Open Radio Access Networks

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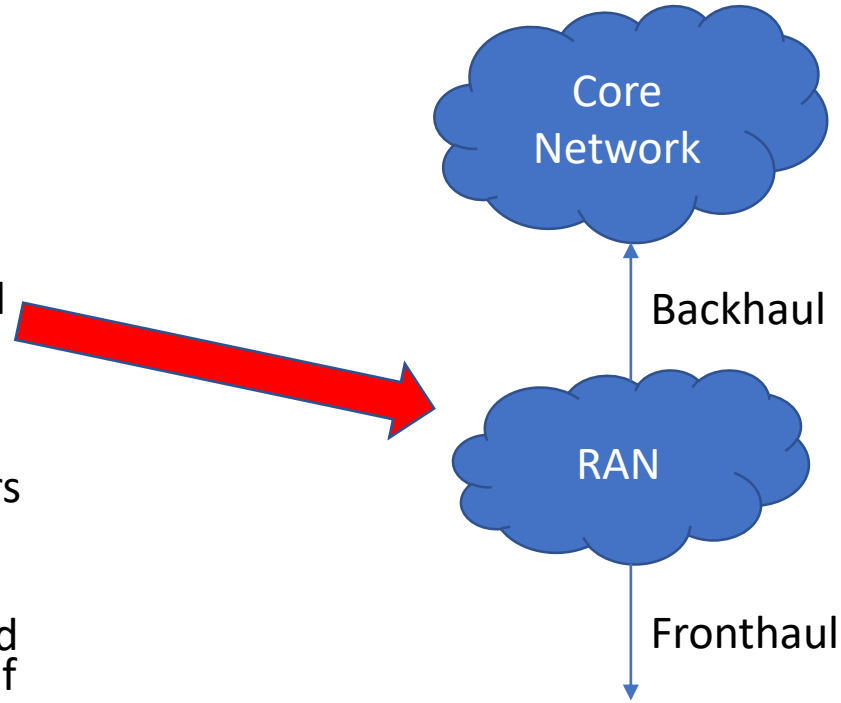
Why “Open RAN”?

- Future RANs will be built on a foundation of virtualized network elements, white-box hardware and standardized interfaces that fully embrace O-RAN’s core principles of intelligence and openness
- Open RAN specifications allow innovative companies to develop products, software solutions and reference designs in a diverse and competitive global market
- Goal of open interfaces is to avoid a “lock-in” effect where proprietary or semi-proprietary implementations inhibit competition among suppliers
- Operators have greater options to mix equipment from different suppliers in the same RAN, and other layers of the network, providing greater flexibility and lower costs and which enables a vibrant ecosystem of suppliers driving innovation



What is “Open RAN”?

- **Open RAN** - disaggregated RAN functionality built using open interface specifications between elements. Can be implemented in vendor-neutral hardware and software-defined technology based on open interfaces and community-developed standards as opposed to closed proprietary interfaces.
- **O-RAN** – O-RAN Alliance or designated specifications. A specification group is defining next generation RAN infrastructures, empowered by principles of intelligence and openness. https://www.o-ran.org
- **TIP** – Telecom Infra Project. A community of more than 500 network operators, technology companies, telecom equipment vendors, standards organizations and Internet companies developing open and interoperable technologies using open interfaces. https://telecominfraproject.com/
- **vRAN** – an implementation of the RAN in a more open and flexible architecture which virtualizes network functions in software platforms based on general purpose processors

Source: Open RAN Coalition

Open RAN Standards

- Global 5G specifications are developed within the 3rd Generation Partnership Project (3GPP)
- The openness of the interfaces between specific elements within the RAN or core network is key to disaggregating the network and facilitating additional suppliers in entering the wireless infrastructure market
- O-RAN Alliance and other consortia such as the Telecom Infra Project (TIP) are developing specifications for these open interface
  - Complementary to standards promoted by 3GPP
- O-RAN Alliance has developed specifications for certain RAN interfaces that had not been addressed by 3GPP

