OpenAirInterface 5G
Core Network:
Status and Roadmap

Sagar ARORA, Raphaël DEFOSSEUX,
Lionel GAUTHIER, Rohan KCHARADE,
Franck MESSAOUDI, Tien Thinh NGUYEN,
Stefan SPETTEL

OAI Hand-on Workshop, 24-25 May 2023
Outline

• Introduction of 5G System and OAI 5G CN project
• Current Implementation Status of OAI 5GC Components
• Roadmap
Outline

• Introduction of 5G System and OAI 5G CN project
• Current Implementation Status of OAI 5G Components
• Roadmap
5G System Architecture

- Access and Mobility Management Function (AMF)
- Session Management Function (SMF)
- User plane function (UPF)
- Policy Control Function (PCF)
- Authentication Server Function (AUSF)
- Unified Data Management (UDM)

- Network Exposure function (NEF)
- NF Repository function (NRF)
- Network Slice Selection Function (NSSF)
- Unified Data Repository (UDR)
- Unstructured Data Storage Function (UDSF)
- Application Function (AF)

5G System Architecture (source: 3GPP TS23.501)
Core Network: From 4G to 5G Networks

CUPS: Control and User Plane Separation
SGW: Serving Gateway
PCRF: Policy and Charging Rules Function

MME: Mobility Management Entity
HSS: Home Subscriber Server
PGW: Packet Data Network (PDN) Gateway

4G-5G CN functions mapping

Control-Plane (CP)
User-Plane (UP)
OAI 5G CN Project Group

• Website: https://openairinterface.org/oai-5g-core-network-project/

• Develop a fully 3GPP compatible 5G CN stack (SA) as open source software for the OAI community

• Sponsors: Qualcomm, InterDigital

• Main contributors:
  • EURECOM/OSA, BUPT, KCL, IITH
Outline

• Introduction of 5G System and OAI 5G CN project

• Current Implementation Status of OAI 5GC Components

• Roadmap
OAI 5G CN – Current Status (1): Release 1.5.1

Control plane

User Plane

Subscriber/Data management NFs

- UDSF
  - Nudsf

- UDM
  - Nudm

- AUSF
  - Nausf

- UDR
  - Nudr

Signaling NFs

- NEF
  - Nnef
  - Nnssf

- NSSF
  - Nnssf

Core NFs

- PCF
  - Npcf

- AMF
  - Namf

- SMF
  - Nsmf

- NRF
  - Nnrf

- SCP

- UE
  - N3

- (R)AN
  - N1

- UPF
  - N2

- DN
  - N6

- N9

Available in the future

- Available

- Under-development

FlexCN

- AF

- NWDAF

OAI Hand-on Workshop, May 2022
OAI 5G CN – Current Status (2)

- **Solid and functional 5GC**
  - Basic procedures (with multiple UEs/PDU sessions): connection and registration procedures (UE registration/de-registration, service request), session management procedures (PDU session establishment, modification, release)
  - Additional features:
    - NF registration, NF discovery
    - Support N2 handover, HTTP/2, and FQDN
    - Event exposure services for SMF (7 events), AMF (6 events), UDM/UDR (on-going)
    - Basic support for Private 5G network (Static UE IP address allocation, non-NATed IP traffic between UE and DN)
    - Support Network slicing with NSSF and multiple AMFs
    - Support of policy enforcement via PCF
    - Support multiple UPFs in the same data path/Support UL Classifier

NF: Network Function, FQDN: Fully Qualified Domain
Different flavors

- Three 5GC modes
  - Minimalist 5GC with AMF, SMF, UPF (and NRF)
  - Basic 5GC with AMF, SMF, NRF, UPF, UDM, AUSF and UDR
  - Full 5GC with AMF, SMF, NRF, UPF, UDM, AUSF, UDR, PCF, NRF and NEF

- Four UPF flavors:
  - SPGW-U (from 4G) with additional features for 5G
  - VPP-UPF (relying on VPP-Travelping, with DPDK support)
  - P4-UPF (SD-Fabric, on-going)
  - eBPF/XDP (on-going)

Deployment options

- Traditional/classic deployment on Servers/Virtual machines
- Automated deployment of NFs in Docker containers using Docker-Compose
- Cloud-native deployment using Helm Chart (on OpenShift cluster)
OAI 5G CN – Current Status (4)

- **Validation, CI/CD with**
  - Tester: Functional, stability, reliability and performance (support 5000+ UEs with traffic) tests
  - OAI gNB/OAI UE, COTS UEs (*Rel 15* and *Rel 16* UEs e.g., Quectel/SIMcom modules, iPhone 14/14 Pro, Pixel 5/6, One Plus 8, etc), Amarisoft UE
  - Open-source RAN simulators (gNBSim, UERANSIM, My5g-RANTester, Omec-gnbsim)
  - Commercial gNBs (Amarisoft/srsRAN/Baicell) with COTS UEs

- **Stabilize 5GCN and add user-friendly functionalities**
  - Reduce image size, reduce CPU utilization footprint
  - Code cleanup for NGAP/NAS libraries
  - Provide customize APIs for User provisioning
  - Provide customize APIs for configuring AMF/SMF/UDR on the fly (e.g., get/update configuration info)
Outline

• Introduction of 5G System and OAI 5G CN project
• Current Implementation Status of OAI 5GC Components
• Roadmap
OAI 5G CN – Roadmap

Quarter 1 2023
- Mobility Support N2
- NAS Layer Improved in AMF
- Functional Testing with 5000 UEs

Quarter 2 2023
- Support of Location Services
- User-friendly YAML Centralized Configuration
- Code Quality Improvements
- Release of Network Data Analytics Functions (NWDAF)
- Release of OAI UPF Based on eBPF-XDP

Quarter 3 2023
- UE IPv6 Support (GTP-U)
- Support of Branching Point
- Support of 5G LAN-type Services
- Support for Traffic Steering/Redirection Feature
- Unit Test for AMF, SMF, and PCF
- Release of Network Exposure Function (NEF)

Quarter 4 2023
- Support of Stateless Network Functions
- Release of Unstructured Data Storage Function (USDF)

https://openairinterface.org/oai-5g-core-network-project/

OAI Hand-on Workshop, May 2022
Useful links

• Project website:
  • https://openairinterface.org/oai-5g-core-network-project/

• Git repositories
  • Federation of the OpenAir CN 5G repositories: https://gitlab.eurecom.fr/oai/cn5g/oai-cn5g-fed
  • 5GC network functions: https://gitlab.eurecom.fr/oai/cn5g

• Videos:
  • OAI 5G Core testing with commercial gNB and COTS UE: https://www.youtube.com/watch?v=N5wuhh-1dxk&t=5s
  • OAI 5G Core Network Deployment: https://www.youtube.com/watch?v=ENQiwl2EYI8

• List of COTS UEs tested with OAI CN
  • https://gitlab.eurecom.fr/oai/cn5g/oai-cn5g-fed/-/blob/master/docs/LIST_OF_TESTED_COTSUE.md
Thank you for your attention!

Q&A!