5G vRAN Technologies

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Broaden the Interoperable Ecosystem with Standardized Open Interfaces

CUS: Control, User and Synchronization plane
nFAPI: Network functional application platform interface

O-RAN Alliance
Small Cell Forum
Third Generation Partnership Project
5G Open vRAN

Support different deployment scenarios
Higher utilization of scalable resources
Efficiently deploy new services
Build RAN cost-effectively
Place processing and analytics where it is needed
Simplify orchestration
Resource pooling allows trunking gains and better cost and energy effectiveness
Rapidly scale virtual resources for additional capacity
Support lower end-to-end latency
Components can evolve and be upgraded separately
Tailor dimensioning and features to suit the use case with 5G private networks
Reduce cell-site footprint by relocating disaggregated functions to data centers
Broaden the ecosystem for competition
Vendor diversity spurs innovation

Deploy networks faster with vRAN and disaggregation
Qualcomm®
5G RAN Platforms

Building open and innovative cellular infrastructure with high performance Modem-RF System.

Qualcomm QRU100 5G RAN Platform, Qualcomm QDU100 5G RAN Platform, Qualcomm X100 5G RAN Accelerator Card, Qualcomm FSM100 5G RAN Platform and Qualcomm FSM200 5G RAN Platform are products of Qualcomm Technologies, Inc. and/or its subsidiaries.
Driving transition to Infrastructure 2.0
Powered by extended portfolio of Qualcomm 5G RAN platforms

- Standard-based open RAN interfaces
- Virtualized software from multiple vendors
- Virtualization with hardware acceleration
- Flexible, scalable, O-RAN compatible
- From Macro to Small Cells
- Integrated Sub-6 and mmWave solution
Thank you
Why OAI?
Why now?

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Overview

• The importance of standards and open interfaces
• The critical role of publicly available software reference implementations
• Why OAI?
  • Pivotal bridge between standards and community software
  • Reference architecture to unify the ecosystem of commercial, closed, and open software bases
  • Advancement of research in academia, industry, and government
• Why the time is right for OAI for YOU
• Bonus:
  • How will OAI lead the industry going forward?
Why OAI?

The Need for 5G Research Platforms

• Support research, prototype system development, and system integration/deployment
• Close alignment with standards organizations
• Validation of standards (e.g., correctness, performance, security)
• Prototyping (e.g., interoperability testing)
• Encourage and enable leading edge radio technology research in universities
Why OAI?

The Need for 5G Research Platforms

- Commercial, academic, and government research use cases:
  - Security: transparent, software-based implementations of every component for:
    - Code inspection
    - Interception, examination, and fuzzing of every internal API/interface
  - Reliability, robustness, recovery in all dimensions
  - 5G enabled use cases beyond basic mobility (massive scale IoT, XR, V2X, Satellite, …)
  - Emerging deployment models (private networks, hybrid public/private networks, slicing)
- Radio experimentation
  - Spectrum sharing
  - Massive MIMO
  - mmWave
  - PHY/MAC experimentation
Why OAI for a healthy vRAN Ecosystem?

We Need Transparent, Publicly Available Software Implementations of the Full Stack

- Fully componentized implementations with open APIs and interfaces
  - E.g., all 3GPP interfaces, O-RAN interfaces, and internal APIs such as FAPI/nFAPI
  - Containerized, cloud-ready implementations (e.g., Kubernetes, cloud-native, automatic installation and configuration)
- Open, standard Hardware Adaptation Layers to allow the integration of commercial and research components
- Mix and match of open source and commercial components
- Enable platforms for academic and government 5G research at the cutting edge
OAI: Reference implementation of the 5G vRAN

OAI 5G Stack:
- Full 3GPP 5G SA/NSA CN and RAN stack
- Goal: Componentized, containerized modules with every interface open
- RIC, private networks, etc.
- Core stack framework, APIs, and interfaces
- 3GPP R15, 16, 17, ...
- E2, O1, and other hooks to support O-RAN architecture
- Componentized, virtualized

