GRADUATE SCHOOL AND RESEARCH CENTER AT THE HEART OF THE DIGITAL SOCIETY

EURECOM
Sophia Antipolis

OPEN AIR INTERFACE

Democratizing innovation in the 5G era

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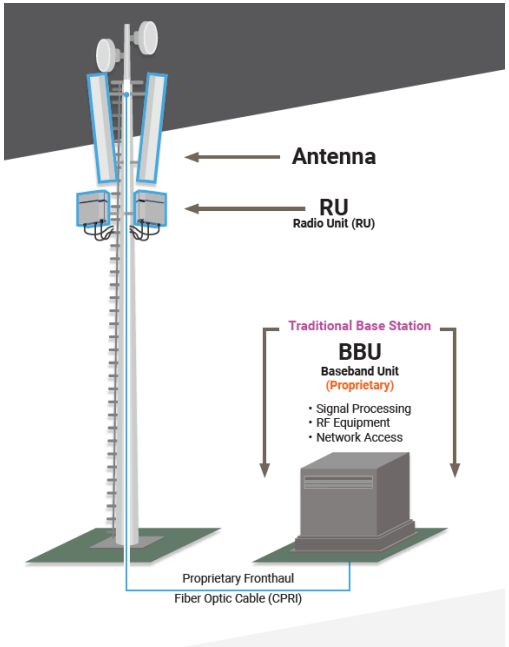
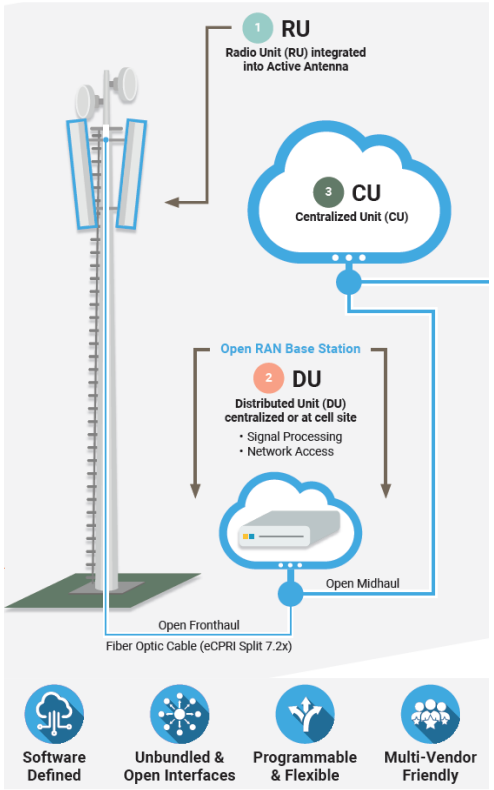
Traditional RAN → Open RAN



Source: open RAN policy coalition



Open RAN ≠ Open Source

- But combination of both is a powerful tool to build **sovereign networks**
- **OpenAirInterface** (OAI) is the **most complete, open-source** implementation of 3GPP 4G/5G RAN and EPC/5GC
- Other types of open-source software
  - ORAN OSC (partially open-source RAN, 3GPP-friendly licensing)
  - srsLTE/srsRAN (4G/5G RAN, OSI licensing)
  - OMEC (EPC, OSI Licensing)
  - Magma (EPC/5GC, OSI Licensing)
  - Free5gc (5GC, OSI Licensing)
  - Open5gs (EPC/5GC, OSI Licensing)

The OpenAirInterface Software Alliance

- Launched in 2014 as an endowment fund (French “Fonds de Dotation”)
- Current strategic members

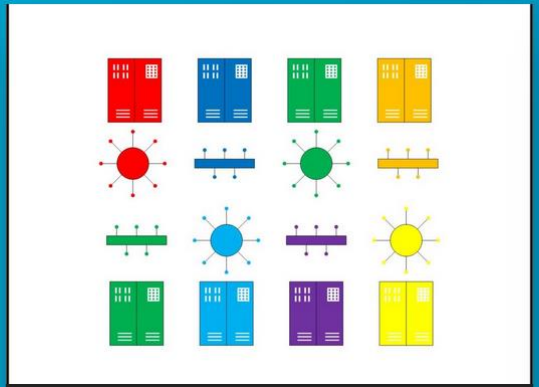
- Many associate members
- Goals:
  - Promote OpenAirInterface and its open-source licensing model
  - Support the community of developers and users
  - Accept donations to maintain engineering support team

OAI Projects

5G RAN

OAI 5G RAN PROJECT GROUP OpenAirInterface 5G Radio Access Network Project The scope of the OAI 5G RAN project is to build...

