Winter Newsletter

OPENAIRINTERFACE SOFTWARE ALLIANCE

January 2022

OSA News

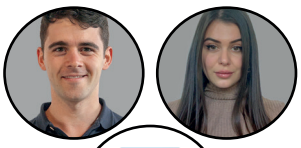
On the 8th and 9th of December, 2021 we held the 11th version of the OAI workshop: « Fall 2021 OpenAirInterface Workshop: Hands-On with the OAI Architects ». This American and European edition was the first where we at OAI, besides giving the status and roadmap update, showcased our technology through demos and hands-on classroom sessions. A separate chapter, this time, organized face-to-face, was organized at the BUPT campus in Beijing on December 12th-14th, 2021 for the OAI community based in the Asian time zones.

Workshop

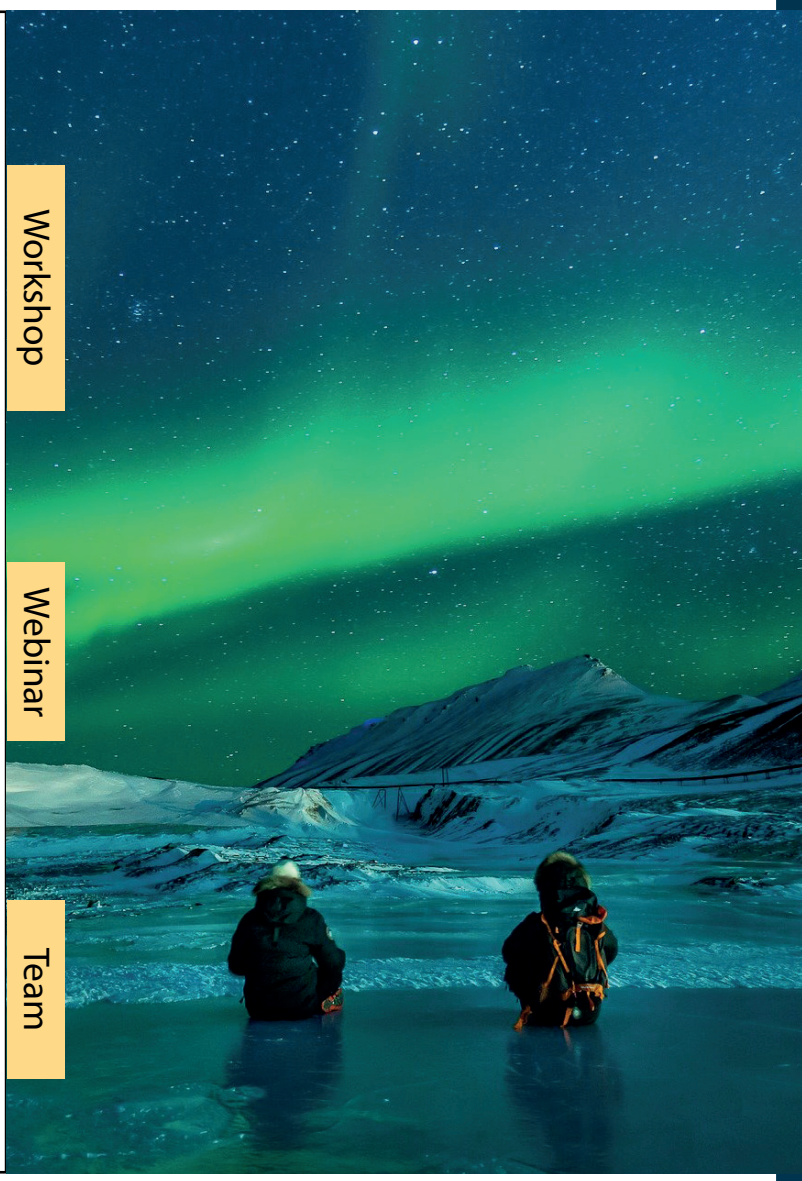
On the 18th of January, 2022 the Alliance launched its webinar series, the first edition of which, «Chapter One: Configuration Files and Linux Threading in the OAI RAN Code » was conducted by the Senior OAI Engineer Laurent Thomas. In this webinar, we taught our community how different configuration options are taken into account in the RAN config files, how to add an option in the source code, how the OAI process synchronizes its multiple threads implementation, and how the thread-pool and the global multi-threads organization works for lower layers.

