

# Sigcomm 5G-MeMu workshop

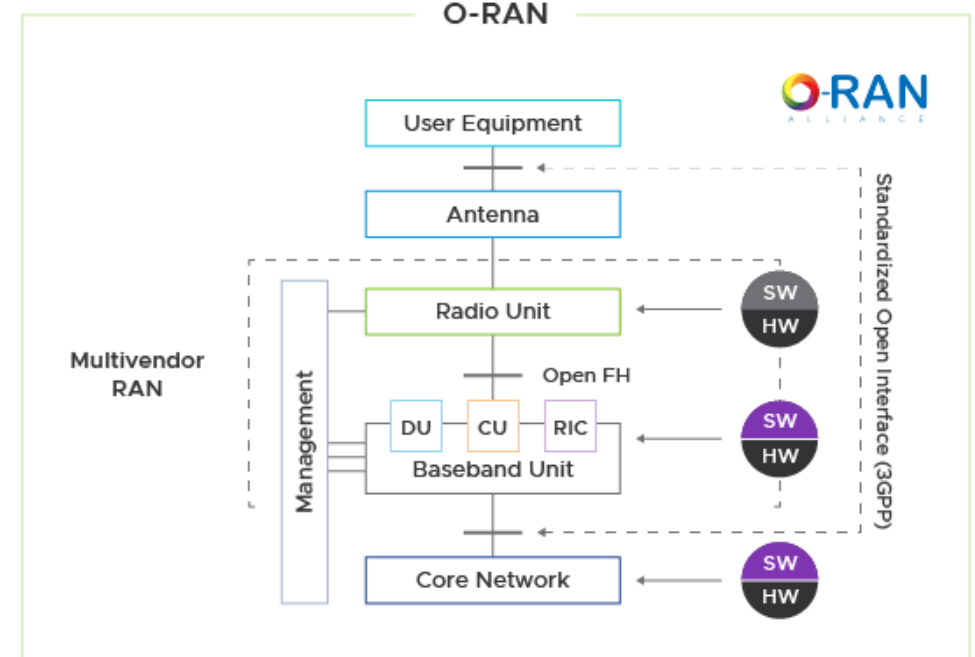
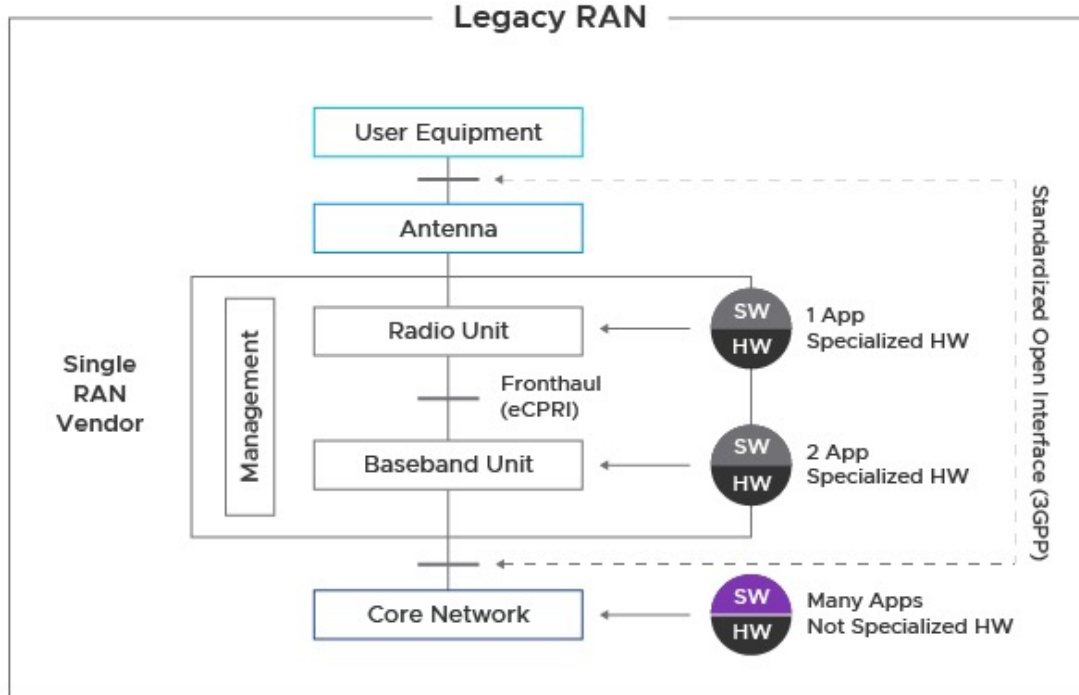
## **O-RAN Software Community (OSC) Progress**

Rittwik Jana, Google

OSC Requirements & Software Arch. Committee (RSAC) co-chair

- What is Open RAN?
- Overview of OSC
- OSC releases and features
- How can you help?

# Traditional RAN vs Open RAN



Source: RAN Transformation [book](#), VMware

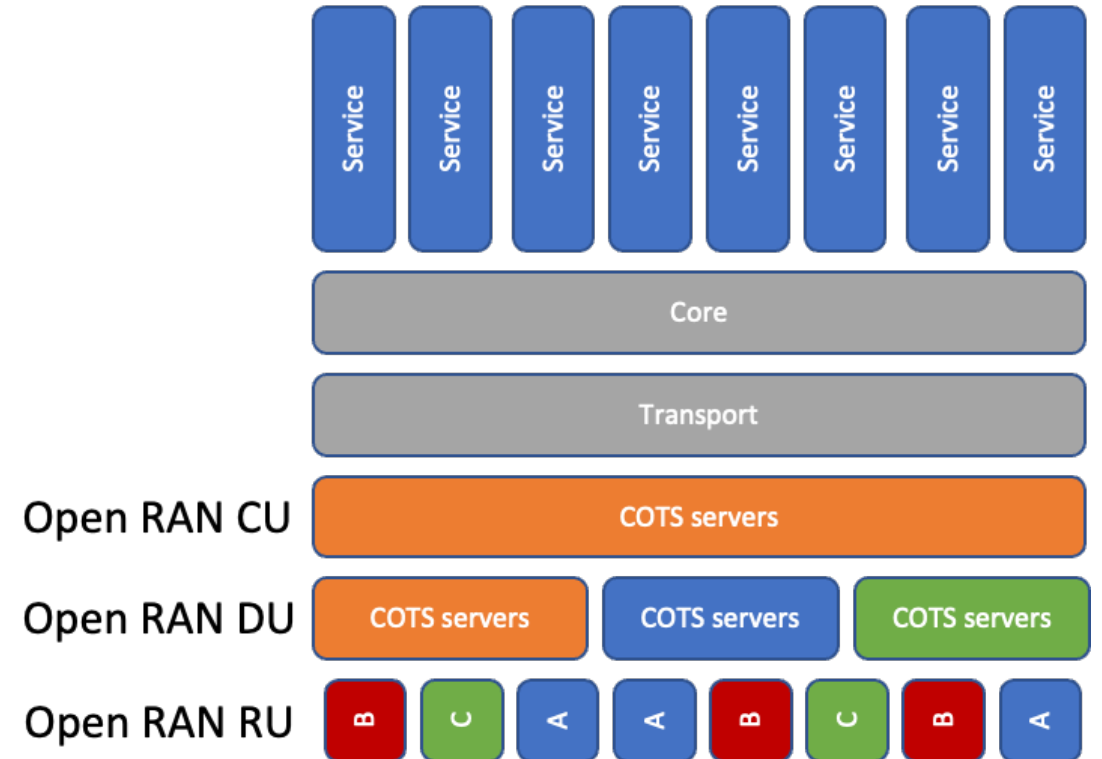
# What is Open RAN?

