5G NR Status and Roadmap

OAI workshop, June 24th 2021

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What is OpenAirInterface?

- Open-source software-based implementation of 3GPP Technologies
    - Starting at LTE (Rel 8), including features from LTE-Advanced (Rel 10/11/12), LTE-Advanced-Pro (Rel 13/14), going on to 5G Rel (15/16/…)
    - Spanning the full protocol stack of 3GPP standard
        - E-UTRAN (eNB, gNB, UE, nr-UE)
        - EPC (MME, S+P-GW, HSS)
        - 5GC (AMF, UMF, SMF)
    - Realtime RF and scalable emulation platforms
    - Works with many SDR platforms (USRP, Benetel, AW2S, …)
- Makes it is feasible to put a fully-compliant 4G eNodeB and 5G gNB in a commodity x86-based computer (or data center)
- Objectives
    - Building a community of individual developers, academics and major industrials embracing open-source for 5G
    - Provide a reference implementation for 4G/5G 3GPP systems
    - Allow easy adoption of the software in other projects or products

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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

5G RAN

Development phases
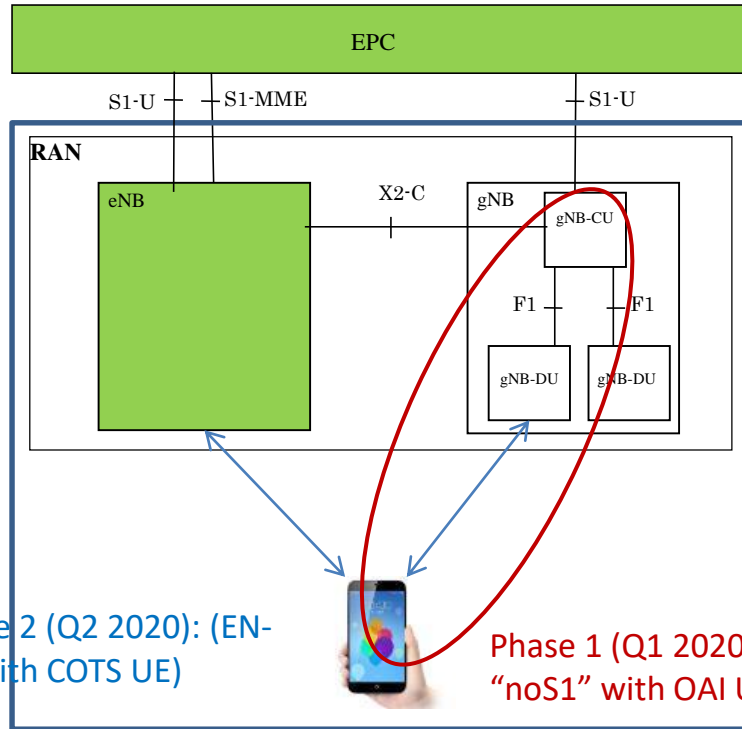

Non-standalone (ENDC)

Standalone

Phase 2 (Q2 2020): (EN-DC with COTS UE)

Phase 1 (Q1 2020): "noS1" with OAI UE

Phase 3 (Q1 2021) (SA with COTS UE)
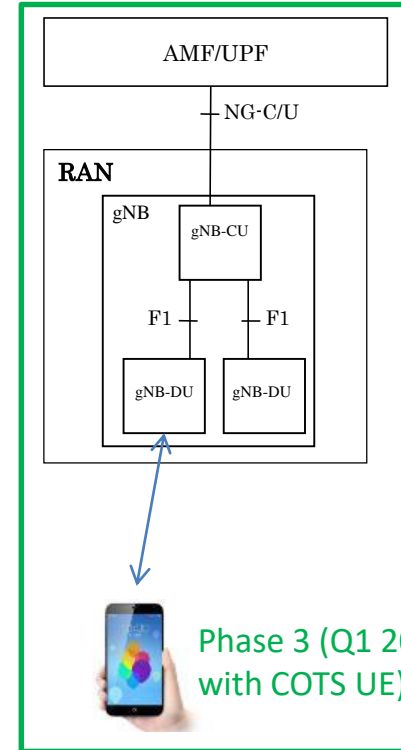
Status of 5G NSA development

- Non-standalone EN-DC with COTS phones since August 2020
  - FR1 TDD with 30kHz subcarrier spacing, 106PRB (40MHz), SISO
  - No split bearer, traffic is redirected to 5G cell
- Current performance
  - 80Mbps DL throughput (with 64QAM)
  - 7Mbps UL throughput (with QPSK, to be improved)
  - Up to 2 users tested
- Available in develop branch

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5G NSA supported platforms

- Tested RRUs
  - USRP B210 and N310 (for both eNB and gNB)
  - Benetel RRU (LTE band 7 and NR band n78): O-RAN 7.2 split
  - AW2S (LTE band 38, NR support in development)
- Tested UEs
  - Oppo Reno 5G
  - Samsung A90 5G
  - Samsung A42 5G
  - Google Pixel 5G
  - Simcom SIMCOM8200EA
  - Quectel RM500Q-GL
- Tested Core networks
  - OAI EPC
  - Nokia LTEbox
  - ...

