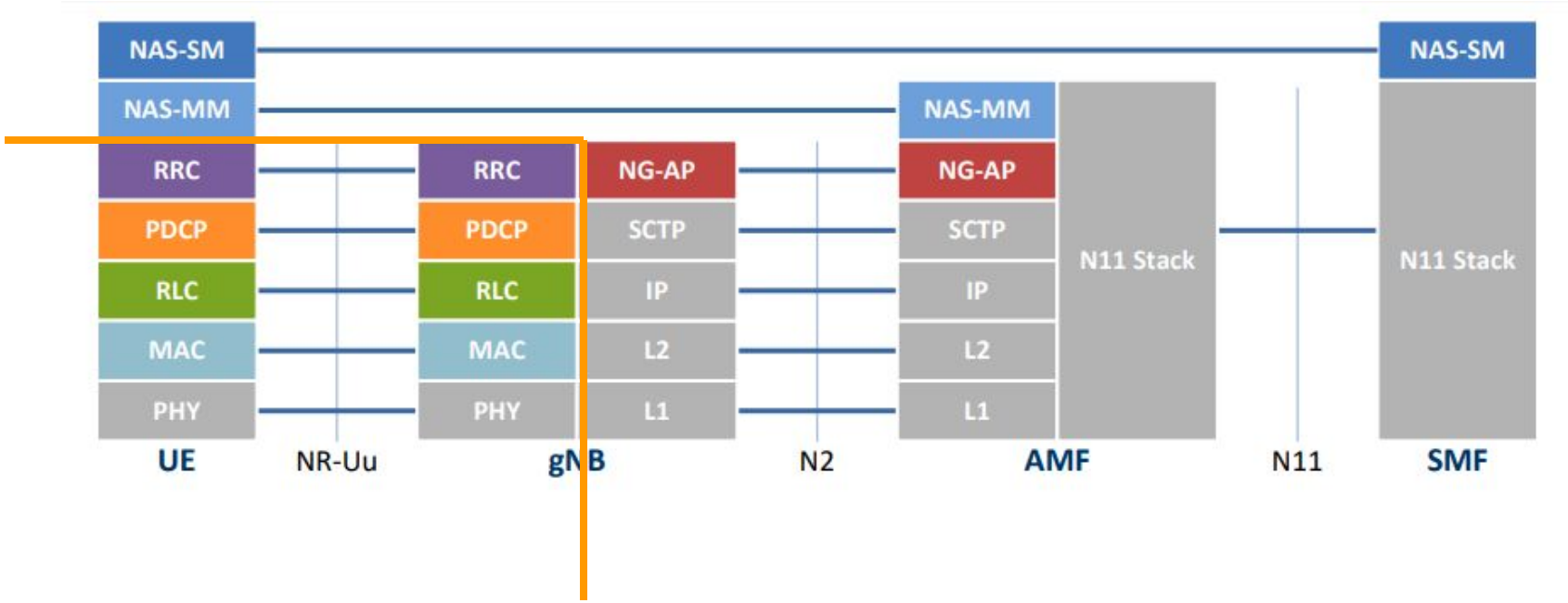
Control Plane



https://www.netmanias.com/en/post/oneshot/14103/5g/5g-protocol-stack-user-plane-control-plane