Webinar

The OAI team welcomed two new members in its team: Software Engineer Robert Schmidt & Communication Assistant Camille Lerda. The OSA board also grew with the arrival of a new strategic member: SEQUANS SAS.



Team



Dear OAI Community,

We would like to thank you for your support and contributions in 2021. We look forward to engaging with you in 2022 and we wish all of you a Happy New Year.

Upcoming important dates

- Challenges winning teams announcement: January 2022
- Next workshop: July 2022
- Next webinar: February 2022

Radio Access Network

OAI 5G Project Group

Throughout the 2021 year, the Radio Access Network team has done a remarkable job to follow the roadmap's quarter objectives and achieve them. You can have a look at the latest RAN roadmap here. The goal of the OAI RAN Project Group is to develop and deliver a 5G software stack under the OAI Public License V1.1.

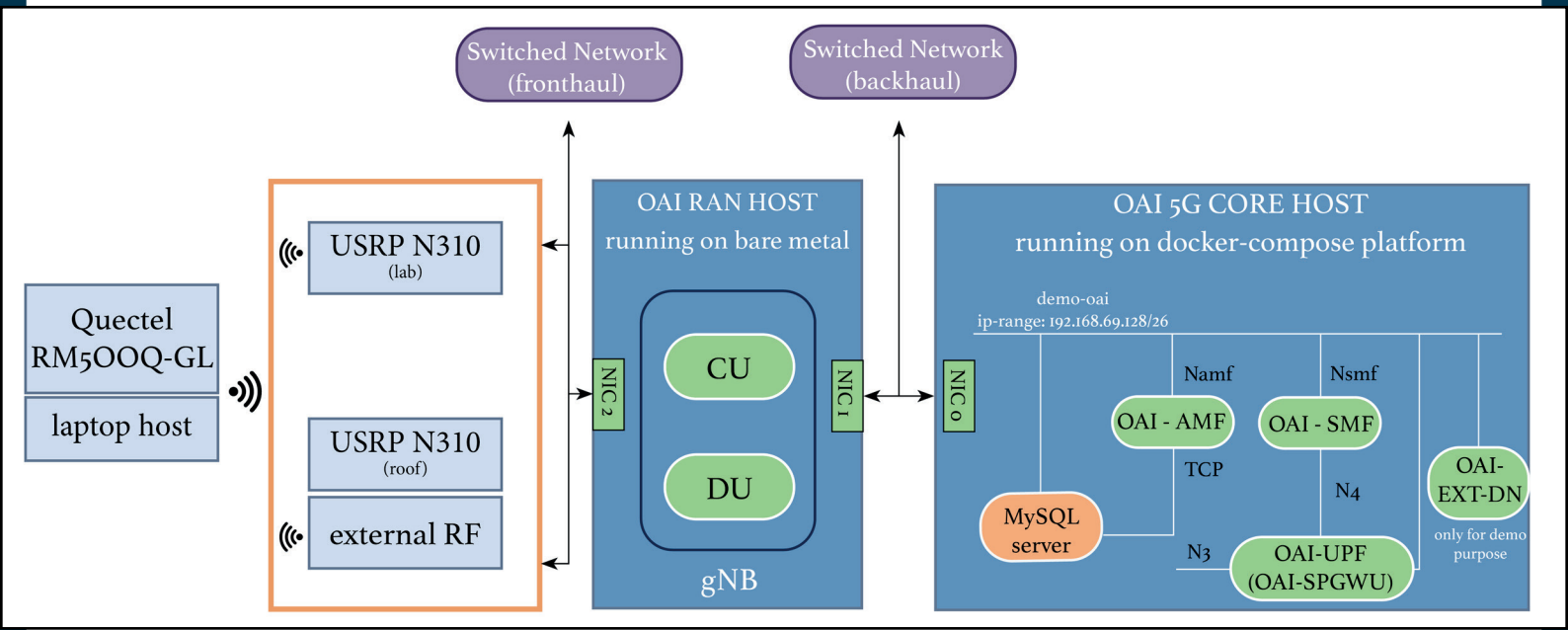
Currently, the OAI RAN stack supports: Non Stand-Alone (NSA) & Stand-Alone (SA) gNB, 5G NSA & SA UE. The 5G RAN Project group is also made of important sub-activities:

- L1-simulation framework
- L2-simulation framework
- CU/DU
- L1 RX improvements
- T1-Telco Card Offload
- MIMO

In July 2021, the OpenAirInterface Software Alliance announced the launch of its 5G Stand-Alone OAI gNB stack. This stack allows us to deploy an end-to-end 5G SA gNB including the Core Network and a COST UE.

