Open AI Cellular (OAIC): Prototyping AI-enabled Control and Testing Systems for Cellular Communications Research

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OAIC - Enabling AI/ML native Cellular Research

While there is lots of optimism in the wireless research community on AI, the reality is that

- There needs to be sufficient real-world experience at scale to prove the added expense of AI is justified in improved performance.
- AI in the network needs to be extensively tested with the rigor that other elements of the network are tested today.

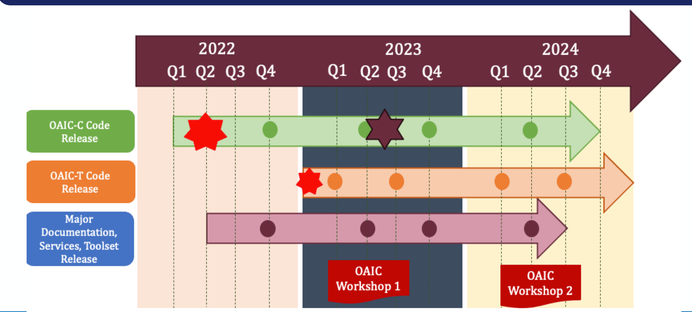
- **Key Research Questions**

- How do we design cellular networks to be more AI suitable at various locations?
- What methodologies apply to test AI performance at various locations in the network?
- How do we test for cross-layer interactions of AI deployed at various points in the network?

OAIC Mission: Provide a fully open-source CIRC infrastructure and tools that spur research, prototyping and testing artificial intelligence-based radio access network (RAN) controllers for next-generation cellular networks.

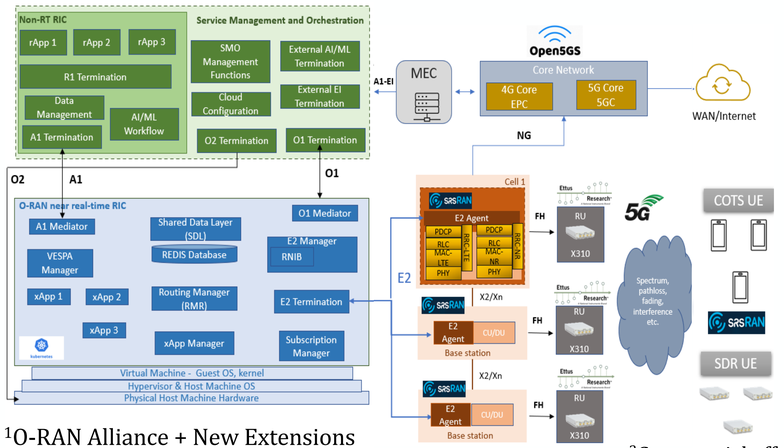
OAIC
- **Open AI-enabled Cellular RAN Controllers (OAIC-C)**
- **OAIC RAN Testing (OAIC-T) Framework**

OAIC Timeline



Open AI-enabled Cellular RAN Controllers (OAIC-C)

OAIC-C => O-RAN Architecture[1] + 5G Protocol[2] + Software Radios[3]



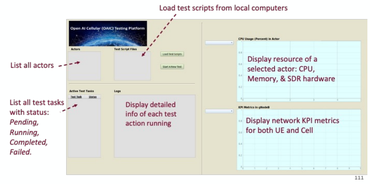
[1]O-RAN Alliance + New Extensions

[2]Open-source software

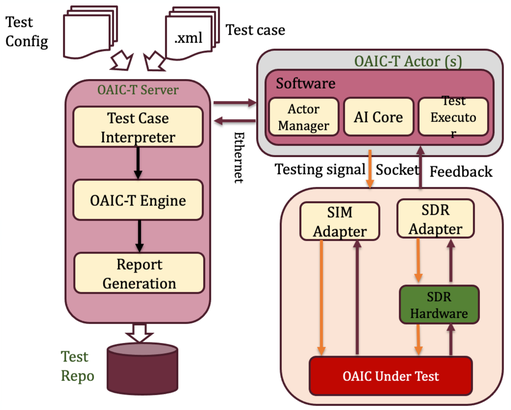
[3]Commercial off-the-shelf hardware

Open AI enabled Cellular RAN Testing (OAIC-T)

- Support automated, multitasking, and distributed **testing**.
- Both modes to test OAIC
  - Simulation
  - SDR Hardware



OAIC-T 1.0 capabilities



OAIC-T 1.0 Framework

Join the OAIC Community

Tell us about your interests, feedback, research problem
User group: https://groups.google.com/g/oaic-user
Follow OAIC website: www.openaicellular.org
Mailing list: openaicellular@gmail.com
YouTube Channel: www.openaicellular.org/videos

OAIC 2.0 Capabilities and Resources

OAIC Capabilities

- 4G and 5G Support
- OSC Near-RT RIC and Non-RT RIC
- Lightweight E2 Implementation
- ZMQ with multiple UE Support

Sample AI-driven xApps

- KPIMON xApp - OSC
- RAN Slicing xApp - POWDER
- RL Scheduling xApp - OAIC
- Interference Class. xApp - OAIC
- OAIC-T test xApp - OAIC

Code Repository: https://github.com/openaicellular/oaic

Documentation: https://openaicellular.github.io/oaic/

Website
3.5K unique visitors
7.5K page views

OAIC Community Growing!

GitHub
80-220 unique visitors/week
30-100 unique clones/week

Google Group
80+ Subscribers

OAIC Workshop
150+ attendees
14+ institutions

Enabled Research and Experimentation

- AI-driven RAN Controllers (xApps /rApps)
- Spectrum sharing
- O-RAN Security and Privacy
- Cellular RAN Testing
- Security of Open Interfaces
- And ...

OAIC publications (partial list)

- Upadhyaya, P.S., Abdalla, A.S., Marojevic, V., Reed, J.H. and Shah, V.K. Prototyping Next-Generation O-RAN Research Testbeds with SDRs.(2022). https://arxiv.org/abs/2205.13178
- Abdalla, A.S., Upadhyaya, P.S., Shah, V.K. and Marojevic, V. Toward next generation open radio access networks: What O-RAN can and cannot do!. IEEE Network, 36(6), pp.206-213, 2022.
- Reus-Muns, G., Upadhyaya, P., Demir, U., Stephenson, N.H., Soltani, N., Shah, V.K., and Chowdhury, K. SenseORAN: O-RAN based Radar Detection in the CBRS Band, in IEEE JSAC Special issue on Open RAN (Accepted).
- Kouchaki, M. and Marojevic, V., Actor-critic network for O-RAN resource allocation: xApp design, deployment, and analysis. Proc. 2022 IEEE GLOBECOM Workshops, Dec. 4-8, 2022, pp. 968-973.
- Pratheek S. Upadhyaya, Nishith Tripathi, Joseph Gaeddert, and Jeff H. Reed. Open AI Cellular (OAIC): An Open Source 5G O-RAN Testbed for Design and Testing of AI-based RAN Management Algorithms. IEEE Network Magazine 2023 Tang, B., Shah, V. K., Marojevic, V., and Reed, J. H. AI Testing Framework for Next-G O-RAN Networks: Requirements, Design, and Research Opportunities. IEEE Wireless Communications, 30(1), 70-77, 2023.
- Abdalla, A.S. and Marojevic, V. End-to-End O-RAN Security Architecture, Threat Surface, Coverage, and the Case of the Open Fronthaul. Under Review IEEE Commun. Standards Mag., pp. 1-8, https://arxiv.org/abs/2304.05513

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