21.10 - CoreScope

Control Plane



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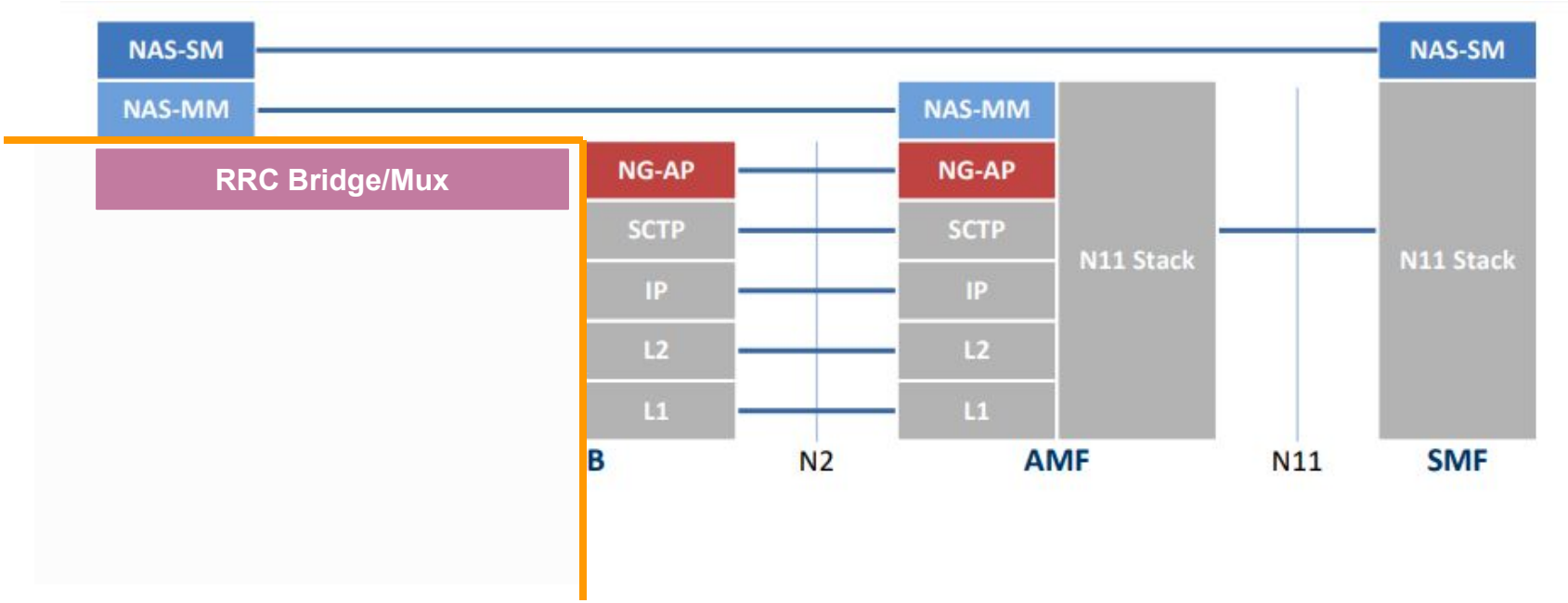
21.10 - CoreScope

Control Plane



https://www.netmanias.com/en/post/oneshot/14103/5g/5g-protocol-stack-user-plane-control-plane

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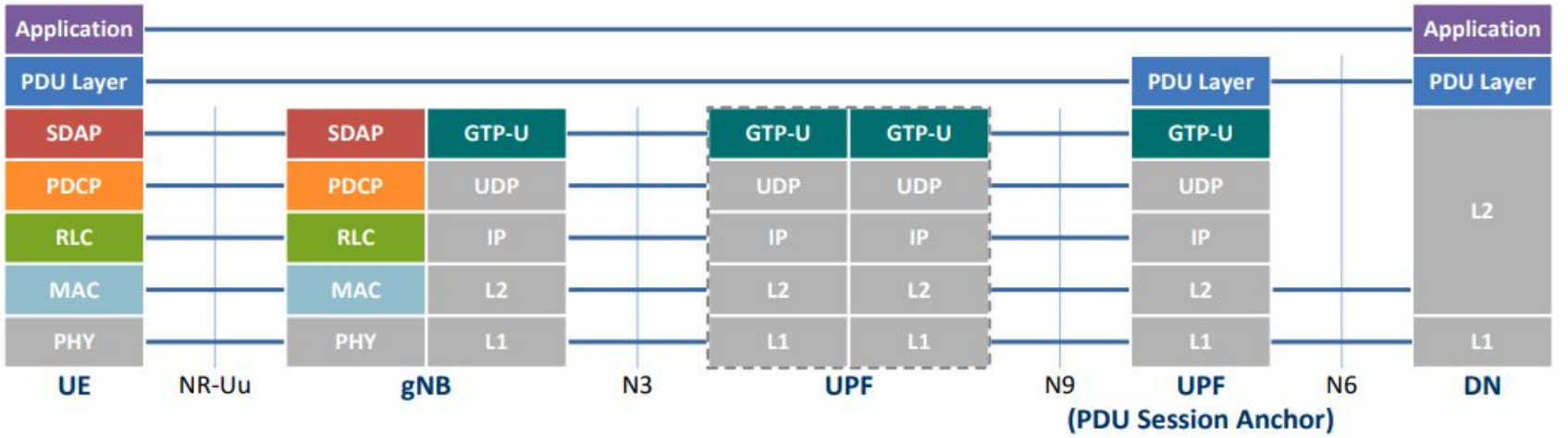
21.10 - CoreScope