How does this work?: The OAI stack is made of a complete 5G Core Network with components AMF, UPF, and SMF deployed in containers on our experimental platform. The gNB is deployed on bare metal using an NR soft modem executable with a config file specific to the standalone mode. It is connected to two external USRP N310 radios (lab & roof).

On the user side, we use a Quectel module connected to a laptop host.



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Radio Access Network

OAI 5G Project Group

Mobile World Congress:

In October 2021, the OSA proudly showcased two demos at the MWC Americas, Los Angeles. One of them was about the end-to-end deployment of the OAI 5G SA network over Colosseum (a massive $20M wireless systems testbed developed by the Defense Advanced Research Projects Agency housed at Northeastern University), and the second one was about the OAI 5G NR demo with channel decoding offload. This was a full-stack demo of an OAI cloud-native 5G NR SA deployed on a general purpose computing equipment and with a Xilinx T1 accelerator card used to offload the channel decoding. This architecture improves performance and energy efficiency in such deployments.

"We are proud to show, through these video demonstrations, the only open-source end-to-end reference 5G-SA implementation available to the community which can henceforth develop additional features, build proof of concepts and improve system performance by adding real-time hardware acceleration."
- **Abhimanyu Gosain,** *Founding Director at OpenAirX-Labs and Senior Director at Northeastern University.*

"The number of projects that we are handling at the OSA is significant and growing, simply because we have many users leveraging OAI in different ways. Some of the projects shown here at MWC Americas L.A. are simple flavors of what the OAI community delivers."
- **Irfan Ghauri,** *Director of Operations at the OSA*

GSMA MOBILE WORLD CONGRESS

Objectives of the next quarter (ending March 2022):

- DL MIMO 4 layer: improve DL throughput
- E1AP and CU-C/U separation
- nFAPI interoperability testing
- Support for SRS + for DL localization signals (Rel 16) + for O-RAN interfaces (E2, O1)

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Core Network

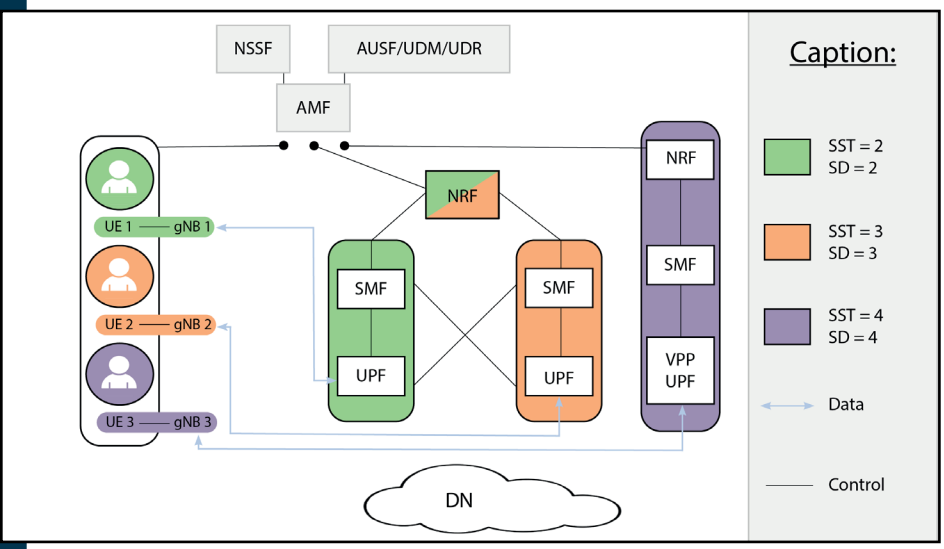
OAI 5G Project Group

In 2021, the Core Network team did an amazing job which allowed for the release of important functionalities. The Core Network Project Group is continuing its work according to its roadmap here.

CN releases:

- **In December 2021**, the Core Network Project Group released the VPP implementation of the UPF. The VPP-based UPF uses vector packet processing and has proven very good performance in the user plane. OAI has also released the first version of NSSF with the capability of slice selection during the PDU session establishment procedure. In this quarter, all SBIs of network functions have been enabled with HTTPv2.
- **In October 2021**, new Network Functions were released: AUSF, UDM, and UDR. These elements are very important to match the 3GPP specifications for the 5G Core Network. Currently, the 5G CN contains the following elements: AUSF, UDM, UDR, AMF, NRF, SMF, and UPF.
- **In April 2021**, we proudly announced the launch of the OAI 5G Core Network software in cloud native. This means that the onset from cloud-native is deployed in both Ubuntu and RHEL (RedHat Enterprise Linux) containers.