**Openness** – Interfaces between different functions or logical nodes in O-RAN architecture are open interfaces to achieve multi-vendor interoperability and co-existence across the functions

**Virtualization** - The network function (NF) implementations in O-RAN architecture are migrated from vendor-proprietary hardware to commercial-off-the-shelf (COTS)

**Intelligence** - RAN functions are now open to radio resource management (RRM) by third-party optimization solutions deployed in a new centralized controller function, called the RAN intelligent controller (RIC)

**Programmability** - Optimizations are programmatically configured and adapted using AI/ML-driven declarative policies, based on continuous monitoring of network and UE performance.



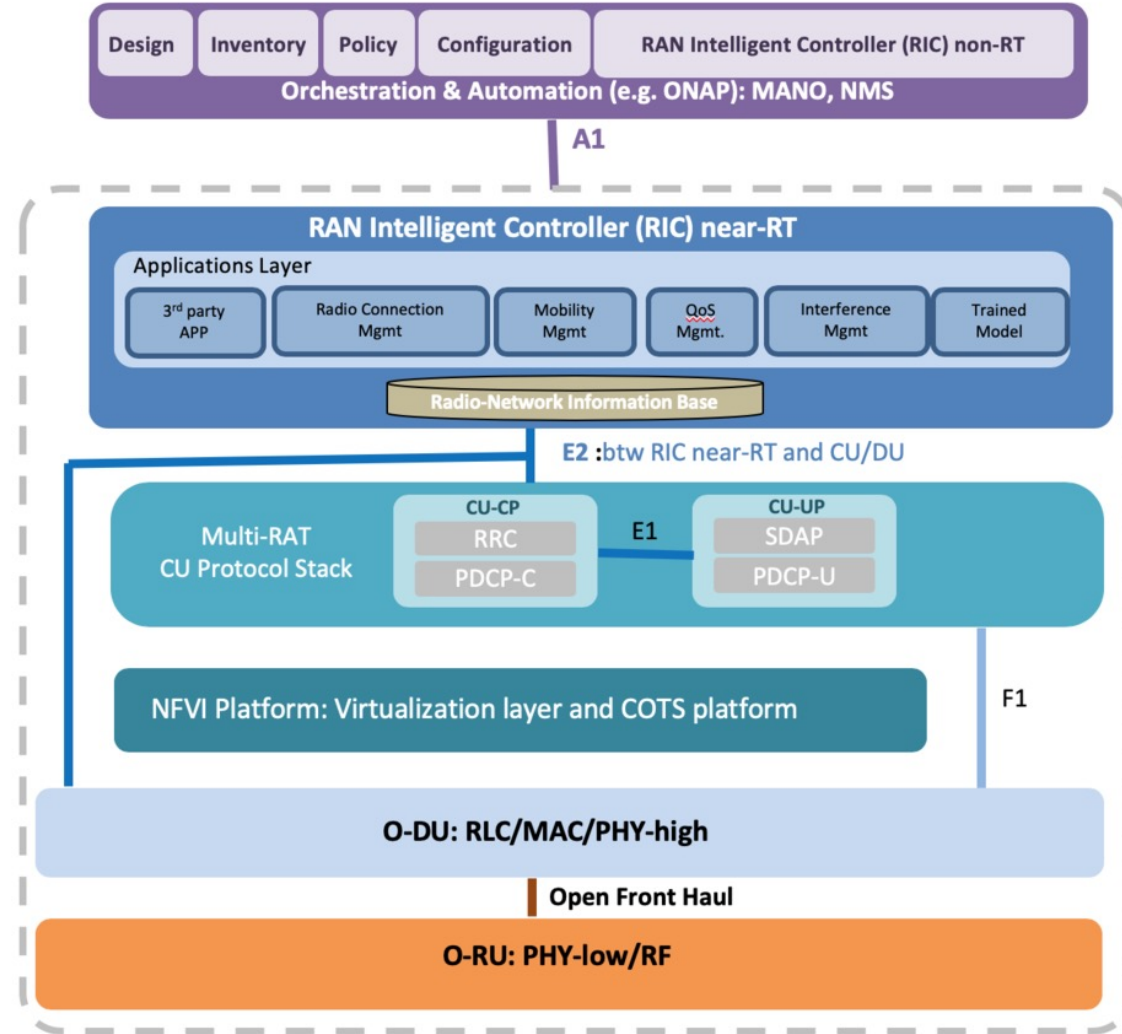
# O-RAN Alliance Workgroups



O-RAN ALLIANCE Wiki Home Home Recent

### Workgroups

- TSC - Technical Steering Committee
  - MVP-C - Minimum Viable Plan Committee
  - ACOP - Ad-hoc Committee for O-RAN Procedures
  - nGRG - next Generation Research Group
- Working Groups (with related Task Groups, if any)
  - WG1 - Use Cases and Overall Architecture Workgroup
  - WG2 - Non-Real-time RIC and A1 Interface Workgroup
  - WG3 - Near-Real-time RIC and E2 Interface Workgroup
  - WG4 - Open Fronthaul Interfaces Workgroup
  - WG5 - Open F1/W1/E1/X2/Xn Interface Workgroup
  - WG6 - Cloudification and Orchestration Workgroup
  - WG7 - White-box Hardware Workgroup
  - WG8 - Stack Reference Design Workgroup
  - WG9 - Open X-haul Transport Workgroup
  - WG10 - OAM for O-RAN
  - WG11 - Security Work Group
- Focus Groups
  - IIEFG - Industry Engagement Focus Group
  - OSFG - Open Source Focus Group
  - SDFG - Standard Development Focus Group
  - TIFG - Test & Integration Focus Group
  - SuFG - Sustainability Focus Group
- O-RAN Software Community ←
- CEAG - Communications and Events Advisory Group



Today's topic

← → ↻ wiki.o-ran-sc.org

Confluence Spaces Create

O-RAN SC TOC Committees Projects Software Documentation Events Meetings Releases Partnerships Participate

O-RAN SC

Pages

Blog

SPACE SHORTCUTS

- O-RAN-SC Docs
- O-RAN-SC Gerrit
- O-RAN-SC Jira

PAGE TREE

- CLA
- Project Developer Wiki
- O-RAN SC Committees
- Partnerships
- Presentations
- Projects
- File lists
- How to Check in Large File(s) to Gerrit

Pages

## O-RAN Software Community

Created by Anonymous, last modified by Sridhar Rao on Jul 31, 2023

Important Links

For more information on the O-RAN Software Community project, charter and our mission go to <https://o-ran-sc.org/>

If you are interested in learning more about the O-RAN Alliance please see <https://www.o-ran.org>

### Attention: The O-RAN Software Community has delivered the Eighth release named "H" Release!

For all the information on the latest release including software, documentation, and help; please check out the Releases menu or click on the link: ["H" Release July 2023](#)

See the [O-RAN Virtual Exhibition](#)

For those of you who would like to dive in please check out the new [Getting Started User Guide](#) for the H Release.

Welcome to the O-RAN Software Community (OSC) wiki.

This community is partnering with the O-RAN Alliance and Linux Foundation to support the software develop for an open RAN solution that is available to everyone. The community will align with the architecture and specifications that are creat to create a working software solution to enable an open and intelligent 5G radio access network.