User Plane



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21.10 - CoreScope

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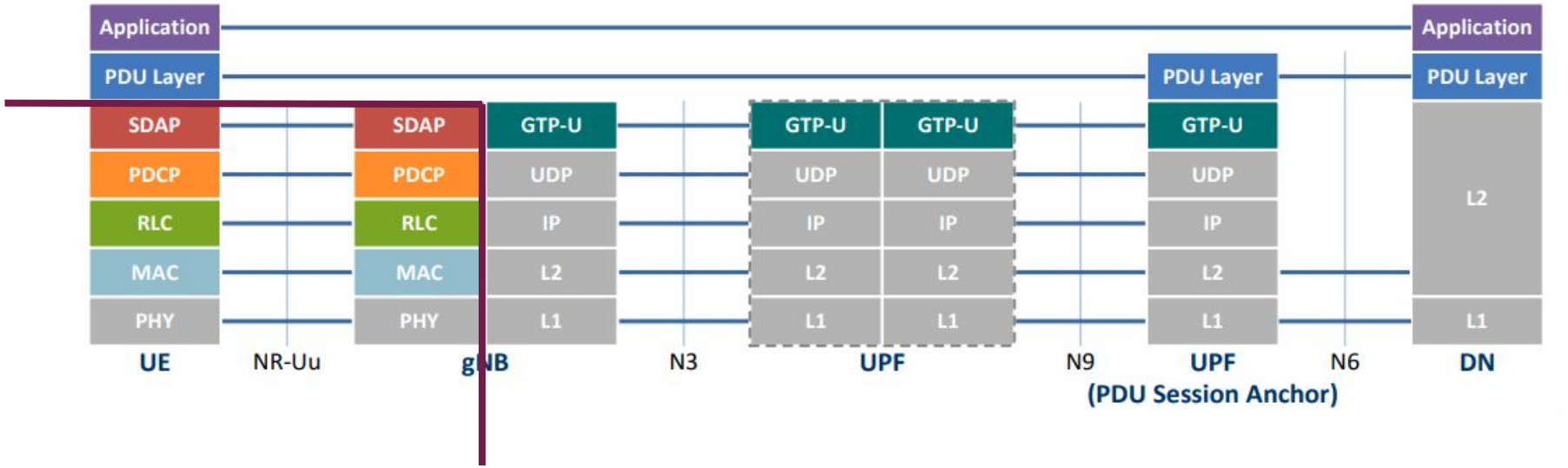