Network slicing with OAI 5G Core:



A Network Slice is defined within a Public Land Mobile Network (PLMN), and it incorporates the 5G Core and 5G RAN components. Network slice is identified by a Single Network Slice Selection Assistance Information (S-NSSAI) that consists of a Slice/Service type (SST) and a Slice Differentiator (SD). OAI CN plans to fully support Network Slicing-related procedures according to the 3GPP standards.

At this stage, with the help of NSSF, AMF can discover and select an appropriate NRF according to the requested slice from UE. After that, the appropriate SMF/UPF will be selected to serve the corresponding slice by relying on the services provided by the selected NRF.

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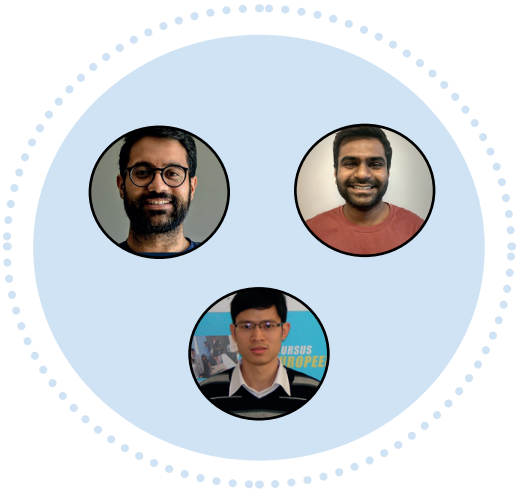
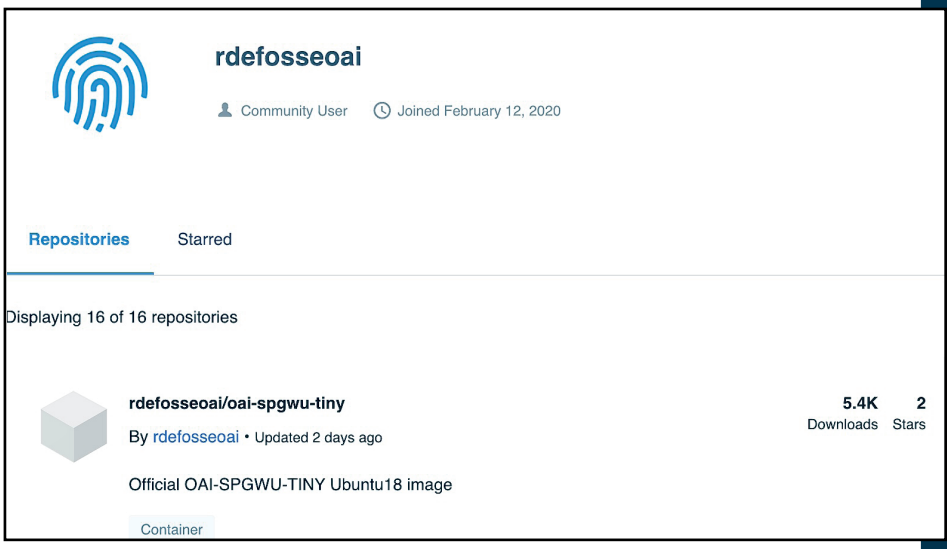
Core Network

OAI 5G Project Group

The OSA is publishing images on the Docker-hub for develop and master branch: Following the desire to make the Core Network more accessible and easy, the CN team has created a docker hub where you can follow up the latest news of the project group.





Private 5G with OAI: We recently started developing features which would allow using OAI 5G core in a private 5G setting. The recent release of OAI 5G core network allows allocating static UE IP-addresses. Once the static UE IP-address configuration is set in the user subscription database, SMF, instead of using its local subscription information, gets the subscription information from UDM (which eventually requests the corresponding information from UDR and its database). User subscription information is stored in the table `SessionManagementSubscriptionData` where there is a mapping between IMSI, Slice Information, PDN information, QoS parameters (QoS is not implemented yet), and IP-address. If there is no IP-address related information then IP-address will be dynamically allocated. To know more about the feature and perform a hands-on, please visit our official page.