O-RAN Software Community

- 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)

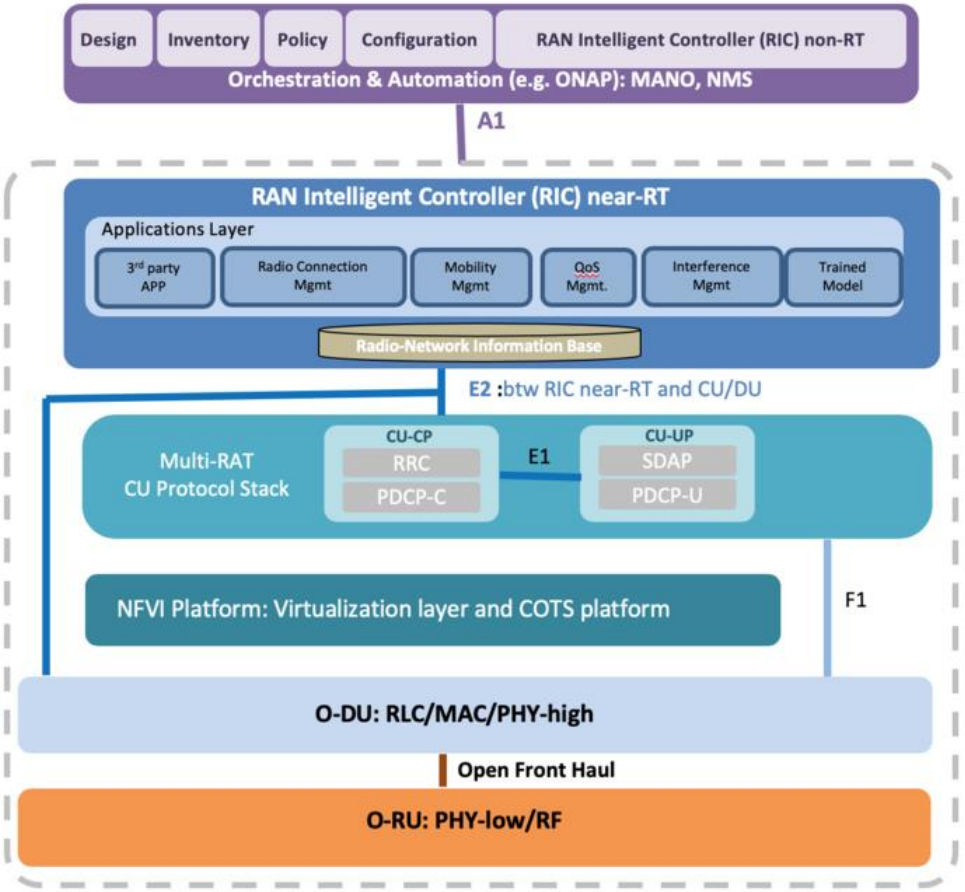
- Leverage other LF network projects, while addressing the challenges in performance, scale, and 3GPP alignment

- Initial set of software projects being discussed may include:
  - near-real-time RAN intelligent controller (nRT RIC),
  - non-real-time RAN intelligent controller (NRT RIC),
  - cloudification and virtualization platforms, open central unit (O-CU),
  - open distributed unit (O-DU), and
  - test and integration effort to provide a working reference implementation.