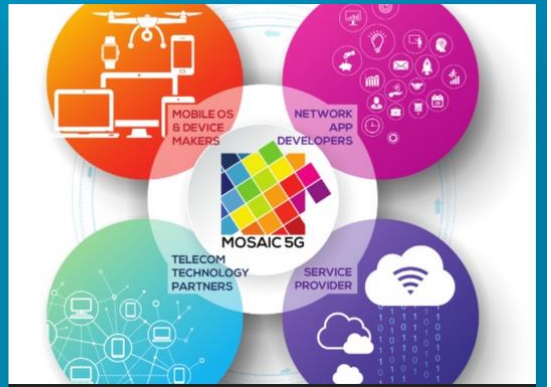
Read more



5G CORE NETWORK

5G CORE NETWORK The scope of 5G CN project developments is to deliver a 3GPP compliant 5G Core Network under the OAI...

Read more



MOSAIC5G

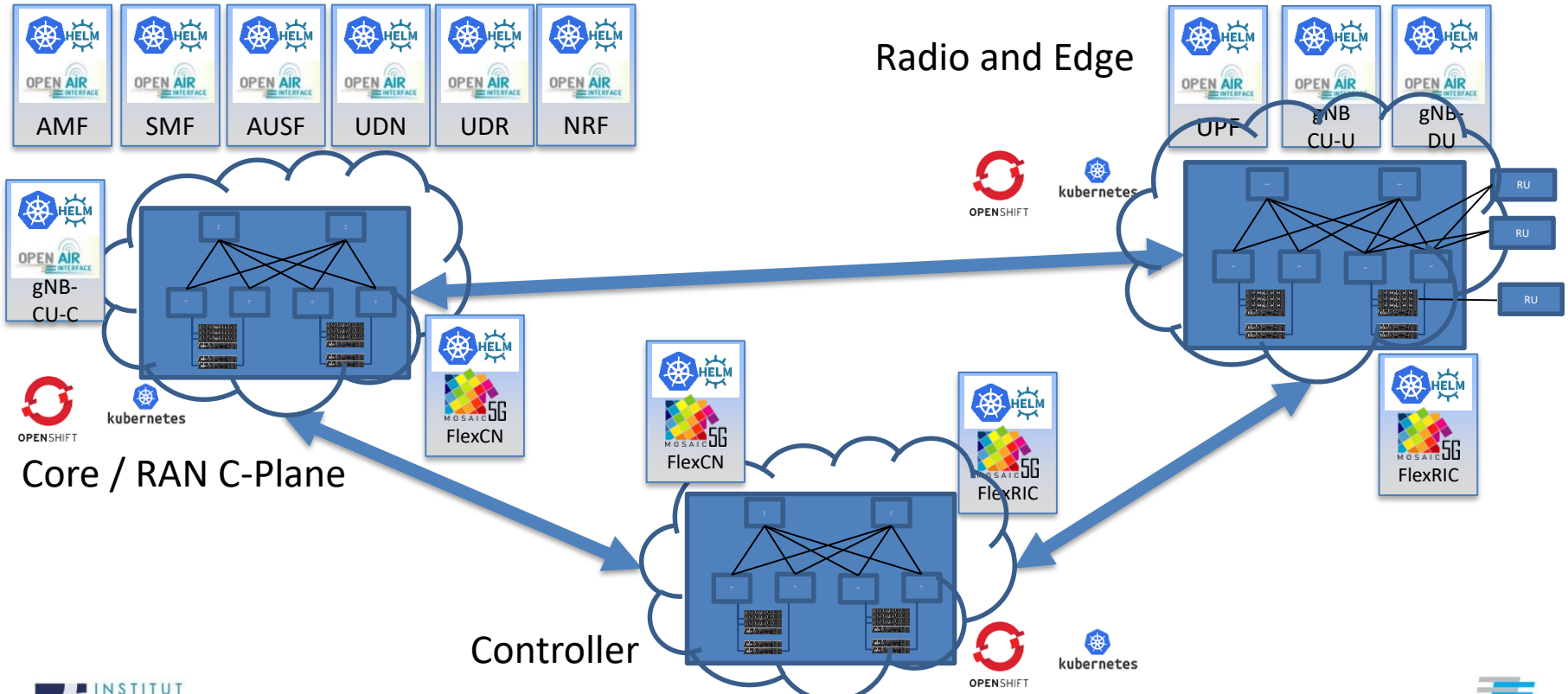
OAI MOSAIC5G PROJECT GROUP OpenAirInterface MOSAIC5G Project Group The newly created MOSAIC5G (M5G) PROJECT GROUP aims to transform radio access (RAN) and...

