

Embracing Open Ecosystem

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Global 5G Landscape



Commercial launches by 81, investment by 386 carriers (deployment and verification)



Source: GSA report, June 2020



Build the largest 5G commercial network in the world



480k+ base stations were deployed by the end of Aug

5G users had surpassed 130+ million by the end of Aug

197+ models of 5G smartphones had obtained certifications by the end of Aug

400+ 5G application trials had been completed, including industrial internet, transportation, and healthcare, etc.

Data source: ICT Institute

5G Standardization: Basic, Enhanced, Extended









RAN Transformation: a Long Journey





O-RAN: Open & Smart RAN



Vision of O-RAN



O-RAN Reference Arch & TSC: 9 WGs, 3 FGs,1 OSC





Open Reference Design: 5G Ecosystem Transformation



- Enable players with diverse domain expertise to participate
- Lower the technical entry barrier for new entrants
- Create source diversity for healthier ecosystem



CMCC Whitebox Field Trials: 4G in 2019, 5G in 2020



Goal

- Verify the functional integrity, stability and reliability of 5g cloud pico station both in public network and the vertical industry,.
- Evaluation of integrated deployment cost (CAPEX/OPEX) \geq
- Verify system reliability (general platform with HA/ \geq dedicated platform)

4G WB field trial (2019)

Suzhou field trial : focusing on stability verification of cloud platform covering an area of 1500 square meters about 200 users. This system worked without stability problem during at least 30 days.



Roadmap of O-RAN Whitebox







www.o-ran-sc.org



April, 2018, preminlinary discussion with LF

Oct, 2018, Open Source Focus Group formed

April 2, 2019, O-RAN SC officially set up

May, 2019, project kick-off, seed code uploaded

Nov. 30, 2019, Amber Release

- 1M+ lines of codes from
- 60+ committers via
- 10+ companies



Innovative dual licensing policy

O-RAN OSC Projects at a Glance



| Project Key | PTL | Description |
|-----------------------|--|---|
| RICAPP | Matti Hiltunen (AT&T) | open source sample xAPPs and platform applications for integration, testing, and demonstrations. |
| RIC | Thoralf Czichy (Nokia) | Initial RIC Platform to support xAPPs with limited support for O1, A1, and E2 interfaces. |
| OCU | Yingying Wang (CMCC) | software deliverable for O-CU. |
| ODU (High and Low) | Sachin Srivastava (Radisys) & Zhimin Yuan (Intel) | Focus on initial L1/2 functional blocks |
| OAM | Martin Skorupski (Highstreet) | O1-related sysdev; initial dashboard for monitoring and demonstration of contributions. |
| SIM | Alex Stancu (Highstreet) | Initial simulators used for testing O-RAN interfaces. |
| INF | XiaohuaZhang (Windriver) | Initial building blocks for infrastructure to run O-RAN NF components. |
| INT | Lusheng Ji (AT&T) | To test the requirements documented in each release. This will focus on end to end test and use case testing. |
| DOC | Weichen Ni (CMCC) | Documentation on contributions and O-RAN SC contents. |
| NONRTRIC | John Keeney (Ericsson) | Non-realtime RIC focus on feature functionality of A1-interface (consumer and provider), and closed-loop use cases. |



• Bronze release (June 21, 2020):

- >3M lines of code contributed by >80 contributors from >15 companies
- Key features/highlights
 - Two E2E use cases: traffic steering and health check
 - O-DU-LOW: OFH interface and FAPI interface implementation
 - O-DU-HIGH: E2 initiation and setup; subset of E2 messages to support traffic steering
 - O-CU: open source CU-U plane implementation with F1-U support in form of binary code
 - nRT RIC: (from pre-spec. to be) compliant with E2 spec. v1.0, E2 setup/failure, xAPP onboarding etc.
 - xAPP: various xAPPs for traffic steering, management, KPI monitoring etc.
 - NRT RIC: A1 flow implementation and test; policy mangement with GUI
 - OAM: health check on O1 flow
 - INF: Container-based O-Cloud design with real-time support & support of ARM-based realtime Kubernetes cluster
 - SIM: enhancement implemented, e.g. E2 ingest data pipeline from trace file;
 - INT: Partial CI/CD pipeline, Deployment artifact automation, Open Test Framework (OTF) integrated
- Cherry Release (Dec. 2021) kicked off





Non-RT RAN Intelligent Controller

The primary goal of the Non-RT RIC is to support non-real-time radio resource management, policy optimization in RAN and providing guidance, parameters, policies and AI/ML models to support the operation of near-RT RIC functions in the RAN.

Near-RT RAN Intelligent Controller

A logical function described by the O-RAN Alliance, targeted for near realtime control and optimization of E2 nodes functions and resources, by finegrained data collection and actions over the E2 interface.

Non-RT RIC OSC Project and Reference Design



OSC Non-RT RIC Project Rel. A (Nov. 2019)

- Initial A1 Adapter/Controller
- Implements a subset of the A1 Policy LCM functions based on a "pre-spec" version of A1 protocol
- Prototype RESTCONF-based NBI for A1 mediation interface to allow messages to be sent up/down A1 interface

OSC Non-RT RIC Project Rel. B (June 2020)

- Implement O-RAN WG2 A1 spec (Release 1.x)
- Implement A1 policy management service
- □ Demonstrate simple **end-to-end usecase** (NONRTRIC, OAM functions, near-RTRIC, xNF,)
- Prototype initial support for observability of policy-affected indicators for policy assessment
- Demonstrate Prototype "R-APP" (SMO / Non-RealTime-RIC application-level function)
- Demonstrate prototype deployment of ML model in near-RT RIC