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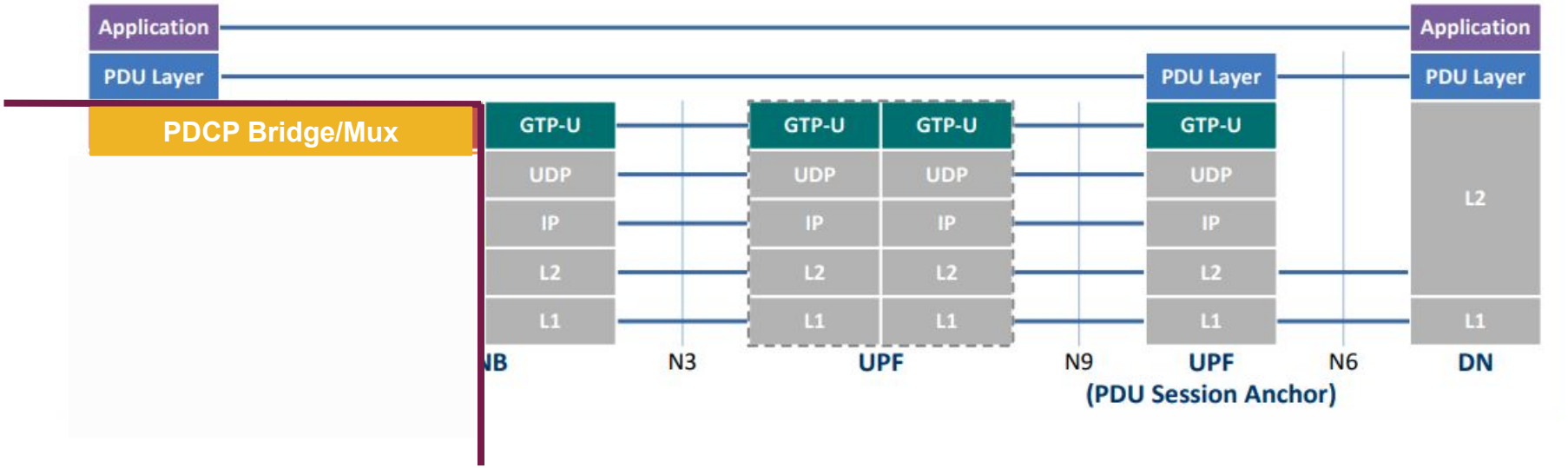
User Plane