Objectives of the next quarter (ending March 2022):

- Complete NSSF functionalities
- Multiple UPFs in the same data path
- Support of 5G LAN-type Services
- Mobility support
- Release NEF
- Test and integrate with FlexCN (MOSAIC5G project group)

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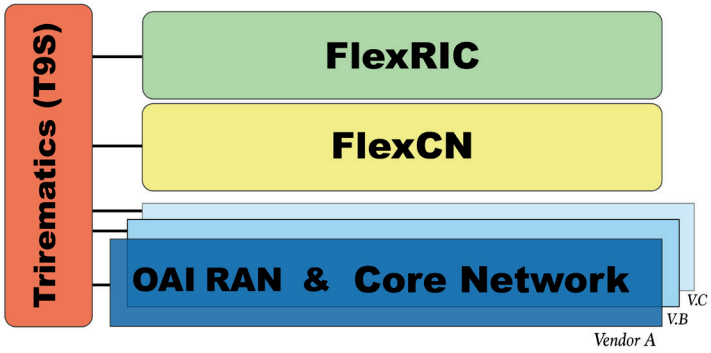
MOSAIC5G

OAI 5G Project Group

In May 2021, the MOSAIC5G Project joined the Alliance with the objective of transforming OAI 4G/5G Radio Access and Core Networks into agile and open network service delivery platforms.

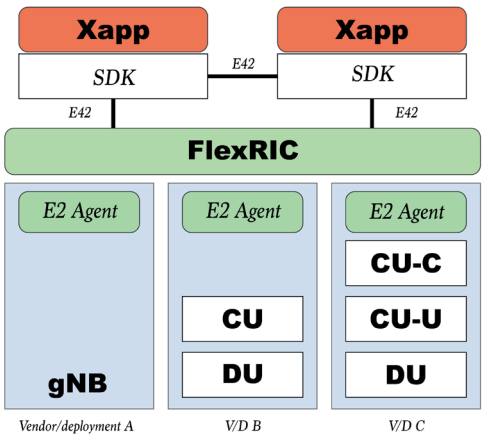
The OAI MOSAIC5G project consists of three platforms:

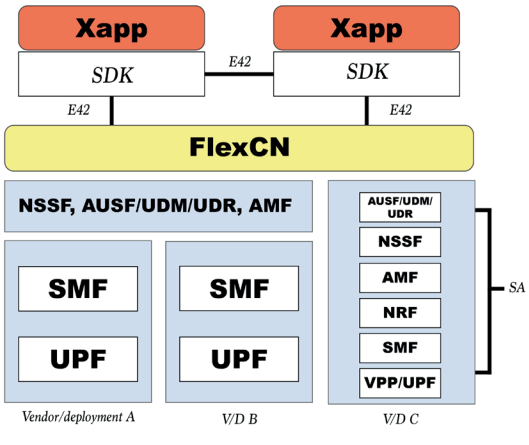


- **FlexRIC** - A flexible RAN intelligent controller that is composed of a RAN E2 Agent and a Near-RT Controller, compliant with O-RAN E2 specifications. Currently, FlexRIC provides PDCP, RLC, and MAC monitoring Service Models (SMs).
- **FlexCN** - It is a flexible CN controller in a form of an SD-CN platform offering similar functionality as FlexRIC for the Core Network. Currently, FlexCN provides AMF and SMF monitoring SMs.
- **Trirematics** - A management and orchestration (MANO) platform for multi-cloud environment deployment empowered by an intelligent operator and it comes with a repository of blueprints/images for divers use-cases.

FlexRIC and FlexCN bring software-development kit (SDK) into next-generation SD-RAN and SD-CN platforms:

In January 2022, the OpenAirInterface publicly released and integrated through the MOSAIC5G project two additional platforms: FlexRIC, and FlexCN. Their roles are to operate on top of the OAI platform with FlexRIC controlling OAI-RAN and FlexCN controlling OAI-CN, both being deployed and managed by Trirematics (T9S). The statistics of RAN and CN will be collected by FlexRIC and FlexCN, respectively. These stats will be further processed by FlexRIC/FlexCN before being sent to third-party xAPPs, and to Trirematics (T9S) for long-term storage. In this way, FlexRIC/FlexCN informs the third-party xAPPs to monitor and/or control RAN and CN functions as per application objectives.