Source: https://o-ran-sc.org/#page-top

O-RAN High Level Architecture

- Based on well-defined, standardized interfaces to enable an open, interoperable supply chain ecosystem in full support of and complimentary to standards by 3GPP and other industry standards organizations
- Uses COTS HW and virtualization SW that enables abstraction – in the form of VMs or containers – to provide multiple hierarchal cloud deployment options



Source: O-RAN Alliance

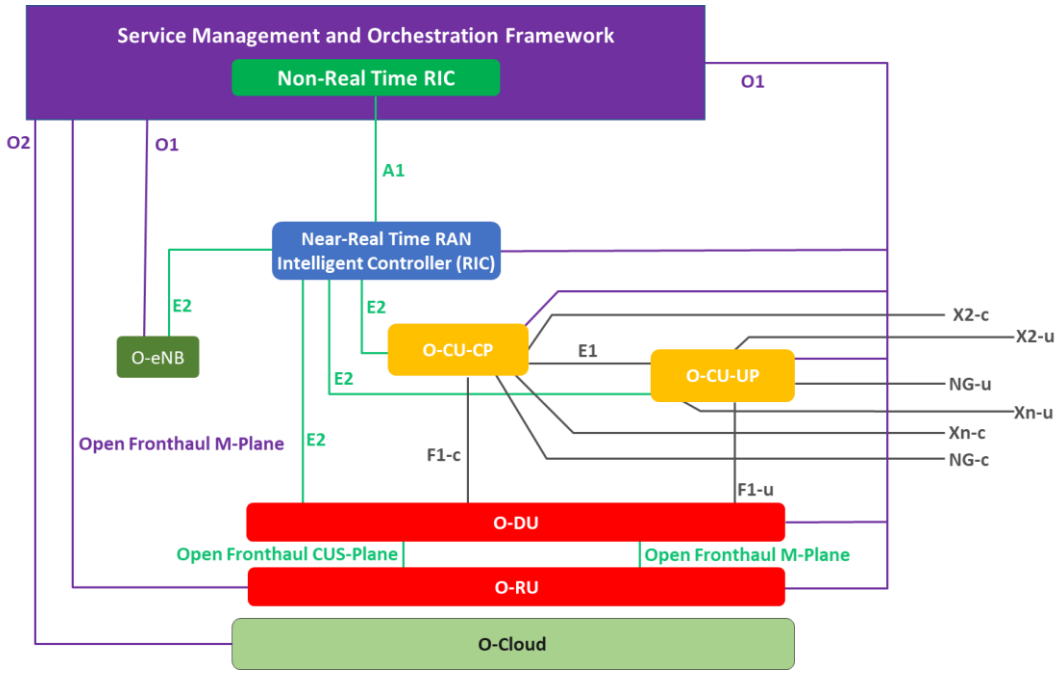
O-RAN Logical Architecture

Traditionally, the RAN was built using specialized, expensive devices sold by a small number of vendors which dictated costs, technical capabilities, and upgrade schedules. They controlled the hardware and the software. That doesn't make sense anymore.

O-RAN Alliance → create open hardware specs that any manufacturer can build to and the software running in these devices will be open source software

- Empowered by principles of intelligence and openness, the O-RAN architecture is the foundation for building the virtualized RAN on open hardware, with embedded AI-powered radio control

Software Defined, AI enabled RAN Intelligent Controller → 5G RAN Intelligent Controller (RIC)



Open RAN Security

- O-RAN offers an ability to have a more modular design, with different suppliers providing different components of the network, which can enhance security by allowing operators to more quickly replace or address network problems, including suspect equipment.
- A more intelligent RAN will enable operators to deploy security capabilities closer to the network edge, allowing operators to more quickly respond to threats and shift network capacity on demand.
- An open RAN provides the framework for communications network stakeholders to align on shared understanding of security requirements and to tailor security requirements at a more granular level than has been possible before.
- A RAN based on open standards helps users and network operators better understand, align on, and demonstrate successful implementation of security requirements.
- Introducing secure software development practices into the SC - vulnerable library upgrade practices, software composition analysis for C++, security tests in the CI pipeline
- O-RAN shall be **treated as a zero-trust environment** and O-RAN security will be **defined follow best practices such as those in NIST SP 800-207 *Zero Trust Architecture***
- Performing risk analysis on C-Plane and S-Plane traffic to determine if the **risk justifies the cost of adding encryption to the fronthaul interface**
- **Investigating security (service) use cases** that will be core to O-RAN, such as **signaling storm detection and mitigation**