This wiki is open to everyone but will require a Linux Foundation ID to contribute or change the material. If you are interested in learning more about the O-RAN Alliance please see <https://www.o-ran.org/>.

To learn more about activities of the O-RAN Software Community you can explore the wiki. Please take a look at the [TOC](#) which provides oversight on the project.

A few key points about the OSC is that it supports two types of projects with each having a charter to provide structure for software contributions. They are the O-RAN Software Community which utilizes the Apache 2 license and the other is th the O-RAN License. Apache 2 is the standard license for open source O-RAN software contributions. The O-RAN License supports software that addresses RAN essential licensing and supports fair, reasonable, and non-discriminatory (FRAND

We delivered our first release (Amber) in November 2019 and will work with the community to continue to develop a software solution and make it open.

Please check back on our progress or even better join in and help move the RAN forward!

## Technical Operating Committee (TOC)

Requirements & Software Arch. Committee (RSAC)

Non-real-time RIC (A1 Interface) (NONRTRIC)

Near real-time RIC Platform (E2 Interface) (RICP)

Near Real-time RIC X-APPS (RICAPP)

OAM (O1 Interface)

O-RAN Central unit(O-CU)

O-DU High

O-DU Low

Simulation (SIM)

Infrastructure (INF)

Integration and Test (INT)

Documentation (DOC)

Service Mgmt. and Orchestration (SMO)

AI/ML Framework (AI/ML)

## TOC Voting Members

Company	Name	Alternate
AT&T	David Kinsey Co-Chair	
China Mobile	Jinri Huang Co-Chair	James Li
Deutsche Telekom	Jakub Nový	Ondřej Hudousek
Ericsson	John-Paul Lane	John Keeney
NTT DOCOMO	Masafumi Masuda	Anil Umesh
Nokia	Arunkumar Halebid	Thoralf Czichy
Orange	William Diego	Vincent Danno
Radisys	Ganesh Shenbagaraman	Ankit Barve
TIM	Andrea Buldorini	
Wind River	Bin Yang	Jackie Huang
Viavi Solutions	Ultan Kelly	Baruch Friedman
Samsung	Avinash Bhat	Hunje Yeon

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Project Key	Project Name	PTL
RICAPP	RIC Applications	@SUNIL SINGH
RIC	Near Realtime RAN Intelligent Controller	@Thoralf Czichy
OCU	O-RAN Central Unit	TBD
ODUHIGH	O-RAN Distributed Unit High Layers	@Manasi Padhy
ODULOW	O-RAN Distributed Unit Low Layers	@Luis Farias
ORU	O-RAN Radio Unit	TBD
OAM	Operations and Maintenance	@Martin Skorupski
SIM	Simulations	@Alex Stancu
INF	Infrastructure	@Jackie Huang
INT	Integration and Testing	@James Li
DOC	Documentation	@weichen ni
NONRTRIC	Non-RealTime RIC (RAN Intelligent Controller)	@John Keeney
SMO	Service Management and Orchestration (SMO)	@Mahesh Jethanandani
AIMLFW	AI/ML Framework	@hoejoo lee

# O-RAN Software Community (OSC) Workflow



Technical Operating Committee (TOC)

TOC

RSAC discusses use cases, call flows and architecture

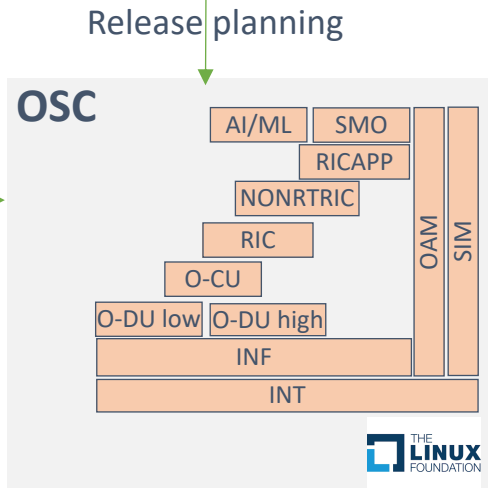
Req. Comm. (RSAC)

Recommended features for inclusion in OSC release

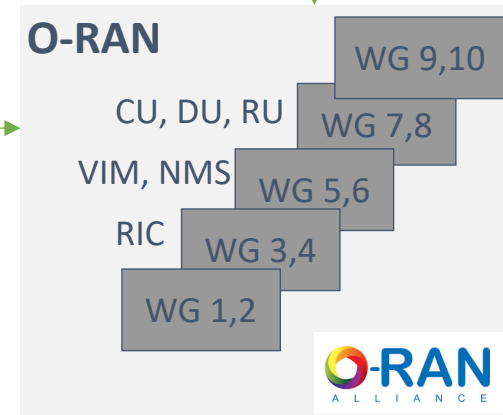
WG1 (ATG), MVP-C, TIFG

Define O-RAN end-to-end priority use cases  
Recommend MVP features from each WG  
Coordinate between WGs to ensure required specs are released

Pre-standards development and code contributions from YOU !! operators, vendors, universities, etc.

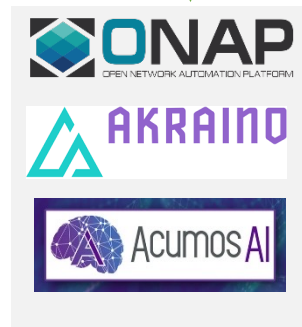


OSC s/w releases →  
← O-RAN feedback



Public O-RAN Specifications

Engage other open source communities



## O-RAN Software Community

The O-RAN Software Community (SC) is a collaboration between the O-RAN Alliance and Linux Foundation with the mission to support the creation of software for the Radio Access Network (RAN). The RAN is the next challenge for the open source community. The O-RAN SC plans to leverage other LF network projects, while addressing the challenges in performance, scale, and 3GPP alignment.