Read more

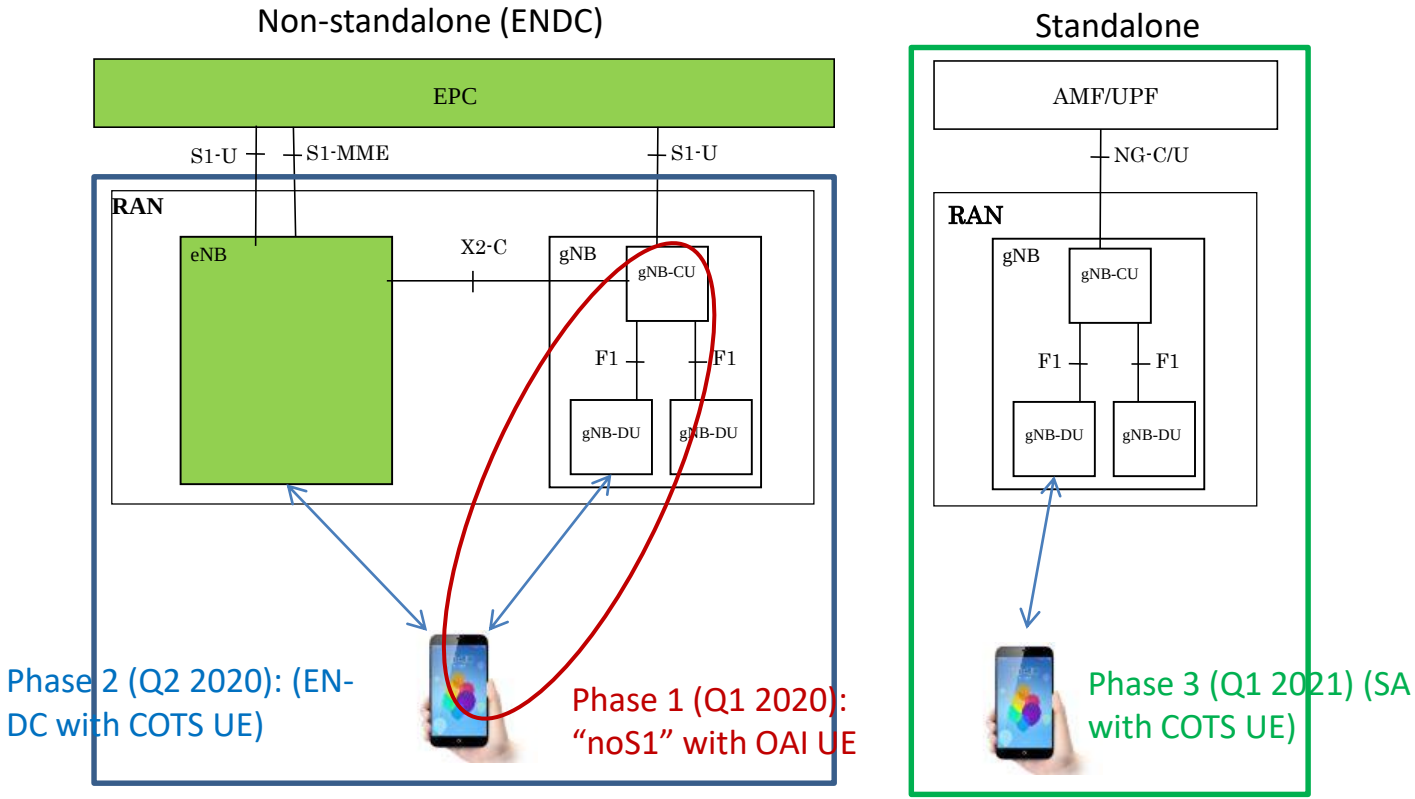
OAI License

- OAI Public License Components
  - 4G / 5G RAN : eNB/gNB/UE L1/L2 Network functions, RF modeling
  - 5G Core : 3GPP Service-Based Architecture Network functions
  - Mosaic5G : RAN and Core Controller functions, Orchestration and Management
- 3-Clause BSD Components
  - Rel16 MME (4G/5G NSA) as part of Magma Foundation

OAI cloud native deployment