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Status of 5G SA development

- First complete attach: 4th May 2021
- First DL and UL user-plane traffic (ping): 18th May 2021
- Validated RRUs
  - USRP B210 and N310
- Validated UEs:
  - QUECTEL RM500Q-GL and
  - SIMCOM SIM8200EA
  - Huawei Mate 30 (by Fujitsu)
- Validated Core networks
  - OAI 5GC and
  - Nokia SAbox
- Limitations
  - Currently only initial bandwidth part (BWP), which uses a subset of the cell bandwidth is used
- Merge status
  - Available in branch develop-NR_SA_F1AP_5GRECORDS
  - Merge request ongoing

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Additions for SA

- CORESET0, SIB1, initial BWP
- Contention based initial access
- RRC:
  - RRCSetup[Complete]
  - SecurityMode[Command|Complete]
  - UECapability[Request|Indication]
  - RRCReconfiguration[Complete]
    - Done in multiple steps
  - [DL|UL]InformationTransfer
    - Integration with NAS
- RLC: Handling of SRB0, SRB1, DRB
- PDCP: security (integrity)
- NGAP: connection to AMF
- GTPU: connection to UPF

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Functional splits in OAI 4G/5G
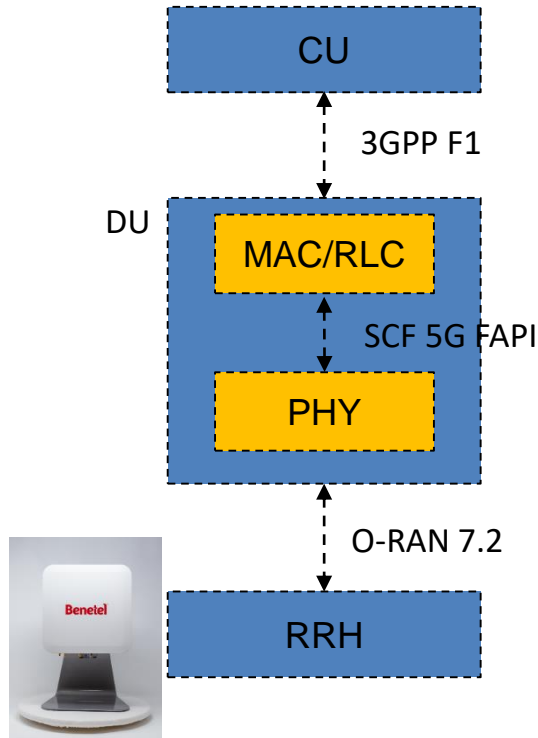
- **F1-C and F1-U**
  - F1-C completed
    - Interoperability testing with Acceleran ongoing
  - F1-U expected Q2 2021
- **5G FAPI**
  - today all L1 procedures compliant with SCF 5G FAPI
  - nFAPI under integration (Q2 2021)
- **Fronthaul**
  - O-RAN 7.2 U-plane done (with Benetel)
  - Interoperability with other RRUs planned for 2H 2021

Roadmap 1/2

- Stabilize X2 and S1 procedures in NSA
  - To recover from errors on 4G or 5G link failures
- Improve throughput
  - Target1: 100Mbps DL, 15Mpbs UL (SISO 106 PRB)
  - Target2: 200Mbps DL, 30Mpbs UL (SISO 273 PRB)
- Link adaptation based on CQI
- Basic NSA FR2 interoperability   Summer 2021
  - Including beamforming procedures
  - Ongoing, debugging initial access procedure
- DL MIMO support   Summer 2021
  - Including CSI RS and feedback reporting
- Support for multiple bandwidth parts and other configurations   Q3 2021
  - 60kHz SCS (Also requires multiplexing multiple SCS)
  - 10/20MHz bandwidth part
- Support for localization (Rel 16)   2022
- Massive MIMO support for FR1   2022

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Roadmap 2/2

- SA specific (immediate)
  - Activation of Dedicated bandwidth part & improve throughput
  - Retransmissions of msg3/msg4
  - Better handling of RRC UE connection/release (recover from link failure)
  - F1AP-U
- SA specific (Long term)
  - SDAP support
  - Support for FR2
  - Support for Non-terrestrial networks (Rel 17)
- Support open-RAN interfaces (E1, E2, …)
  - See presentation on Mosaic5G

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L1 Offload

- Xilinx T1 accelerator card
  - Contains ZU19EG MPSoC and ZU21DR RFSoC
  - Offload of forward error correction and fronthaul
- Goal1: integrate offload channel coding/decoding (LDPC) in OAI
  - T1 card set up with latest bitstream from VVDN
  - Integrated reference code as library in OAI
- Goal2: use card for O-RAN 7.2 fronthaul offload
  - Need O-RU for testing

MAC/RLC

SCF 5G FAPI

PHY

FH   FEC

DPDK   BBDEV

XILINX

T1 Telco Accelerator

O-RAN 7.2 C/U/S

RRU

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