9.08K  
Commits



141  
Repositories



5.14M  
Lines Of Code



4.45K  
Pull Requests / Changesets



81.33K  
Builds



2.67K  
Emails



No Data  
Earned Media Mentions



3.83K  
Total Issues



No Data  
Messages



1.14K  
Documents



No Data  
Registry



3M

6M

1Y

2Y

3Y

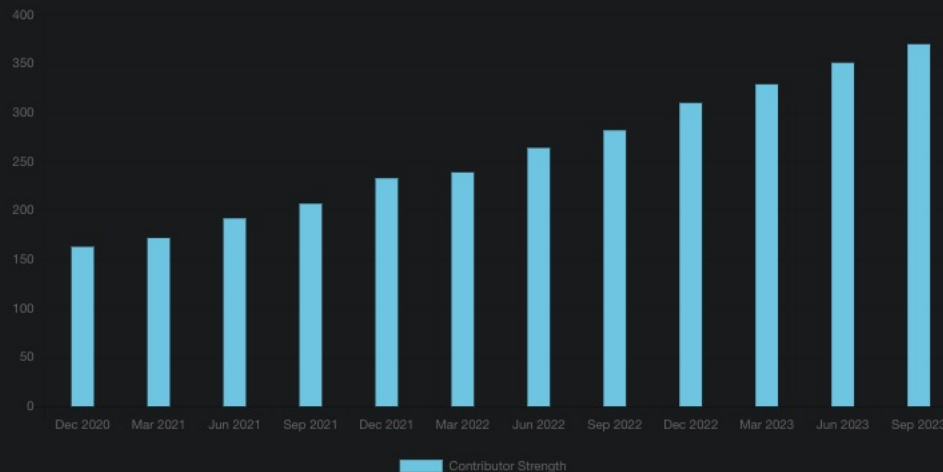
5Y

10Y

SINCE 2000

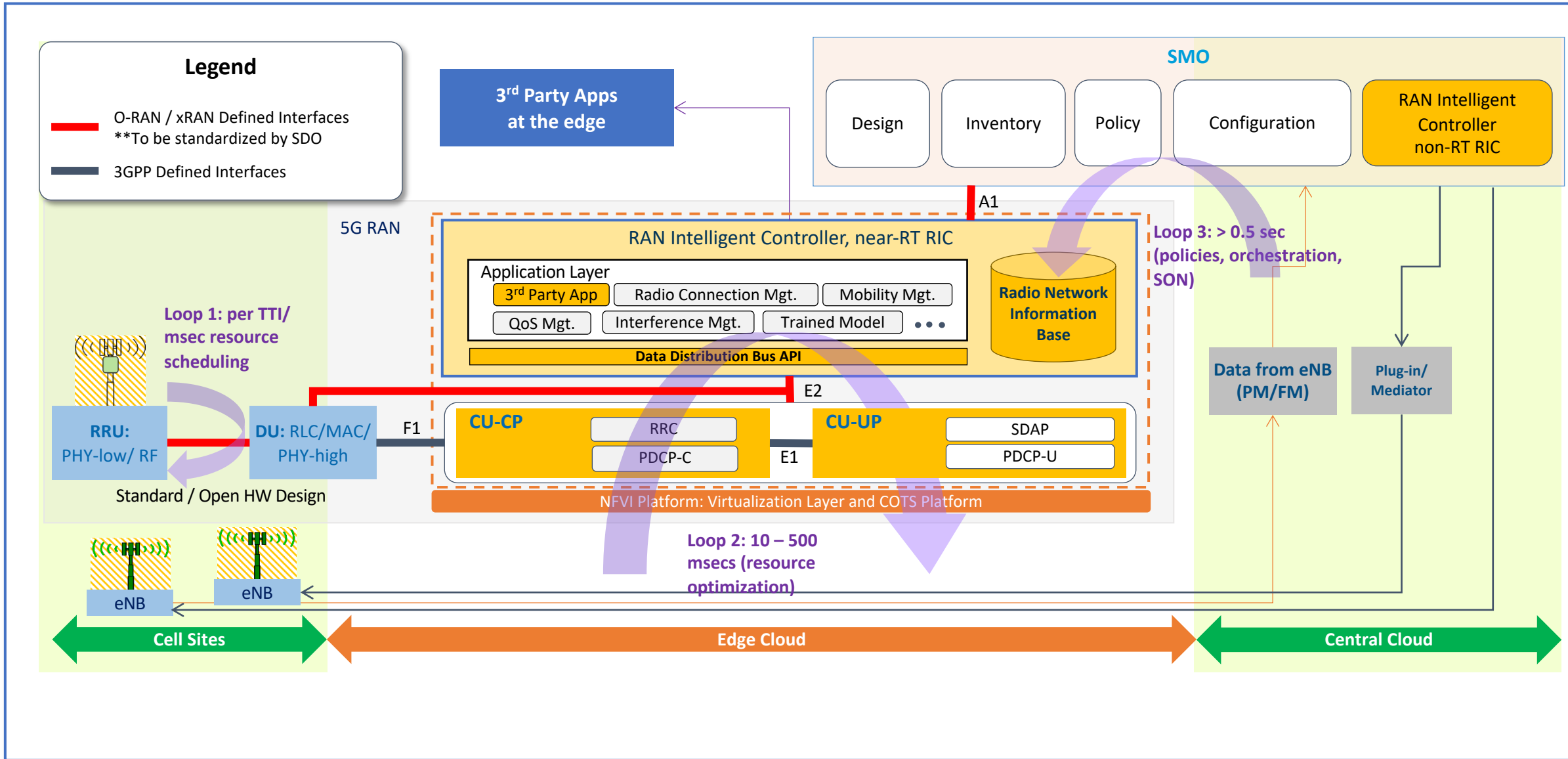
## Contributor Strength

The growth in the aggregated count of unique contributors analyzed during the selected time period. A contributor is anyone who is associated to the project by means of any code activity (commits/PRs/changesets) or helping to find and resolve bugs.

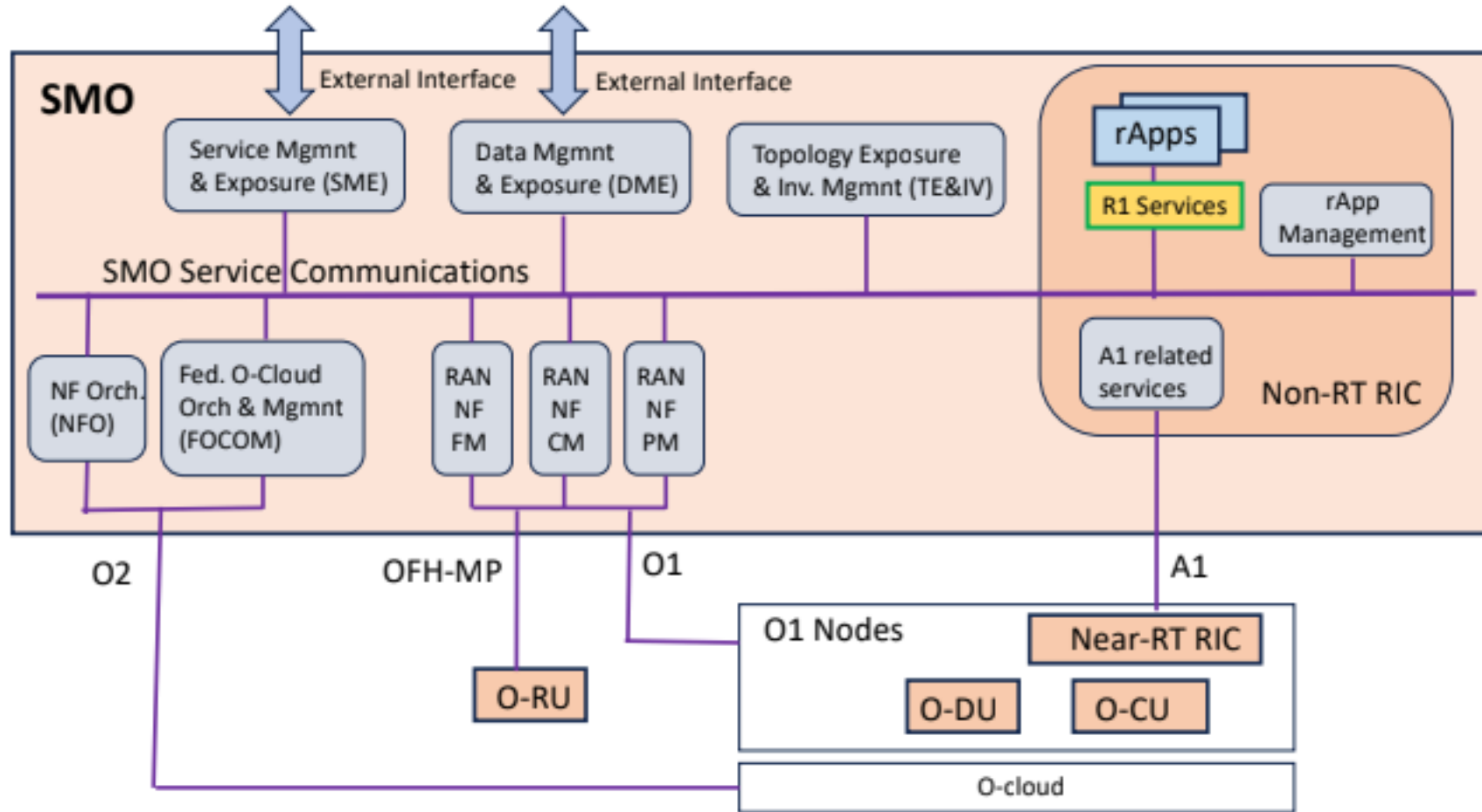


The average contributor strength was 259 during the last 3 Years.