OSC Near-RT RIC Project Rel. A

- RIC Platform Project
 - Application/microservices framework to host
 multiple xApps
 - A message bus to publish and subscribe messages inside near-RT RIC
 - A1 mediator to relay basic policies from Non-RT RIC to near-RT RIC
 - E2 Termination agent to interface with O-CU
 - R-NIB DBaaS to store RAN state information
 - E2 manager to transact E2 data into the R-NIB
- RIC APP Project
 - xApps: Access Control, Measurement Campaign, KPI monitor

OSC Near-RT RIC Project Rel. B

- Traffic steering use case
- E2/A1/O1 Alignment
- Platform hardening: performance improvement, tracing support, health check & recovery







OSC Cherry Release being developed

| | / / | | | / | / | | | | | | | | | / | | | | | | / / | | | / | | | |
|--------------------------------|--|--|--------------------------|-------------------------------------|-------------------|----------------------------------|-------------------------|------------|------------------------------------|---------------------------------|---------|--------------|---------------------------------|--------------|---------|---------------------------------|--------------|---------|---------------------|----------------|---------|-------------------|---------|--------------------------|---------|-------------------|
| Mile Stones | M0: | | | | M1: | | | M2: | | | | | M3: | | | | | | | M4: | | | RC0: | | RC1: | Release: |
| | Week 21 | Week 22 | Week 23 | Week 24 | Week 25 | Week 26 | Week 27 | Week 28 | Week 29 | Week 30 | Week 31 | Week 32 | Week 33 | Week 34 | Week 35 | Week 36 | Week 37 | Week 38 | Week 39 | Week 40 | Week 41 | Week 42 | Week 43 | Week 44 | Week 45 | Week 46 |
| Mon | 15-Jun | 22-Jun | 29-Jun | 6-Jul | 13-Jul | 20-Jul | 27-Jul | 3-Aug | 10-Aug | 17-Aug | 24-Aug | 31-Aug | 7-Sep | 14-Sep | 21-Sep | 28-Sep | 5-Oct | 12-Oct | 19-0ct | 26-Oct | 2-Nov | 9-Nov | 16-Nov | 23-Nov | 30-Nov | 7-Dec |
| Fri | 20-Jun | 27-Jun | 4-Jul | 11-Jul | 18-Jul | 25-Jul | 1-Aug | 8-Aug | 15-Aug | 22-Aug | 29-Aug | 5-Sep | 12-Sep | 19-Sep | 26-Sep | 3-Oct | 10-0ct | 17-0ct | 24-0ct | 31-0ct | 7-Nov | 14-Nov | 21-Nov | 28-Nov | 5-Dec | 12-Dec |
| Dev Sprints | v Sprints Maintenance/Defect Release Dev | | | | Maint. Release | No Activity | D | lev 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 & F | | | | | anning & Pre | eparation 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/Tæks Identified & Review | Map Epics and US/Task | Sub Tasks identified & Review | | Sprint Planning and Design | I | | Software and Project Documentation | | | | | | | | | | Release Preparation | | | Release | | | | |
| O-RAN Alliance | WG Input Specification Freeze | | | | WG Review | | | | | | | | | WG Review | | | | | | | | O-RAN Demo | | Documentatio n Review | | O-RAN Hand Off |













- Asia OTIC in Beijing has been launched (9 Nov. 2019, by China Mobile, China Telecom & China Unicom)
 - achieve decoupling tiered commercial procurement capability
- Asia OTICs in Japan & India is in planning

European OTIC Lab

- Supported by DT, Orange, Telefonica and TIM (and open for others...)
- Two physical locations currently:
 - Berlin in Germany (hosted by DT in partnership with Orange) & Torino in Italy (hosted by TIM)
- Collaboration with TIP based on recent O-RAN/TIP LA (initially joint lab in Berlin)
- On Open FH interface (O-RU/O-DU) and ONAP O-RAN integration & testing (O1)
- Virtualized RAN solutions testing and integration
- Non-RT and Near-RT RIC co-development and testing (E2, A1)

North America OTIC Lab





WINLAB Tech Center Facility

- Dec 2019, O-RAN OSC Amber Release, over 3 sites coordinated by AT&T
- Sep 2020 for O-RAN open interface specs w/ O-RAN OSC Bronze Release & real equipment & simulators.



Two Years of Great Momentum: 220 Members





- 53 Published specification since Feb. 2019
- 2 Open Source software release
- 1 Global Plugfest event
- 31 Demos in O-RAN virtual exhibition (https://www.virtualexhibition.o-ran.org/)

The Harbinger of Global Ecosystem Transformation



• Vodafone: to purchase >100,000 OpenRAN BSs in 14 countries;

• Deutsche Telekom: Plan on Evenstar RRU with Mavenir, Parallel wireless;

• Turkcell: plan to deploy OpenRAN/vRAN.

China Unicom: MoU on OpenRAN 5G NR with TIP; NRT-RIC test with solution provided by ONF.

> **Rakuten:** 4G O-RAN network has been deployed ; 5G Open RAN solution test with **TPG** in Singapore.

NTT DOCOMO: 5G network with O-RAN FH and X2 interfaces commercialized in Sep 2019.

• AT&T: nRT-RIC/FH test and trial;

DISH network: plan to deploy 5G O-RAN network starting from scratch;
Verizon: O-RAN FH interface lab test w/ 5G equipment.

Etisalat: Open RAN test with Parallel Wireless in the Middle East, Africa, Aisa.





Green & Soft Open & Smart ICDT Deep Convergence!

SDO, Open Source, Native AI A Perfect Storm!

Thank You!

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