OAI 5G deployment options



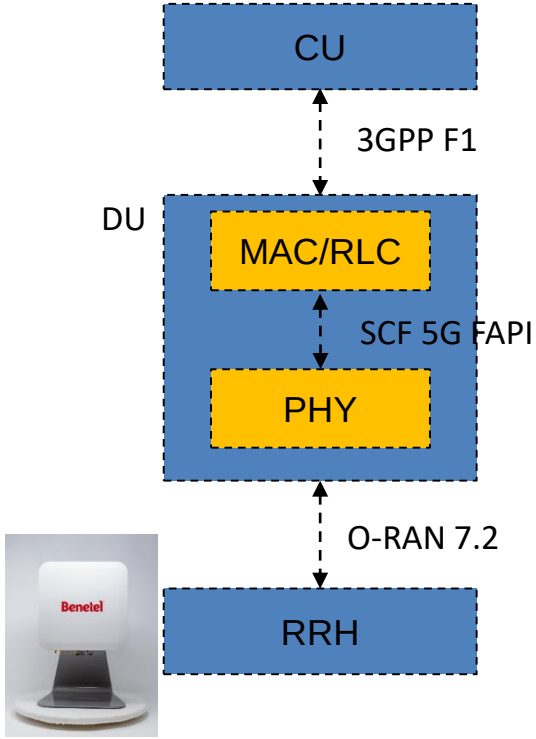
OAI supported hardware platforms

- Tested RRUs
  - USRP B210, X310, and N310 (for LTE and NR)
  - Benetel RRU (NSA bands 7 and n78 only): O-RAN 7.2 split
  - AW2S (LTE and NR): eCPRI
- Tested UEs
  - Oppo Reno 5G
  - Samsung A90 5G
  - Samsung A42 5G
  - Google Pixel 5G
  - Simcom SIMCOM8200EA
  - Quectel RM500Q-GL
  - Huawei Mate 30