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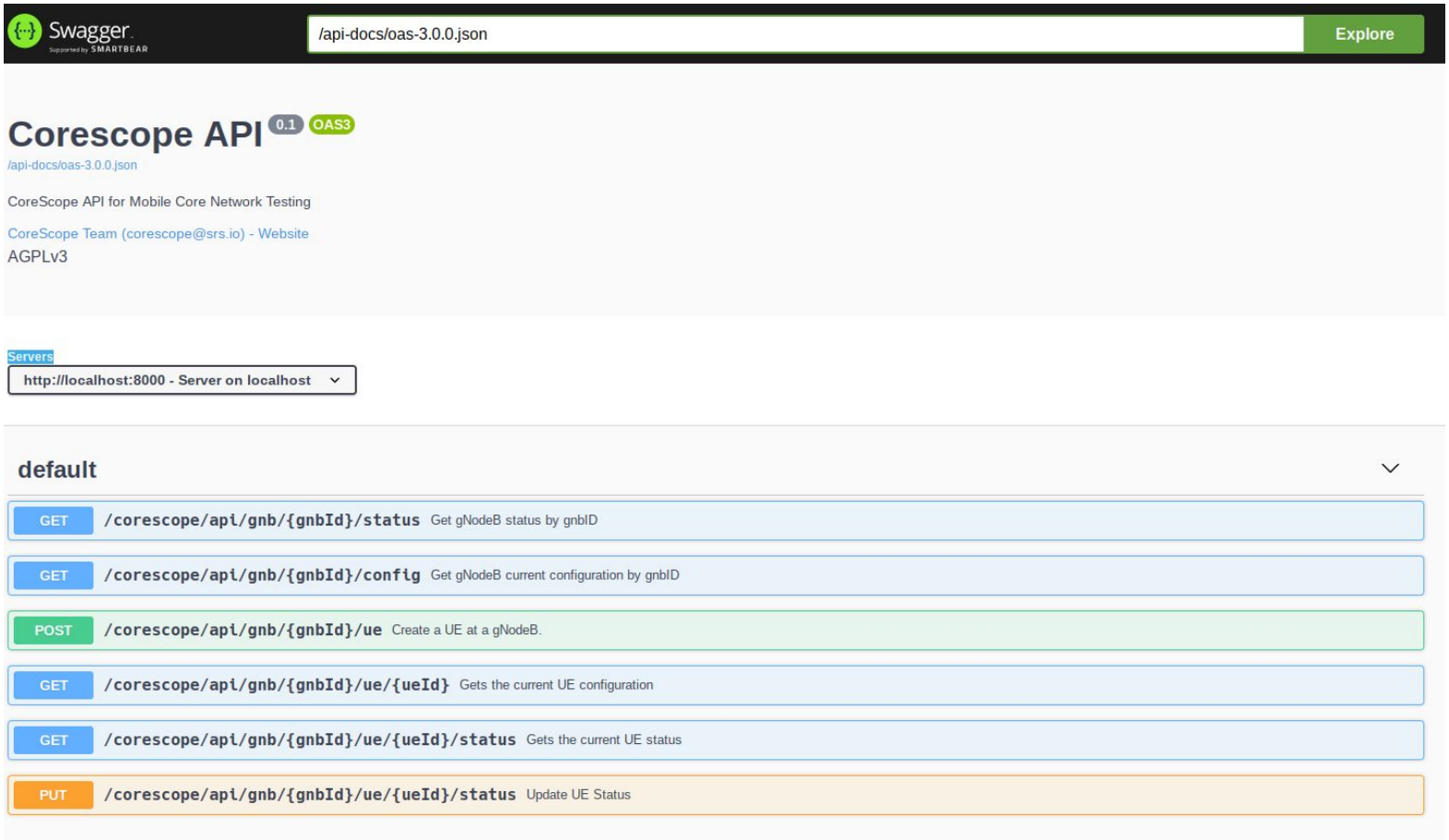
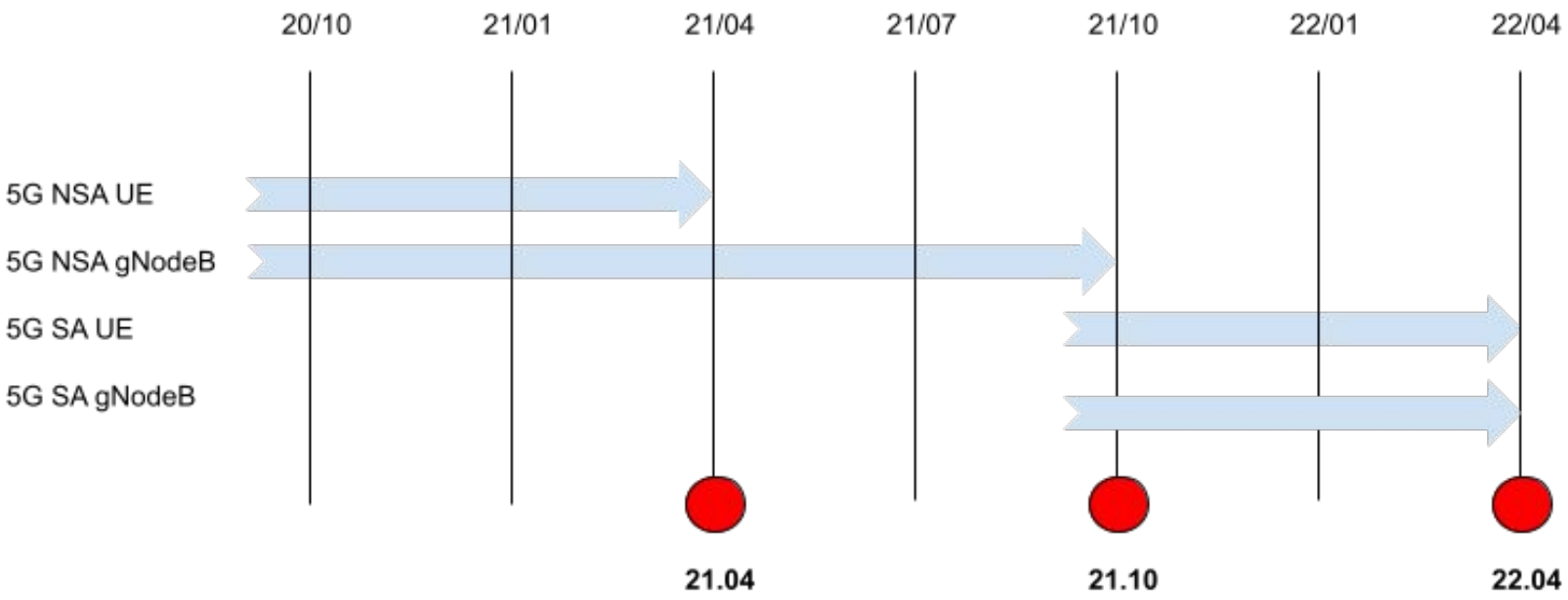