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MOSAIC5G

OAI 5G Project Group

MOSAIC5G news and events:

• **Mobile World Congress:** In October 2021, the MOSAIC5G Project Group presented a demo at the Mobile World Congress America, Los Angeles: *FlexRIC, a flexible O-RAN compliant RIC and a RAN agent running on top of the OpenAirInterface (OAI) radio software stack*. The goal of this demo was to showcase the different FlexRIC capabilities, show its uniqueness and difference from the O-RAN alliance near-RT RIC.
• **Workshop:** In December 2021, the MOSAIC5G team delivered two hands-on labs for the community in the Fall 2021 OpenAirInterface Workshop.
• **Challenges:** Following the workshop, the team elaborated four programming challenges: creating an SM, a PDCP xAPP, an RLC xAPP, and a MAC xAPP.

• **Article:** On July 2021, the MOSAIC5G team published a research paper in the ACM CoNEXT Conference (Munich, Germany) entitled *FlexRIC: an SDK for Next-Generation SD-RANs*

The MOSAIC5G Project Group is continuing its work according to its roadmap here.

Objectives of the next release:

• FlexRIC/FlexCN SDK and Xapp framework
• FlexRIC/FlexCN controllers with DB integration
• Example of ML-based xAPPs

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CI/CD

OAI 5G DevOps

What is CI/CD?

OAI Continuous Integration (CI) is a software development process in which the OpenAirInterface contributors submit their code modifications for the CI team to review, test, and accept. Mainly, the CI process achieves the following goals:

- Build the software contributions automatically
- Test the software contributions automatically
- Return a human-readable feedback to the contributor about his work quality

How is the code verified?

Through Automation: Automation is a big part of the OAI CI process. It always starts with the contributor opening a merge request on one of our OSA-hosted GIT repositories. This action then automatically triggers one or multiple Jenkins jobs. Builds and tests are then automatically performed in a distributed environment among the OAI partners. Ultimately the process results in immediate feedback, historical records, and accountability. We have also automated a Dashboard creation on the pending Merge Requests, so maintainers and contributors have an easy-to-read executive summary of all Merge Requests.

OAI RAN MR Status Dashboard

Tests Dashboard

Update : 19/01/2022 09:50

MR	Created_At	Author	Title	Assignee	Reviewer	CAN START	IN PROGRESS	COMPLETED	Review Form	OK Merge	Merge Conflicts
1400	2022-01-18	Remi Hardy	integration_2022_wk03	Robert Schmidt							
1397	2022-01-14	Thomas Laurent	fix issue created from fix int8 overflow (int8 overflox is small)		Robert Schmidt				X	X	
1396	2022-01-14	Thomas Schlichter	NR fix harq round calculation		Francesco Mani	X					
1394	2022-01-13	Melissa	This commit includes several nfapi bug fixes	Thomas Laurent	Thomas Laurent			X	X		
1390	2022-01-07	Robert Schmidt	WIP: various CI improvements	Raphael Defosseux	Remi Hardy		X				
1389	2022-01-07	Remi Hardy	WIP: [CI] support tcp bidir	Raphael Defosseux		X					
1388	2022-01-06	Francesco Mani	NR SA 10MHz with OAI UE		Luis Pereira		X				
1386	2022-01-05	Roberto Louro Magueta	WIP: UE phy sync improvements			X					
1383	2022-01-05	Luis Pereira	bler tx optim			X					
1382	2022-01-04	knopp	Semi-automatic code generator for LDPC decoder for AVX2 and AVX512.	knopp							YES
1380	2021-12-24	Luis Pereira	Rename pusch_proc_threads to thread_pool_size		Robert Schmidt		X				
1375	2021-12-22	Robert Schmidt	Draft: Optimized (un-)scrambling in nrUE and L1 task time measurement		Francesco Mani			X	X		
1371	2021-12-20	Francesco Mani	NR UE capabilities		Robert Schmidt			X	X		
1367	2021-12-16	Shweta Shrivastava	WIP: Changes for triggering NU CI	Raphael Defosseux		X					
1366	2021-12-16	Robert Schmidt	Remove basic simulator	Cedric Roux	Raphael Defosseux						

How do this work in the OAI Core Network and RAN Project Groups?

CN: On the OAI 5G Core Network, we have fully automated the OAI 5G Core Network validation pipelines. Each Cloud Network Function has its own repository and its own initial CI pipeline. You can find below an AMF example. We not only build images but also automate tests at unit level («Bracket Testing» stage) and at the integration level in two different environments.

