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

- **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/L1/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**
  - IEFG - 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
O-RAN Software Community (OSC)
wiki.o-ran-sc.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 created 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 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) licensing.

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

<table>
<thead>
<tr>
<th>Company</th>
<th>Name</th>
<th>Alternate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;T</td>
<td>David Kinsey Co-Chair</td>
<td>James Li</td>
</tr>
<tr>
<td>China Mobile</td>
<td>Jinli Huang Co-Chair</td>
<td>Ondřej Hudousk</td>
</tr>
<tr>
<td>Deutsche Telekom</td>
<td>Jakub Nový</td>
<td></td>
</tr>
<tr>
<td>Ericsson</td>
<td>John-Paul Lane</td>
<td>John Keeny</td>
</tr>
<tr>
<td>NTT DOCOMO</td>
<td>Masafumi Masuda</td>
<td>Anil Umesh</td>
</tr>
<tr>
<td>Nokia</td>
<td>Arunkumar Halebid</td>
<td>Thoralf Czichy</td>
</tr>
<tr>
<td>Orange</td>
<td>William Diego</td>
<td>Vincent Danno</td>
</tr>
<tr>
<td>Radisys</td>
<td>Ganesh Shenbagaraman</td>
<td>Ankit Barve</td>
</tr>
<tr>
<td>TIM</td>
<td>Andrea Buldorini</td>
<td></td>
</tr>
<tr>
<td>Wind River</td>
<td>Bin Yang</td>
<td>Jackie Huang</td>
</tr>
<tr>
<td>Viavi Solutions</td>
<td>Ulan Kelly</td>
<td>Baruch Friedman</td>
</tr>
<tr>
<td>Samsung</td>
<td>Avinash Bhat</td>
<td>Hunje Yeon</td>
</tr>
<tr>
<td>Project Key</td>
<td>Project Name</td>
<td>PTL</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>RICAPP</td>
<td>RiC Applications</td>
<td>@ SUNIL SINGH</td>
</tr>
<tr>
<td>RIC</td>
<td>Near Realtime RAN Intelligent Controller</td>
<td>@ Thoralf Czychy</td>
</tr>
<tr>
<td>OCU</td>
<td>O-RAN Central Unit</td>
<td>TBD</td>
</tr>
<tr>
<td>ODUHIGH</td>
<td>O-RAN Distributed Unit High Layers</td>
<td>@ Manasi Padhy</td>
</tr>
<tr>
<td>ODULOW</td>
<td>O-RAN Distributed Unit Low Layers</td>
<td>@ Luis Farias</td>
</tr>
<tr>
<td>ORU</td>
<td>O-RAN Radio Unit</td>
<td>TBD</td>
</tr>
<tr>
<td>OAM</td>
<td>Operations and Maintenance</td>
<td>@ Martin Skorupski</td>
</tr>
<tr>
<td>SIM</td>
<td>Simulations</td>
<td>@ Alex Stancu</td>
</tr>
<tr>
<td>INF</td>
<td>Infrastructure</td>
<td>@ Jackie Huang</td>
</tr>
<tr>
<td>INT</td>
<td>Integration and Testing</td>
<td>@ James Li</td>
</tr>
<tr>
<td>DOC</td>
<td>Documentation</td>
<td>@ weichen ni</td>
</tr>
<tr>
<td>NONRTRIC</td>
<td>Non-RealTime RiC (RAN Intelligent Controller)</td>
<td>@ John Keeney</td>
</tr>
<tr>
<td>SMO</td>
<td>Service Management and Orchestration (SMO)</td>
<td>@ Mahesh Jethanandani</td>
</tr>
<tr>
<td>AIMLFW</td>
<td>AI/ML Framework</td>
<td>@ hoejjo lee</td>
</tr>
</tbody>
</table>
O-RAN Software Community (OSC) Workflow

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

RSAC discusses use cases, call flows and architecture

Release planning

Recommended features for inclusion in OSC release

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

OSC s/w releases → O-RAN feedback

Use
Contribute

Engage other open source communities

Technical Operating Committee (TOC)

O-RAN

CU, DU, RU
VIM, NMS
RIC
WG 9,10
WG 7,8
WG 5,6
WG 3,4
WG 1,2

Public O-RAN Specifications

AI/ML
SMO
NONRTRIC
RIC
O-CU
O-DU low
O-DU high
INT
GAM
SMK

ONAP
AKRAIN
AcumosAI

3GPP 5G

WG 1 (ATG), MVP-C, TIFG

WG 5,6

WG 1,2

WG 3,4

WG 7,8

WG 5,6

WG 3,4

WG 1,2

SDO
OSC status

O-RAN Software Community

The O-RAN Software Community (OSC) 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.