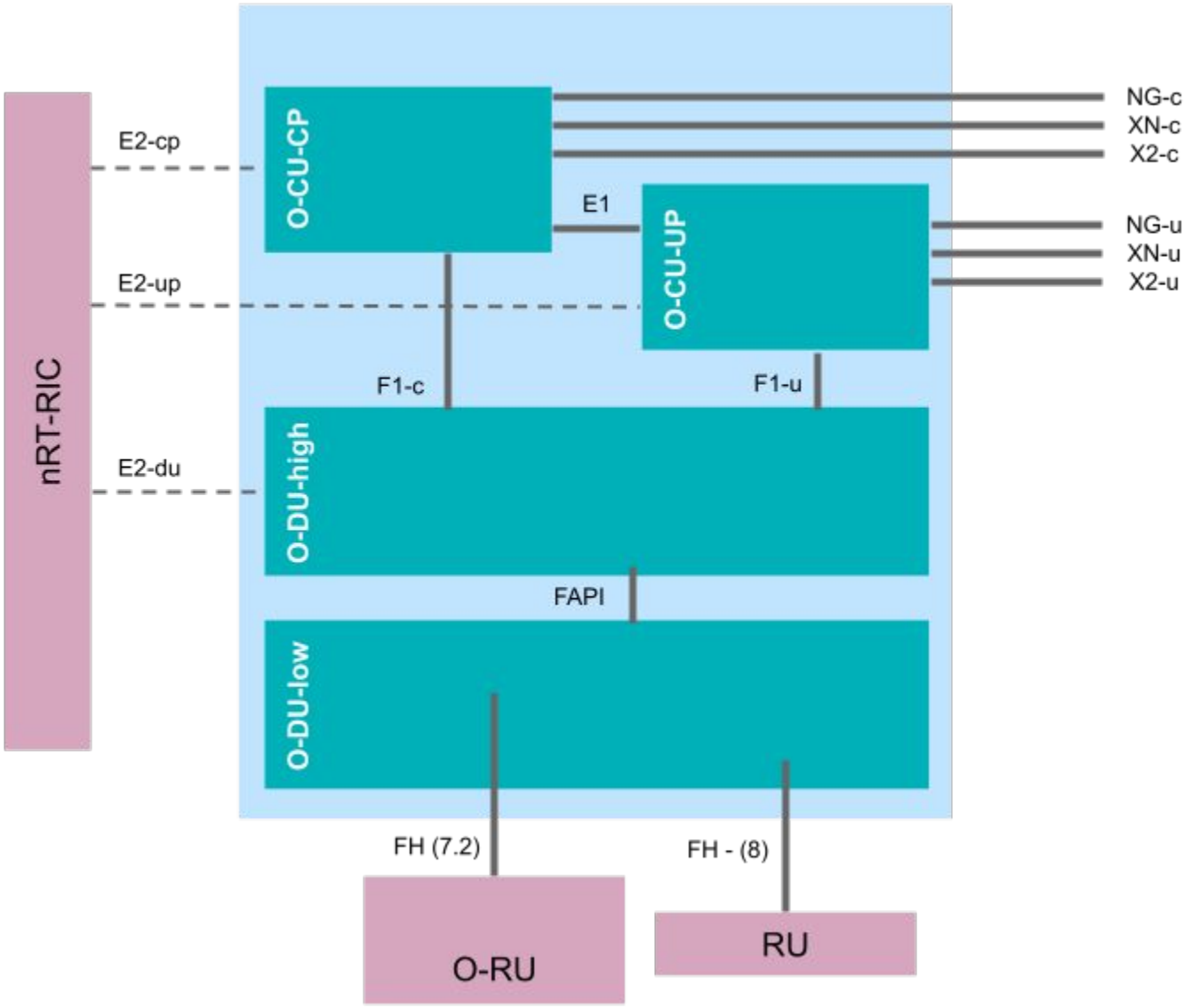
https://github.com/srsran/corescope/wiki/Configuration