# Control loops in O-RAN

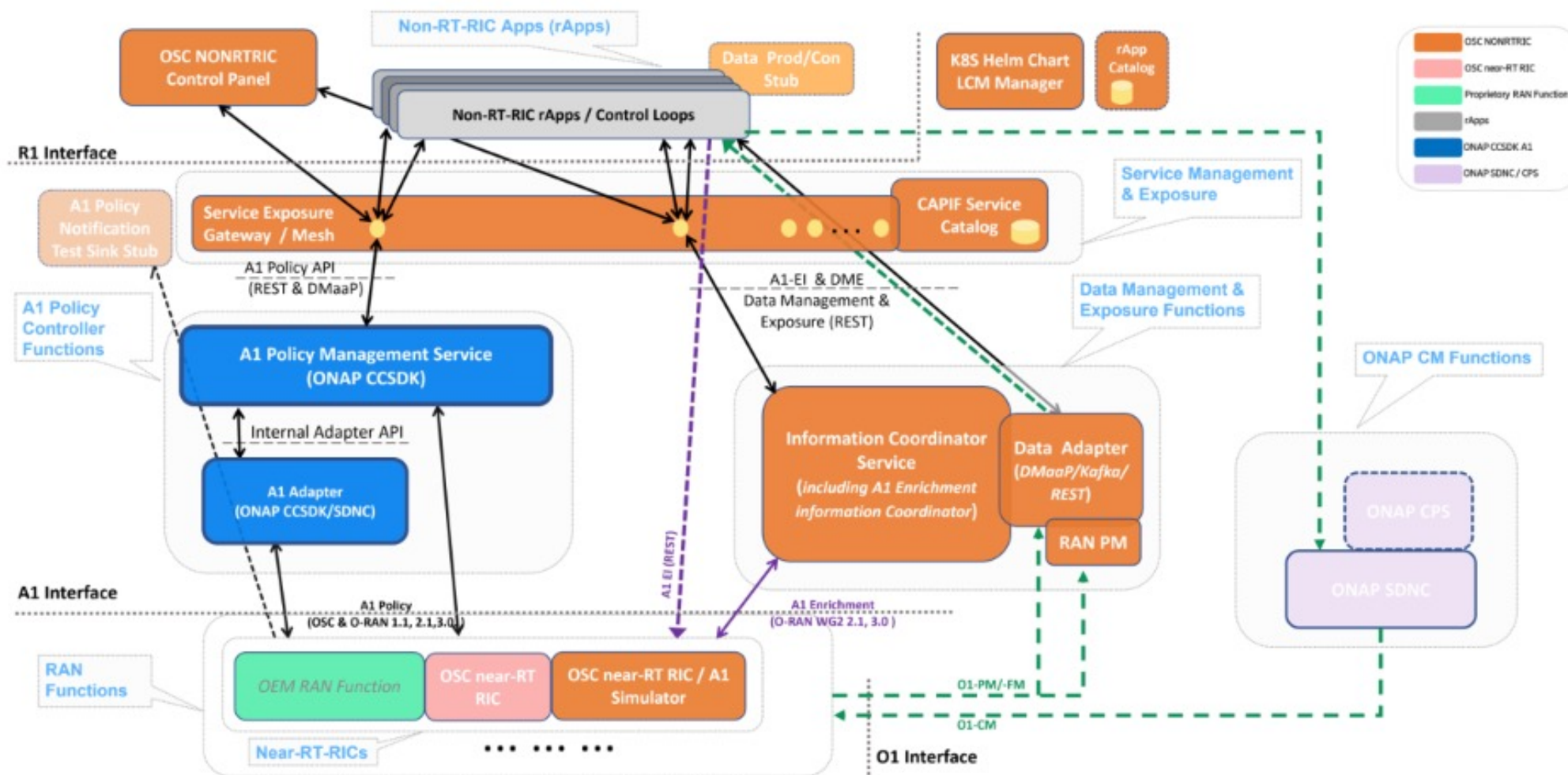


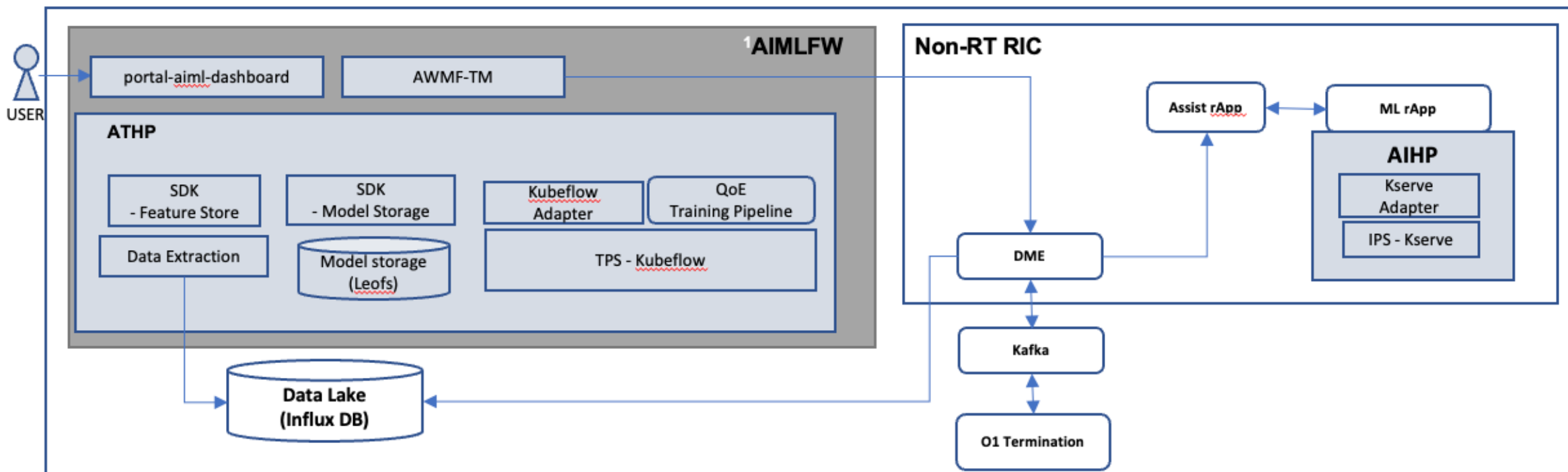
Current draft of O-RAN SMO architecture (June 2023)



Ref: O-RAN Decoupled SMO Architecture Decoupled SMO Architecture TR-R003-v01.00.09