NSA only

SA & NSA

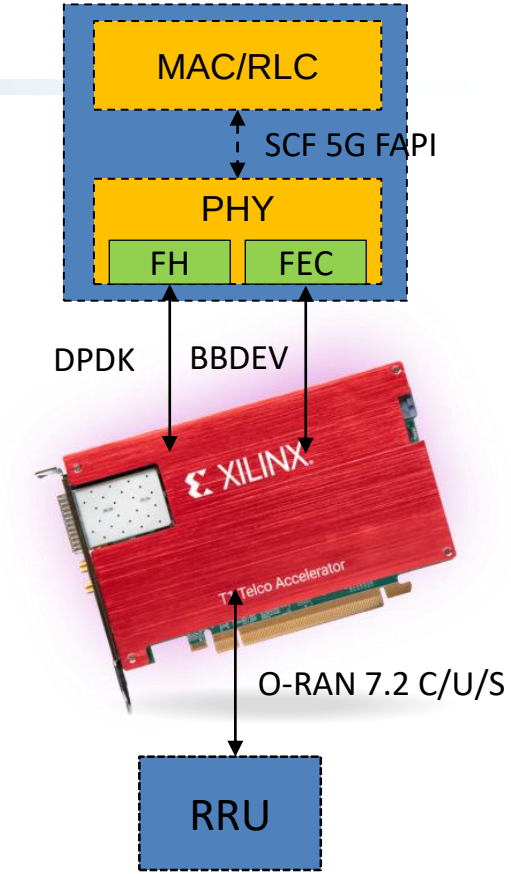
Functional splits in OAI 4G/5G



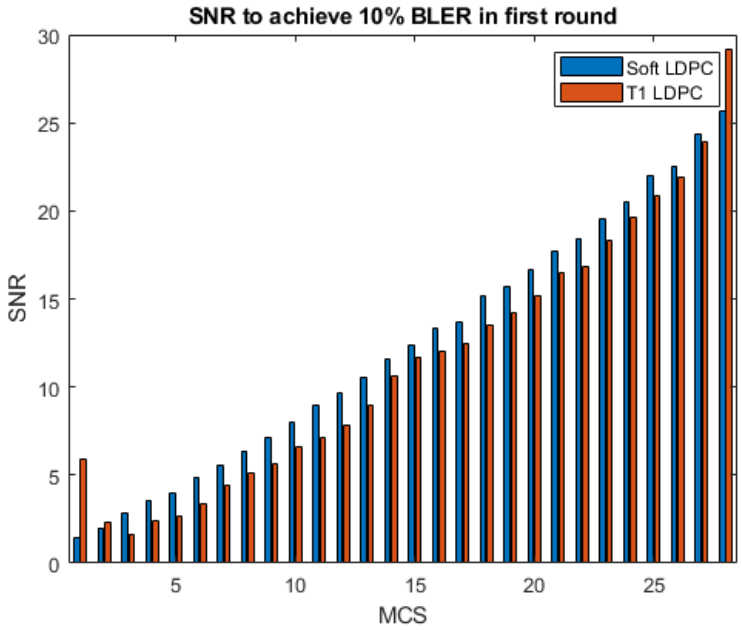
- F1-C and F1-U
  - Revised implementation under integration
  - Interoperability testing with Acceleran ongoing
- 5G FAPI
  - today all L1 procedures compliant with SCF 5G FAPI
  - 5G nFAPI
- Fronthaul
  - O-RAN 7.2 U-plane done (with Benetel)
  - Interoperability with other RRUs planned for 2H 2021
  - Integration of Xilinx T1 card

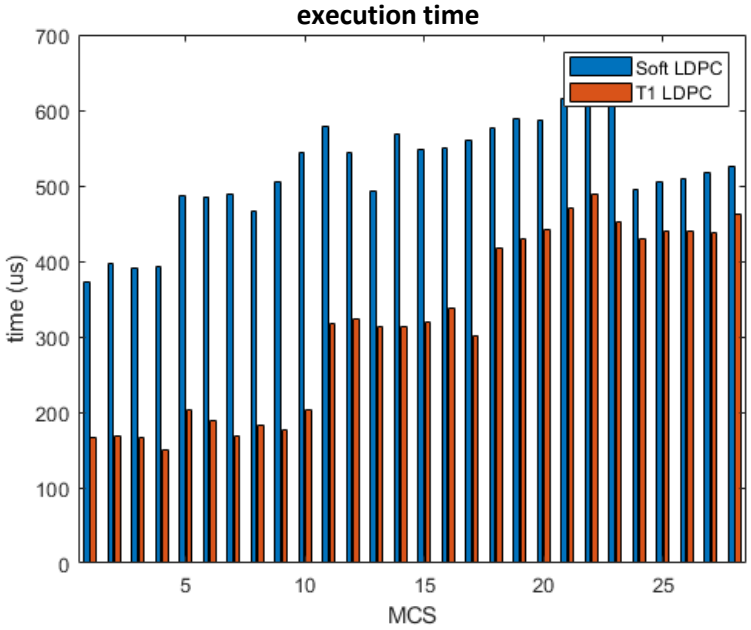
T1 LDPC Offload

- Channel coding/decoding consumes most energy/processing time
  - 91% of total RX processing time in OAI
- Xilinx T1 accelerator card
  - Contains ZU19EG MPSoC and ZU21DR RFSoC
  - Offload of forward error correction and fronthaul
  - Bitstream and drivers provided by VVDN
- LDPC channel decoding integrated in OAI
  - Works with nr_ulsim and nr-softmodem