O-RAN Alliance/OSC:
- Commercial RAN disaggregation model (RIC, O-CU/O-DU)
- RAN Intelligent Controller (Near-RealTime and Non-RealTime RIC)
- Cloudification model
- O&M
- White box reference designs

Magma Project:
- Containerized packages
- O&M
- Customization for community use cases

ONF:
- Overall carrier-scale M&O platforms
- RIC
- SDN/NFV
Reference Stack for R&D, Trials, Prototypes, and Commercial Integration

- **O&M**
  - OAI 5G CN
  - OAI 5G L3, CU
  - OAI 5G L2
  - OAI 5G L1 High
  - OAI 5G L1 Low
  - 7.2x Front haul

- **O-CU**
  - OAI 5G L3, CU

- **O-DU**
  - OAI 5G L2
  - FAPI/nFAPI
  - OAI 5G L1 High
  - OAI 5G L1 Low

- **O-RU**
  - OAI 5G L1 Low

- **Non-RT RIC**
  - OAI MOSAIC
  - Near-RT RIC

- **A1**

- **O1**

- **ONAP, ONF, etc.**
- **Private Network/ Light Weight O&M**
- **Magma, free5GC**
- **Commercial CN Components**
- **Commercial CUs**
- **Commercial DU Accelerators** (FPGAs, GPUs, NPs, SoCs)
- **Commercial DU Accelerators** (e.g., OSC L3)
- **Commercial DU Accelerators** (SDR, FPGA, ASIC/SoCs)
- **Cloud O&MaaS**
- **Cloud CNaaS**
- **Commercial Cloud Platforms, Including MEC**
- **Custom Radio Research Platforms**

- **E2**

- **N2/N3/etc.**

- **Fronthaul**
Why OAI?

OAI’s Pivotal Relationships with Key Partners

• Close alignment and partnership with all the key standards organizations
  • 3GPP
  • O-RAN Alliance
  • Small Cell Forum

• Strong cooperation with other software projects and stacks
  • O-RAN Software Community
  • Magma Foundation
  • Integration testing with commercial and open source partner components (e.g., accelerators, SDRs)

• Strong academic relationships in multiple regions

• Wide support by commercial vendors

• Balanced publicly available software license
Why OAI?

OAI’s Technical Excellence as the Most Complete 5G Reference Implementation

- Striving for completeness of features in standards
  - All major entities and interfaces from 3GPP architecture
  - All major interfaces and entity structure from O-RAN Alliance
  - Hardware and platform interfaces (e.g., FAPI, containerization)
- Free from unnecessary extensions or non-standard features
- Core developer team and contributor community with exceptional technical expertise
  - 3GPP 4G/5G Radio Technologies
  - RAN-CN interfaces and entities
  - CI/CD expertise and practice
OAI Technical Strength in 3GPP 5G Architecture

Core Network

RAN
Why OAI now?

OAI is at the tipping point.

• Performance, stability, functionality are radically improving
  • See demos at this workshop; hard to even keep up!

• Community is expanding rapidly, which will lead to exponential advancements in quality
  • E.g., Advisory Board membership expansion!

• Broad support from technology vendors can improve interface consistency and interoperability, e.g.,
  • Hardware accelerators from Xilinx, NVIDIA, Qualcomm, and others
  • (O-)RU and (O-)DU implementations from many vendors
  • Containerization and pre-built images
  • Alignment and cooperation with other industry projects like Magma and OSC
Where can OAI head in the future?

- The OAI 5G stack is reaching maturity relatively early in the 5G lifecycle
- Potential for viable OAI-derived commercial-quality code bases for some use cases is emerging
- OAI positioned well for evolution as a 6G/nG research platform of choice
  - Assessment, experimentation, validation of new ideas
  - Academic/government/industry collaboration
  - Proof of concept
- Work is underway, and OAI will be well represented
  - O-RAN Alliance nGRG (“nG Research Platforms”)
  - Government research programs
Thank you!