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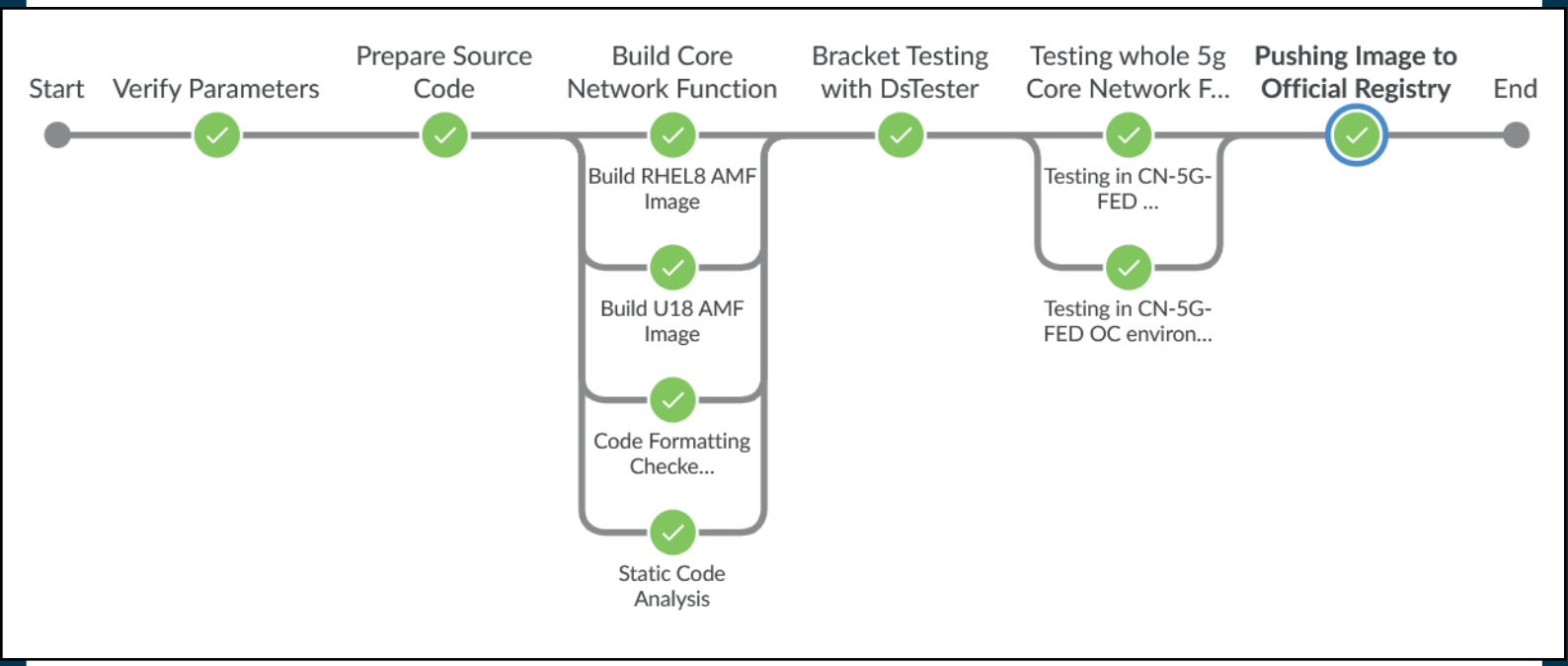
CI/CD

OAI 5G DevOps



RAN: On the RAN side, we have fully automated both the 5G NR Non-Standalone and Stand-alone mode tests (on eNB and gNB) with our own 4G/5G Core Networks. As DevOps team, we are using a Jenkins server that is running within an on-premise OpenShift Cluster and we are in charge to perform the maintenance in terms of image upgrade, CPU usage and reliability. We are also helping other partners do their own OAI deployment through tutorials and support.

"Better CI/CD, Better Quality, Better Software, Better User Experience' is our motto!"



Objectives of the next quarter:

- Increase the test coverage, especially on the RAN side:
  - full-OAI stack 5G SA testing with radio and our own OAI-NR-UE
  - testing with other commercial 5G RRU or DU radio elements
  - testing of the new L2 nFAPI simulator in LTE/NSA/SA modes
- On the 5G Core Network side, new Network Functions will be public that will require CI and testing automation with another RAN emulator

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