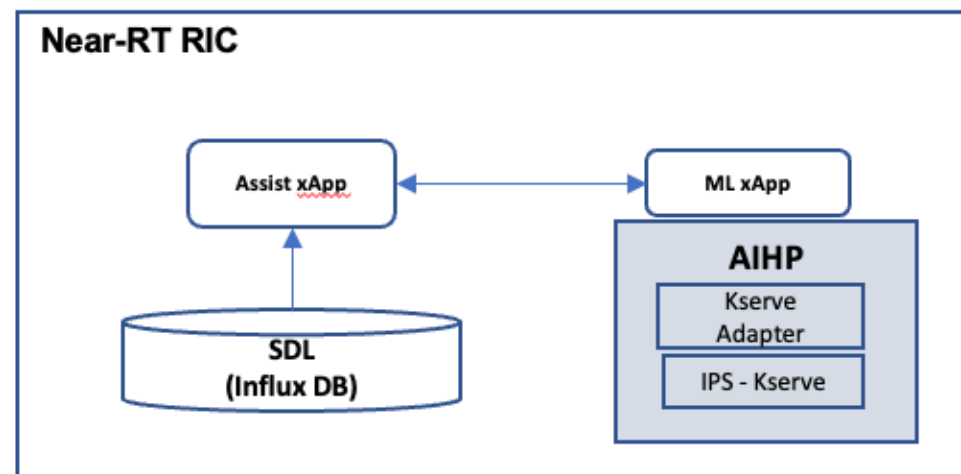
OSC is building some of the components of this disaggregated architecture



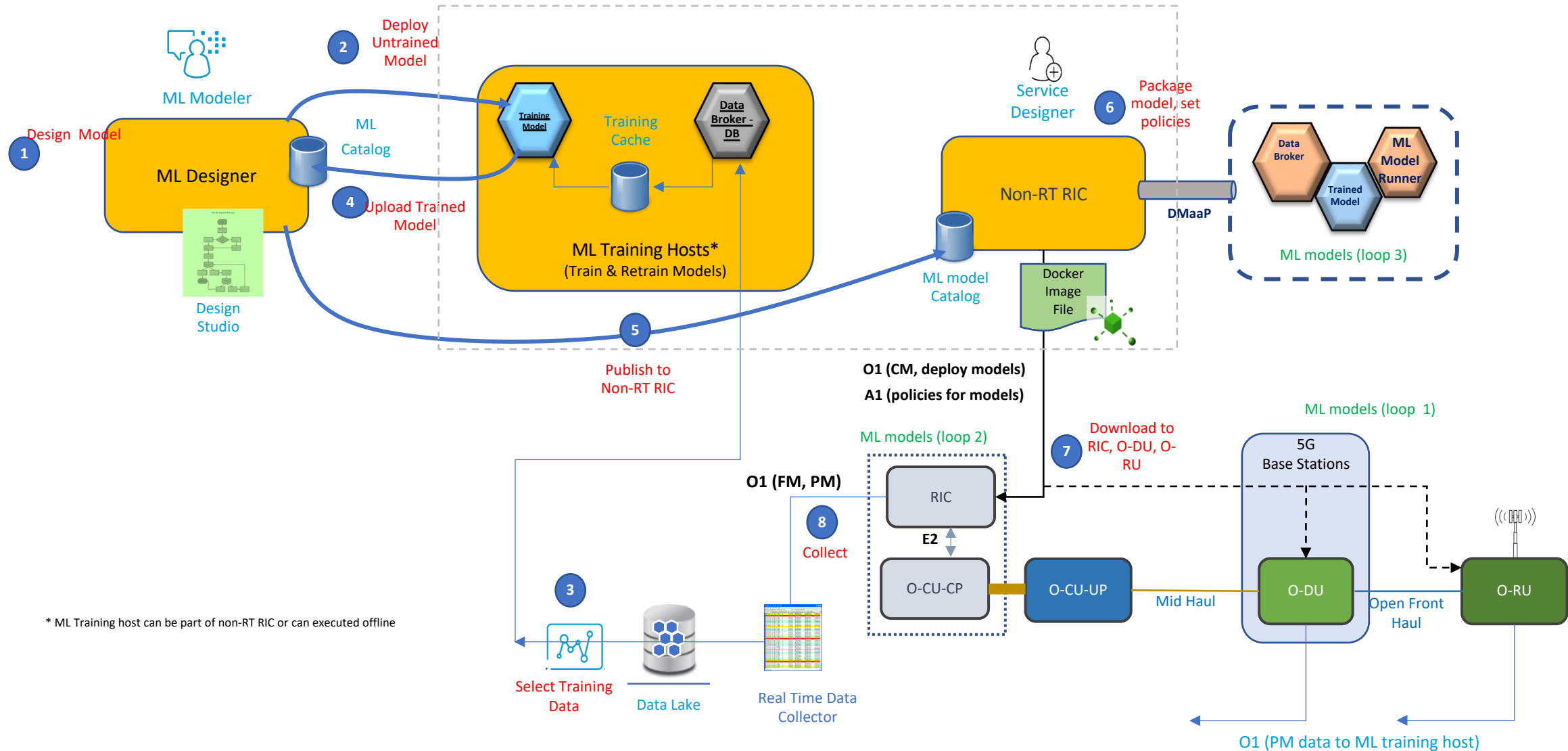


AIMLFW	AI/ML Framework
AWMF	AI Workflow Management Function
TM	Training Manager
TPS	Training Platform Service (e.g. <u>Kubeflow</u> )
ATHP	AI Training Host Platform
IPS	Inference Platform Service (e.g. <u>Kserve</u> )
AIHP	AI Inference Host Platform

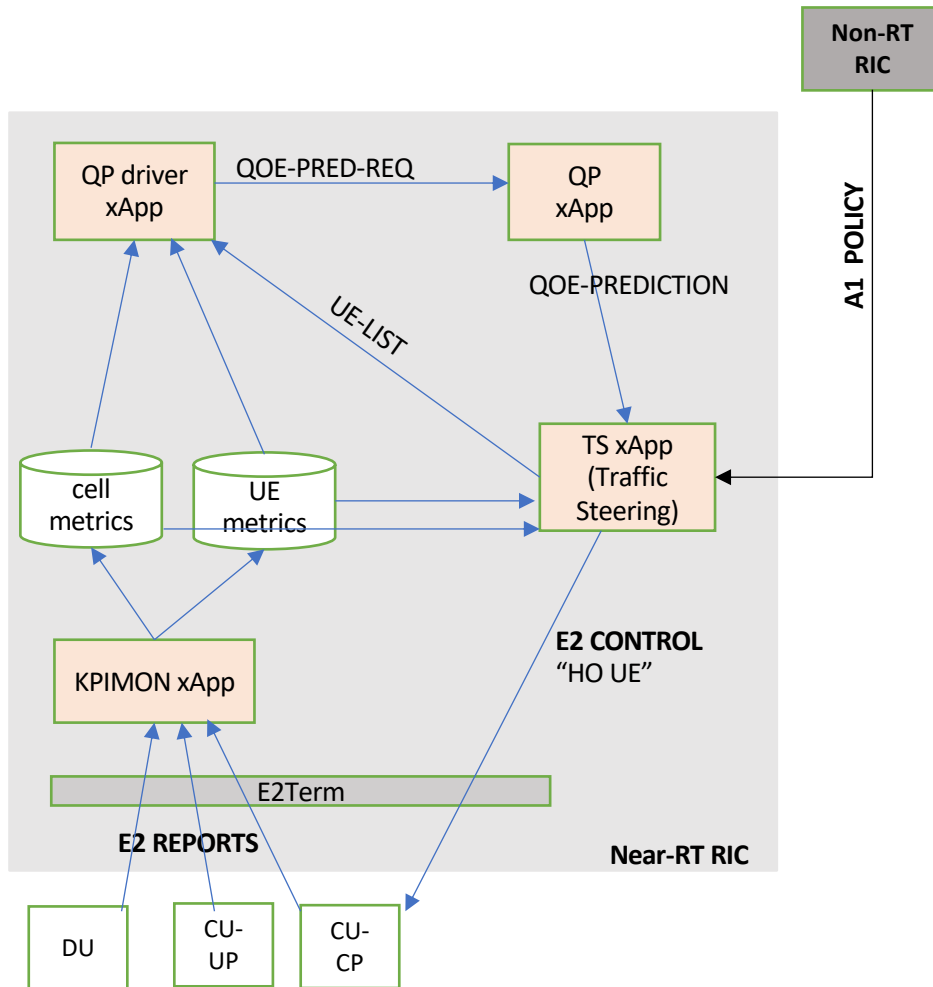
<sup>1</sup>Location of AI Training functions is not fixed and may vary according to usecase.