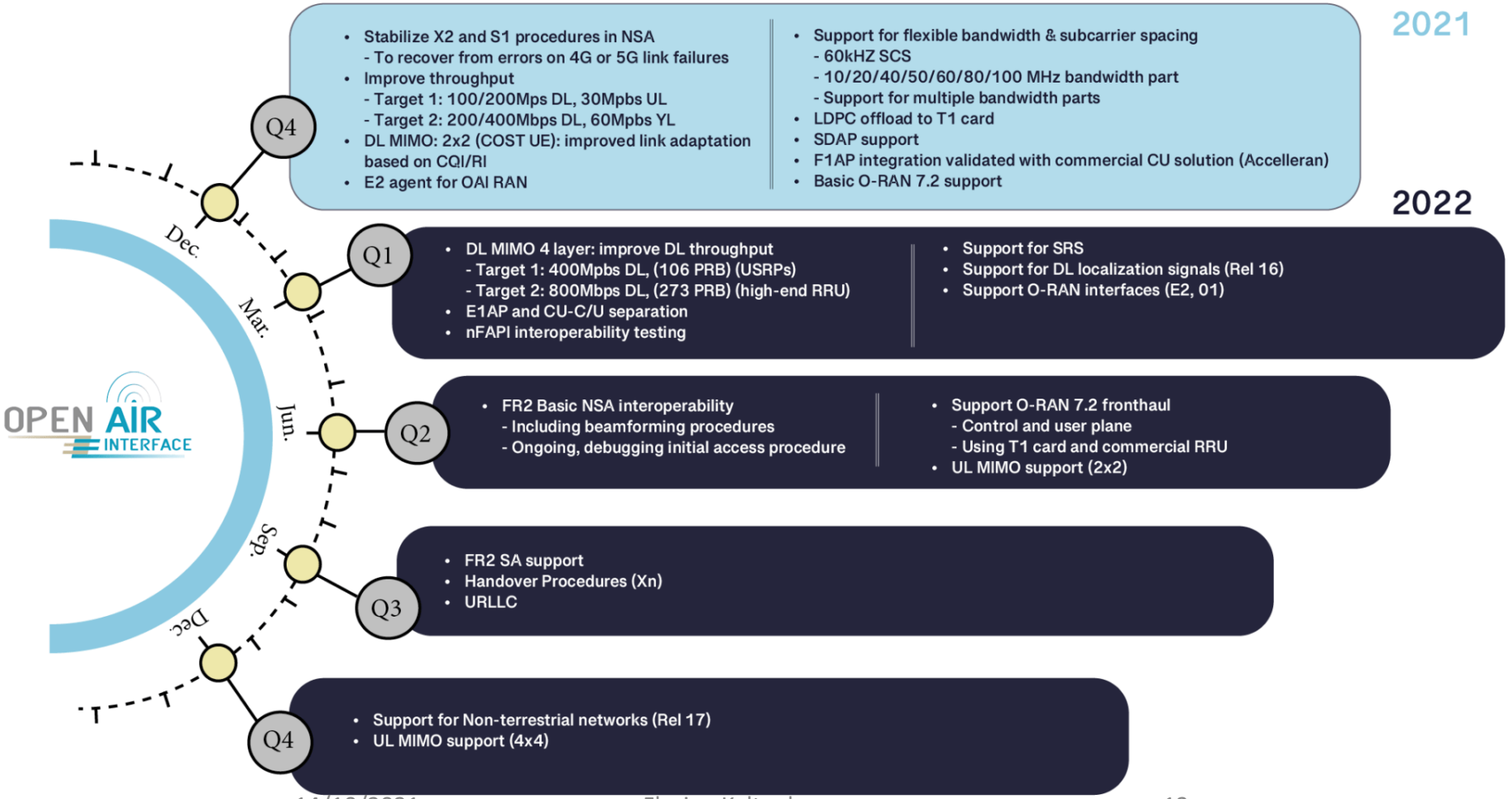
T1 LDPC Offload





NR-PUSCH, SCS 30kHz, 106PRB, 12OFDM symbols, 1 DRMS, SISO, TDL-C channel

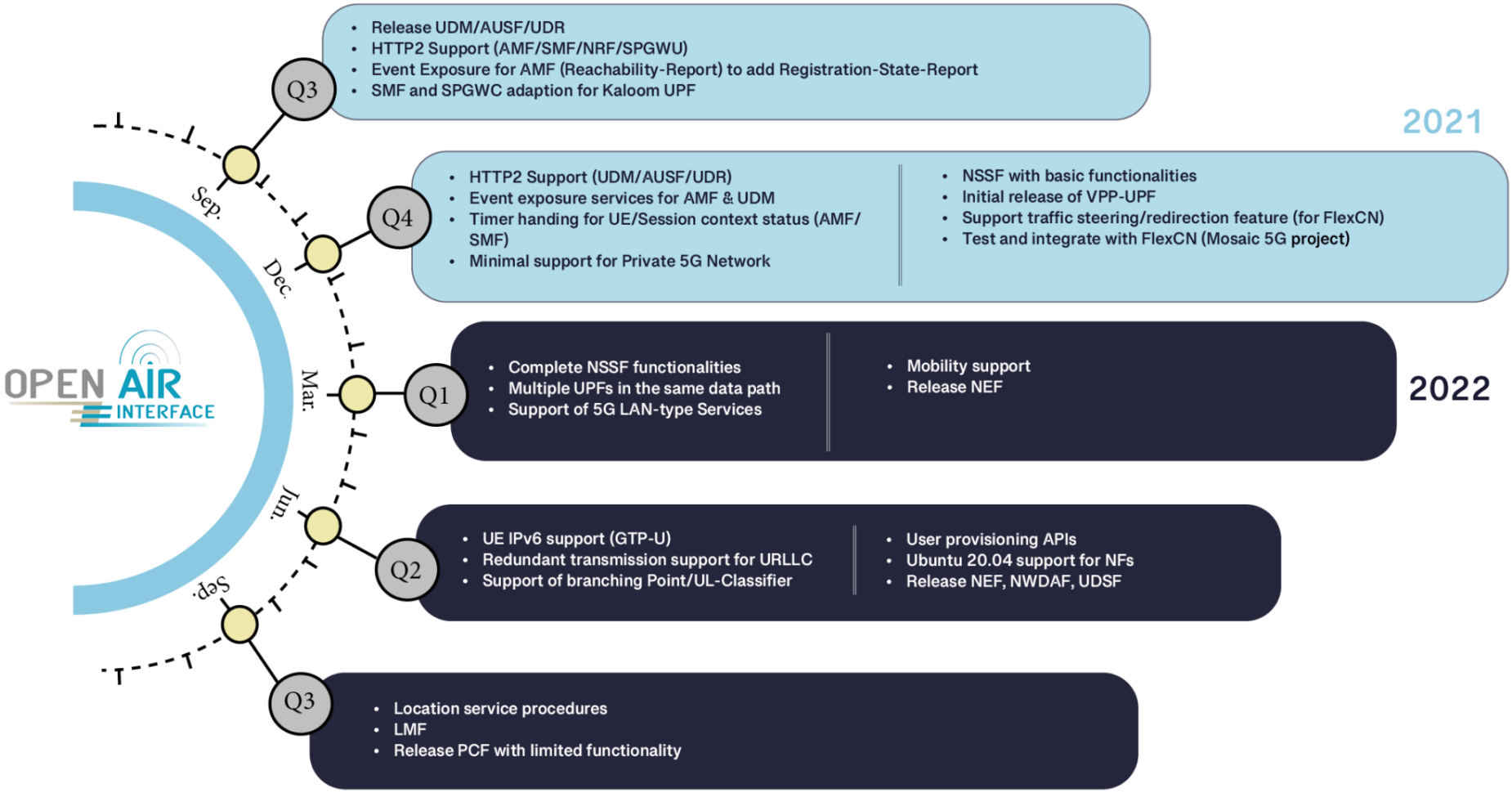
Florian Kaltenberger, Hongzhi Wang, Saktivel Velumani, “Performance evaluation of offloading LDPC decoding to an FPGA in 5G baseband processing,” Workshop on Smart Antennas (WSA2021), Sophia-Antipolis, France, 10-12.11.2021.