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/Pull Requests) or helping to find and resolve bugs.

The average contributor strength was 259 during the last 3 Years.
Control loops in O-RAN

Legend
- O-RAN / xRAN Defined Interfaces
- **To be standardized by SDO
- 3GPP Defined Interfaces

Loop 1: per TTI/msec resource scheduling
- RRU: PHY-low/RF
- DU: RLC/MAC/PHY-high
- Standard/Open HW Design

Loop 2: 10 – 500 msec (resource optimization)
- CU-CP: RRC, PDCP-C
- CU-UP: SDAP, PDCP-U

Loop 3: > 0.5 sec (policies, orchestration, SON)
- Data from eNB (PM/FM)
- Plug-in/Mediator

3rd Party Apps at the edge

NFVI Platform: Virtualization Layer and COTS Platform

Radio Network Information Base

3rd Party Apps at the edge

Edge Cloud

Cell Sites

Central Cloud

Design
Inventory
Policy
Configuration

RAN Intelligent Controller non-RT RIC

Legend:
- **To be standardized by SDO
- 3GPP Defined Interfaces
OSC is building some of the components of this disaggregated architecture.
Non-RT RIC project

ML workflow

1. Design Model
2. Deploy Untrained Model
3. Collect Real Time Data
4. Upload Trained Model
5. Publish to Non-RT RIC
6. Package model, set policies
7. Download to RIC, O-DU, O-RU

* ML Training host can be part of non-RT RIC or can executed offline
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](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

<table>
<thead>
<tr>
<th>Milestones</th>
<th>M0</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>RC0</th>
<th>RC1</th>
<th>Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kickoff Review M0</td>
<td>Week 1 Mon - 3-Jul</td>
<td>14-Aug</td>
<td>11-Sep</td>
<td>18-Sep</td>
<td>2-Oct</td>
<td>6-Nov</td>
<td>13-Nov</td>
<td>17-Nov</td>
</tr>
<tr>
<td>Functionality Freeze M2</td>
<td>Week 3 Mon - 17-Jul</td>
<td>28-Aug</td>
<td>8-Sep</td>
<td>15-Sep</td>
<td>13-Oct</td>
<td>23-Oct</td>
<td>30-Oct</td>
<td>1-Dec</td>
</tr>
<tr>
<td>Code Freeze M4</td>
<td>Week 5 Mon - 31-Jul</td>
<td>7-Aug</td>
<td>4-Oct</td>
<td>6-Oct</td>
<td>3-Dec</td>
<td>1-Dec</td>
<td>5-Dec</td>
<td>15-Dec</td>
</tr>
<tr>
<td>Integration Review RC0</td>
<td>Week 6 Mon - 7-Aug</td>
<td>14-Aug</td>
<td>11-Sep</td>
<td>18-Sep</td>
<td>2-Oct</td>
<td>1-Dec</td>
<td>2-Dec</td>
<td>22-Dec</td>
</tr>
</tbody>
</table>

### Dev Sprints
- Maintenance/Defect Release Dev

### Test Sprints
- Maintenance Test Release
  - Test Planning & Preparation of Test Cases
  - IST Sprint-1
  - IST Sprint-2
  - IST Sprint-3
  - IST Sprint-4

### SW Req.
- Task Description
  - TGs Identified
  - Identified & Ready
  - Prerequisites and Design

### O-RAN Alliance
- WG Freeze
- WG Review

### Software and Project Documentation
- WG Review

### Software and Project Documentation Preparation
- O-RAN Demo
- Document Review

### Release
- O-RAN Hand-Off
**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.
  - Ongoing 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 (?)
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) or David Kinsey (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 I
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