# ML workflow



# OSC End-to-end control loop use case: Traffic Steering



## Closed loop control

- ML based Traffic Steering algorithm
- ML model trained and loaded in QoE predictor
- Initial POLICY from non-RT RIC
- Measurement data collected from E2 nodes
- QoE prediction and Traffic Steering analytics in near-RT RIC
- CONTROL action to E2 node to handoff user from Cell A to Cell B'
- Multi-vendor example
- OSC Cherry Release (Dec 2020)
- <https://wiki.o-ran-sc.org/pages/viewpage.action?pageId=20876303>

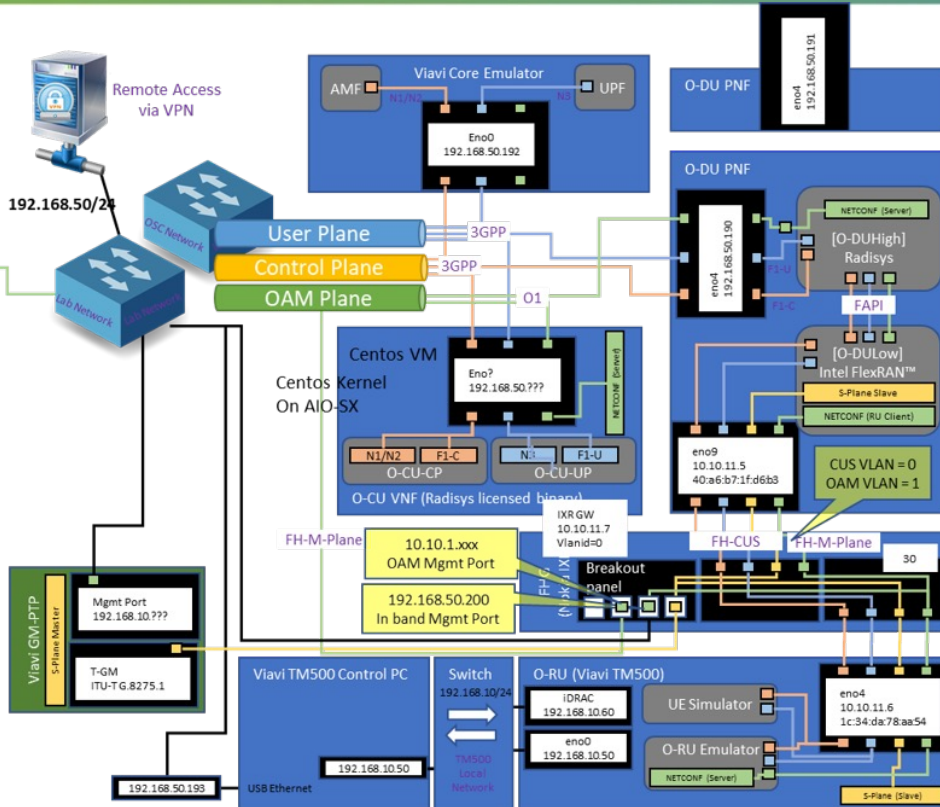
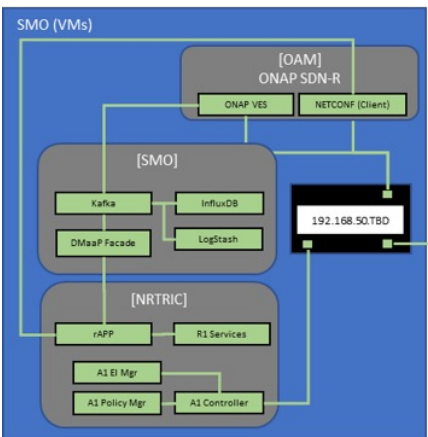
# OSC "I" Release Timeline



## O-RAN Software Community "I" Release Revised - Sprint Calendar 2023

Mile Stones	Kick-off Review M0				Planning Review M1				Functionality Freeze M2				API Freeze M3				Code Freeze M4				Integration Review RC0			Sign Off Review RC1		Release				
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26				
Mon	3-Jul	10-Jul	17-Jul	24-Jul	31-Jul	7-Aug	14-Aug	21-Aug	28-Aug	4-Sep	11-Sep	18-Sep	25-Sep	2-Oct	9-Oct	16-Oct	23-Oct	30-Oct	6-Nov	13-Nov	20-Nov	27-Nov	4-Dec	11-Dec	18-Dec	25-Dec				
Fri	7-Jul	14-Jul	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug	1-Sep	8-Sep	15-Sep	22-Sep	29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	3-Nov	10-Nov	17-Nov	24-Nov	1-Dec	8-Dec	15-Dec	22-Dec	29-Dec				
Dev Sprints	Maintenance/Defect Release Dev					Maint. Release	No Activity	Dev Sprint 1				Dev Sprint 2 - Sprint 1 Demo				Dev Sprint 3 - Sprint 2 Demo				Dev Sprint 4 - Sprint 3 Demo				Sprint 4 Demo			Defect Management		No Activity	
Test Sprints	Maintenance Test Release					Test Planning & Preparation of Test Cases						IST Sprint-1				IST Sprint-2				IST Sprint-3				IST Sprint-4			End 2 End Test		No Activity	
SW Req. Task Description	Epics Identified	User Stories/Tasks Identified & Review	Map Epics and US/Task	Sub Tasks Identified & Review	Sprint Planning and Design			Software and Project Documentation																	Release Preparation			Release		
O-RAN Alliance	WG Input; Specification Freeze				WG Review									WG Review												O-RAN Demo		Documentation Review		O-RAN Hand-Off

# OSC lab status (NJ, CA, Taiwan)



New Jersey lab

Status:

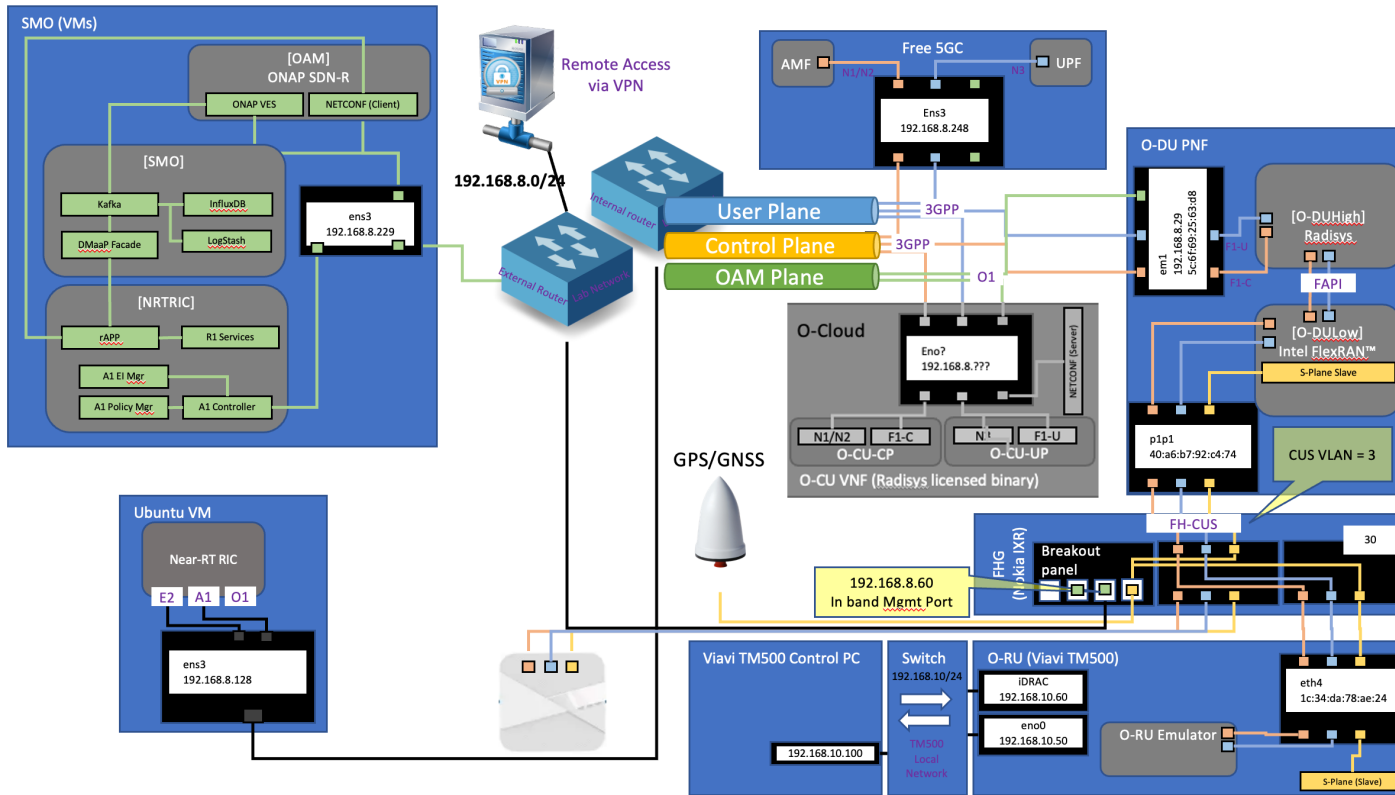
- Full compute, storage and networking support.
- Pair-wire testing happening between OSC subprojects in the first 4 OSC releases.
- PTP GM and IXR Switch under installation.
- On going full integration test:
  - NR registration and PDU session establishment with the UE (FDD stack integration and end to end attach/PDU session procedure validation), and
  - Basic close loop RAN slicing for two UE slices in gNB system (manual validation).
- Access and resource sharing: available

Taiwan lab

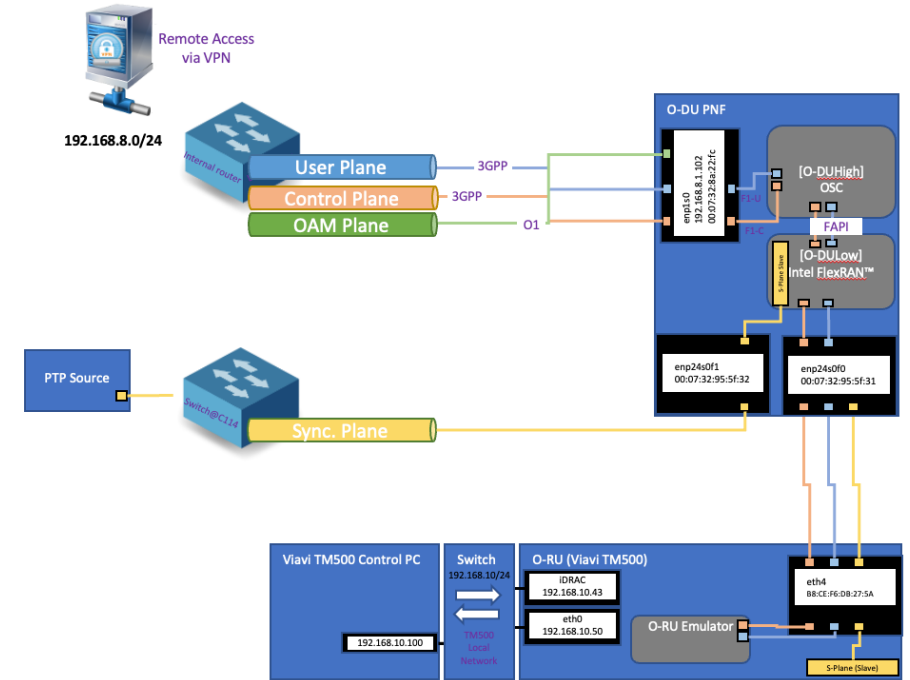
Status:

- Ongoing installation.
- PTP GM integration still in progress.
- O-DU already set up and connected to Intel RU Simulator.
- Non-RT RIC, Near-RT RIC, and O-DU High Integration
- Access and resource sharing: not available yet (??)

# Taiwan labs (NTUST, CHT, Auray)



NTUST labs



CHT labs

# How can you help?



- Join the OSC community!!
- We need s/w developers to actively contribute in many projects.
  - Students, professors, engineers, telco experts... all are welcome!!
- We need help with lab infrastructure and ecosystem development (servers, test equipment, simulators, etc.)
- O-RAN alliance is continuously releasing MVP packages
  - Many interesting use cases that we would like to demonstrate in OSC; Currently working on ML based RAN Energy Savings use case.
- Working in open source like OSC provides you the opportunity to learn and understand O-RAN protocols and pipeline
  - Fully equipped Labs are available in NJ, CA and Taiwan with OSC components
- Operators are hungry for new innovative RAN use cases for generating new revenues and provide substantial CAPEX/OPEX savings
  - First time the cellular development ecosystem is now open and available to be “programmed”
- Please contact RSAC co-chairs if you are interested in contributing to OSC projects
  - Rittwik Jana ([rittwikj@google.com](mailto:rittwikj@google.com)) or David Kinsey ([dk8126@att.com](mailto:dk8126@att.com))
  - Join RSAC meetings weekly
    - Zoom bridge: <https://zoom.us/j/9644759813>
    - Time: Tue 9pm Eastern OR Wed, 8am Eastern;
    - Calendar: <https://wiki.o-ran-sc.org/display/RSAC/calendars>

# OSC Release 1

# I release feature updates

- End-to-End Call - Pairwise Testing, James Li - 14 Sep 2023
- Lab Updates - James Li - Next 14 Sep 2023
- Disaggregated SMO Flows - N.K. Shankaranarayanan - 21 Sep 2023
- Onboarding and Orch. - Seshu Kumar Mudiganti - 21 Sep 2023
- RIC Platform Enhancements - Thoralf Czichy - 28 Sep 2023
- Energy Savings - Alex Stancu - 28 Sep 2023