

# Cloud-Native O-RAN

## Internship Projects/Mentors

Title	Cloud-Native O-RAN
Status	NOT ACCEPTING APPLICATIONS - NOW IN EVALUATING STAGE
Difficulty	MEDIUM

## Description

5G/6G wireless networks based on O-RAN architecture will have O-RAN Network Functions (NFs) deployed on the O-cloud infrastructure. The cloud infrastructure and the NF orchestration is managed by the SMO using the O-RAN O2 interface. Open-source projects such as O-RAN SC, ONAP, Nephio, OAI are actively engaged in developing open-source software for O-RAN networks, in alignment with guidance from the O-RAN Open-Source Focus Group.

Building on the progress of open-source implementation of O-RAN NFs, the open-source community is now focusing on implementation of cloud-native O-RAN NF (e.g., O-CU, O-DU) as well as the SMO functionality to manage them via the O2 interface. There is an opportunity to set up an implementation in a university testbed to participate in the open-source projects, and enable research in cloud-native O-RAN (e.g., methods of monitoring the energy consumption of the cloud infrastructure and the NFs)

In this project the student will leverage open-source code and

- implement an example O-cloud infrastructure hosting one or more O-RAN NF(s) (e.g. O-CU, O-DU) at Rutgers University WINLAB (<https://winlab.rutgers.edu/>)
- develop a setup and tutorial to enable multiple users to replicate the cloud-native open-source implementation and contribute to open source
- study and develop open-source software to support management/data collection of the infrastructure and NFs from the SMO, using energy consumption as an example

## Additional Information

Following links are to open-source projects related to O-cloud/SMO and O-RAN Alliance specifications

1. O-RAN SC SMO project: NF Orchestration Using SMO: <https://wiki.o-ran-sc.org/download/attachments/110788981/NF%20Orchestration%20Using%20SMO%20%28Design%20details%29.pdf?version=1&modificationDate=1707960856308&api=v2>
2. O-RAN SC INF project for O-cloud: <https://wiki.o-ran-sc.org/pages/viewpage.action?pageId=1179726>
3. Joint ONAP/O-RAN SC Discussions - [ONAP/O-RAN-SC/SMO Meetings - Developer Wiki - Confluence](#)
4. O-RAN Architecture Description 11.0, O-RAN.WG1.OAD-R003-v11.00, [O-RAN Downloads \(orandownloadsweb.azurewebsites.net\)](#)
5. O-RAN Cloud Architecture and Deployment Scenarios for O-RAN Virtualized RAN 6.0 O-RAN.WG6.CADS-v06.00 [O-RAN Downloads \(orandownloadsweb.azurewebsites.net\)](#)

## Learning Objectives

The student will learn:

- to work with the industry experts in the open-source community
- to deploy and test open-source code, and contribute back to the open-source projects
- to integrate open-source work with other university/industry research initiatives
- from interactions with industry/academia experts and other interns

## Expected Outcome

- Implement an example O-cloud infrastructure in Rutgers WINLAB using methods aligned with LF/LFN open-source projects. We intend to make this available to users globally to perform academic/open-source research
- Demonstrate instantiation of sample O-RAN NF(s) on O-cloud
- Implement sample SMO functionality for cloud management/orchestration
- Demonstrate data collection from cloud/NF(s) through O2 interface (e.g. energy consumption of O-DU)

## Relation to LF Networking

This project enhances the wireless networking open-source ecosystem. It will use code from, and enhance, LF/LFN projects such as O-RAN SC, ONAP, and Nephio. Note that there are ongoing efforts to harmonize the work in various LF/LF projects in areas related to the O-RAN O-Cloud and SMO.

## Education Level

Preference will be given to graduate students, and students with interest in pursuing this work for their graduate research. The student can work remotely, or join other interns onsite at Rutgers WINLAB in North Brunswick, NJ.

## Skills

- Programming experience, especially in cloud and network-related applications in languages such as: Python, Java, C/C++, Go
- Knowledge/experience of cloud systems, particularly Kubernetes/Docker
- Knowledge/experience with unix/linux, IP networking
- Experience with open-source, software configuration management, software development preferred
- Experience with network interfaces and APIs preferred
- Knowledge of wireless networks, network management is a plus

## Future plans

The results of this project will contribute back to the open-source projects. We plan for this work to integrate with Rutgers WINLAB research projects. The learnings from each project feeds into other projects and will be captured as part of the knowledge base to help train future contributors.

## Preferred Hours and Length of Internship

Full-time (40 hours a week for 12 weeks during the summer)

## Mentor(s) Names and Contact Info

N.K. Shankaranarayanan [shankar@winlab.rutgers.edu](mailto:shankar@winlab.rutgers.edu), Rutgers WINLAB

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## Application Process

This project will be managed as part of the Rutgers University WINLAB summer internship program which lists Cloud-Native O-RAN as one of the summer projects. To apply for this LFN Mentorship project:

1. Please go to the Rutgers WINLAB page listed below and follow the instructions there to apply for the internship, and make sure you state that you are applying for the LFN Cloud-Native O-RAN mentorship project. This LFN mentorship page has more details and requirements; so make sure to address those in your statement / essay. Note that the LFN mentorship term is June1-Aug31 which runs a little longer than the Winlab summer internship program May28-Aug 7. Due to the volume of applications, we may not respond till April 28. So please be patient.  
Rutgers WINLAB Summer 2024 Internship page: <https://winlab.rutgers.edu/prospective-students/summer-internship/>
2. Please also do the following:
  - Send an email to:
    - [shankar@winlab.rutgers.edu](mailto:shankar@winlab.rutgers.edu)
    - with CC: [mentorship@lfnetworking.org](mailto:mentorship@lfnetworking.org)
  - Include your name, resume, and a statement of why you would be best for this project.
  - Due to the volume of applications, we may not respond until up to April 23rd.
    - Please be patient.