The Road Ahead

The Road Ahead



The Road Ahead



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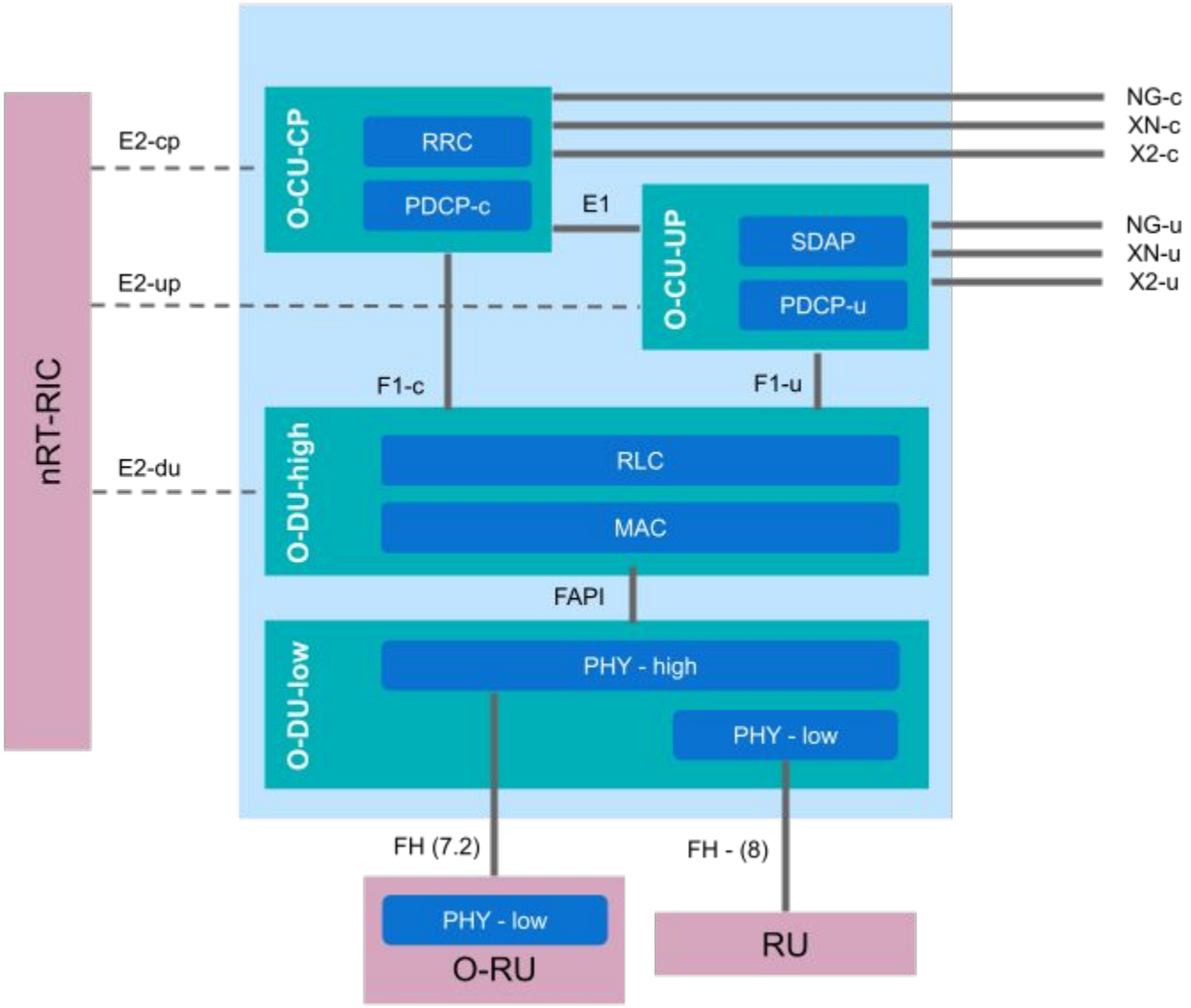
The Road Ahead



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Thank you

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