O-RAN Alliance Update

O-RAN has recently published 23 new or updated specifications

- O-RAN Use Cases and Deployment Scenarios white paper introduces the initial set of O-RAN use cases and cloud native deployment support options
- O-Cloud cloud computing platform that can host relevant O-RAN functions to enable flexible deployment options in virtualized telco clouds

2nd release of O-RAN software “Bronze” adds support for new key elements of the O-RAN architecture and updates aligned with the latest O-RAN specifications

- Initial release of an A1 policy manager and an A1 controller that implements the Non-Real-Time Radio Intelligent Controller (Non-RT RIC) architecture.
- Near-Real-Time RIC updated to current O-RAN E2 and A1 specifications with 5 sample xAPPs.
- Initial O-CU and O-DU Low/High code contributions that support a FAPI framework and integration between the O-DU and RIC with E2 functionality and subscription support.
- Traffic Steering and Quality Prediction use case leveraging an E2 interface data ingest pipeline to demonstrate the functionality of RAN traffic steering with an E2 interface KPI monitoring capability.
- OAM use cases that exercise Health Check call flows including the Near-RT RIC and its O1 and A1 interfaces.

O-RAN Virtual Exhibition adds more demonstrations of O-RAN based technologies

- https://www.virtualexhibition.o-ran.org/

Deployment Highlights

- Open RAN systems are already deployed
  - NTT Docomo and the Rakuten deployments in Japan are prominent examples, as are deployments by major European operators, Telefonica and Vodafone
- AT&T has conducted several demos and trials including working with CommScope and Intel to demonstrate a mmWave 5G gNB and open fronthaul leveraging developments at O-RAN and hosted the O-RAN Alliance Plugfest where Samsung demonstrated the multi-vendor compatible Configuration, Performance, and Fault Management capabilities of the O1 interface
- Verizon is partnering with key suppliers to successfully conduct vRAN trials as a move to hardware-agnostic solutions
- DISH has entered into a multi-year agreement with Mavenir to deliver cloud-native open RAN software software-defined for its 5G wireless broadband network, utilizing an open, intelligent RAN architecture

22 MNOs have announced intentions to deploy Open RAN based commercial networks globally (as of May 31, 2020)

Operators, integrators and analysts indicate cost savings of 35-49% as the main driver

Source: https://www.parallelwireless.com/wp-content/uploads/iGR-OpenRAN-Integration-White-Paper.pdf

Open RAN Policy Coalition

Formed to promote policies that will advance the adoption of open and interoperable solutions in the Radio Access Network (RAN) as a means to create innovation, spur competition and expand the supply chain for advanced wireless technologies including 5G

Promote policies that:

- Support global development of open and interoperable wireless technologies;
- Signal government support for open and interoperable solutions;
- Use government procurement to support vendor diversity;
- Fund research and development;
- Remove barriers to 5G deployment; and
- Avoid heavy-handed or prescriptive solutions.

5G and Open RAN Security: Next Generation Trust

- Open interfaces, defined in technical specifications, provide a foundation and architecture for improving security
- Standards play an important role in 5G security and an open RAN

Key Take-aways

- Future RANs will be built on a foundation of **virtualized network elements**, **white-box hardware** and **standardized interfaces**
- O-RAN Alliance and other consortia such as the Telecom Infra Project (TIP) are developing specifications for these open interface **complementary to standards promoted by 3GPP**
- O-RAN shall be **treated as a zero-trust environment** and O-RAN security will be **defined follow best practices**
- Open RAN systems **are already deployed**
- Adoption of open and interoperable solutions in the Radio Access Network (RAN) is a means to **create innovation, spur competition and expand the supply chain** for advanced wireless technologies including 5G