2021
Q4
Stabilize X2 and S1 procedures in NSA
- To recover from errors on 4G or 5G link failures
Improve throughput
- Target 1: 100/200Mps DL, 30Mpbs UL
- Target 2: 200/400Mbps DL, 60Mpbs YL
DL MIMO: 2x2 (COST UE): improved link adaptation based on CQI/RI
E2 agent for OAI RAN
Support for flexible bandwidth & subcarrier spacing
- 60kHZ SCS
- 10/20/40/50/60/80/100 MHz bandwidth part
- Support for multiple bandwidth parts
LDPC offload to T1 card
SDAP support
F1AP integration validated with commercial CU solution (Accelleran)
Basic O-RAN 7.2 support
2022
Dec.
Q1
DL MIMO 4 layer: improve DL throughput
- Target 1: 400Mpbs DL, (106 PRB) (USRPs)
- Target 2: 800Mbps DL, (273 PRB) (high-end RRU)
E1AP and CU-C/U separation
nFAPI interoperability testing
Support for SRS
Support for DL localization signals (Rel 16)
Support O-RAN interfaces (E2, 01)
Mar.
Jun.
Q2
FR2 Basic NSA interoperability
- Including beamforming procedures
- Ongoing, debugging initial access procedure
Support O-RAN 7.2 fronthaul
- Control and user plane
- Using T1 card and commercial RRU
UL MIMO support (2x2)
Sep.
Q3
FR2 SA support
Handover Procedures (Xn)
URLLC
Dec.
Q4
Support for Non-terrestrial networks (Rel 17)
UL MIMO support (4x4)
OPEN AIR INTERFACE

5G CORE

5GC Component Implementation Status

- AMF: https://gitlab.eurecom.fr/oai/oai-cn5g-amf
- SMF: https://gitlab.eurecom.fr/oai/oai-cn5g-smf
- UPF: https://github.com/OPENAIRINTERFACE/openair-spgwu-tiny
- Docker containers and deployment: https://gitlab.eurecom.fr/oai/cn5g/oai-cn5g-fed
- Support basic call flows:
  - Connection and registration procedures: UE registration/de-registration, service request
  - Session management procedures: PDU session establishment, modification, release
- Validated with
  - a professional tester (DsTester) (https://youtu.be/ENQiwl2EYl8)
  - Amarisoft gNB + COTS UE (https://youtu.be/N5wuhh-1dxk)
  - OAI gNB + COTS UE or OAI UE (https://youtu.be/ZD4tEgCNv9E)
- CI/CD framework:
  - Deployment of AMF, SMF and UPF in docker containers (Ubuntu bionic)
  - Validation with DsTester


Q3
Release UDM/AUSF/UDR
HTTP2 Support (AMF/SMF/NRF/SPGWU)
Event Exposure for AMF (Reachability-Report) to add Registration-State-Report
SMF and SPGWC adaption for Kaloom UPF
2021
Sep.
Q4
HTTP2 Support (UDM/AUSF/UDR)
Event exposure services for AMF & UDM
Timer handing for UE/Session context status (AMF/SMF)
Minimal support for Private 5G Network
NSSF with basic functionalities
Initial release of VPP-UPF
Support traffic steering/redirection feature (for FlexCN)
Test and integrate with FlexCN (Mosaic 5G project)
Dec.
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Mar.
Q1
Complete NSSF functionalities
Multiple UPFs in the same data path
Support of 5G LAN-type Services
Mobility support
Release NEF
2022
Jun.
Q2
UE IPv6 support (GTP-U)
Redundant transmission support for URLLC
Support of branching Point/UL-Classifier
User provisioning APIs
Ubuntu 20.04 support for NFs
Release NEF, NWDAF, UDSF
Sep.
Q3
Location service procedures
LMF
Release PCF with limited functionality

THANK YOU