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OVERVIEW OF OPEN RAN (O-RAN) ARCHITECTURE, CHALLENGES AND FUTURE DIRECTIONS

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Abstract : ORAN (Open RAN) helps with interoperation as it promotes device interoperability across providers and also leads to offering great feasibility with networks. Disaggregation approach helps to realize such openness by ORAN and its interfaces help with providing associated services and leverages the vendor's capability also helps with escape being bounded to specific vendor's proprietary hardware. ORAN is result of ORAN Alliance that works to provide RAN and associated services with Artificial Intelligence/ Machine Learning focus.

***IndexTerms* - Open RAN, Interfaces, Intelligent Controller**

I. INTRODUCTION

ORAN is termed as Open RAN. It allows for interoperability. It provides a platform for vendors and different companies to come together and share services, resources as needed. It was identified and came into existence by 3GPP standards, IEEE, O-RAN Alliance. The standards specify a variety of Next Gen RAN infrastructure solutions and the related open networking interfaces to accommodate all the various 5G use cases and carrier implementation limitations. ORAN was a result of breaking the RAN into smaller possible parts that is referred to as splitting. It is a defined result of service requirements with concerns of QoS and QoE. ORAN works in a way that it itself can manage networks that means no labor/ in-person attention to the networks are required.

With ORAN the possibility of latency and QoS has been taken care of. The ORAN facilitates the next gen architecture with possible new open interfaces that provide openness to work with any vendor on the platform. This paper focuses on ORAN Architecture, ORAN Interfaces, and Security concerns, Platforms for ORAN realization and Conclusions and Future Instructions.

II. ORAN ARCHITECTURE

Disaggregation is a crucial component that enables carriers to choose specific RAN pieces from several manufacturers. In particular, owing to improved interoperability is provided by open interfaces amongst decoupled RAN elements. RAN virtualization is a major aspect of O-RAN architecture. Virtualization helps with network slicing by splitting the protocol stack. The ORAN architecture has various interfaces called O1, A1, O2, E2 and these play a significant role in supporting openness of the ORAN Architecture for the carriers. The CU,DU and RU constitutes the main aspect of RAN as interfaces make it possible for these 3 to work with eliminating the need to have locked vendor system. The Open RAN Network Management Services permits the development of equipment plug-ins to address functionality discrepancies amongst vendors in order to fully support multi-vendor Open RAN devices. Device adaptors use intermediate abstractions of devices to accomplish the capabilities. The device adaptors utilize southbound plug-ins to interface to and communicate with domain controllers. Southbound plug-ins offers a selection of standard protocol versions for interactions [4].

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III. ORAN INTERFACES

A1 Interface: It exists between Near Real Time Radio Intelligent Controller (NRT RIC) and Non Real Time RIC(nRT RIC), as from Figure.1. The interface throughout which nRT RIC receives options - based, enriching information and up - to -date to the Machine learning model from NRT RIC, and conversely.

The non-real time functionalities are separated from the real time functions for an instance is model and service mentoring. Radio Management is offered by a near-RT RIC that is tracked by Artificial Intelligence and Machine Learning. The various functions like the handoffs, QoS regulation are taken care of by E2 Interface [3].

E2 Interface: It encounters and enters the O-RU, O-DU, and O-CU unique elements inside the base station. For instance, leveraging supervision, suspension, overriding, control messages, and develop action plans originating from xApps/nRT RIC, and receiving collection of data and response from such entities, also might control what really is occurring within that BS from one side.

O1 and Open Fronthaul M-Plane Interface: A standard FCAPS (Fault, Configuration, Accounting, Performance, Security) connection with setup, reconfiguration, registrations, assurance, achievement, and tracking factors interchange with different nodes, such as O-CU-UP, O-CU-CP, O-DU, O-RU, in addition to nRT RIC.

O2 Interface: It functions to regulate the resources and FCAPS like scaling. To be more precise the SMO interacts with the O-Cloud in which it is housed using the O2 interface. The networks can then be operated and maintained by telcos linked to the O-Cloud.

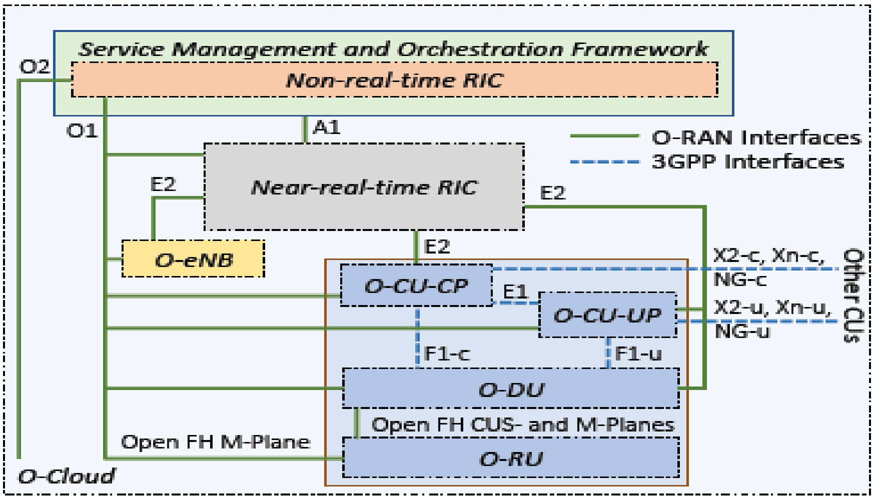

Fig.1: ORAN Architecture and Interfaces

IV. BENEFITS OF ORAN

- Agility: Provides flexibility for networks to be more agile and unified
- Openness: Open to flexibility leading to more open services been delivered
- Implement security fixes and upgrades available quickly
- Protect the RAN cryptographically
- Reduced Operating Costs: It is predicted that the plug-and-play functionality of O-RAN with contemporary learning techniques may lower the installation costs by up to 80%. Providers can combine the connection improvements of all stages underneath one roof by placing software at the core of the network. The providers could save huge amounts of money by doing so [3].

V. CONCERNS OF ORAN

- Design and implementation of use cases and operating models
- Validation and ubiquity
- Real-time scale adjustments
- AI/ML algorithms development, evaluation, and implementation that works
- Integrity

These concerns provide the whole center of ORAN Concerns. It is also challenging to create a standalone service-oriented architecture due to various QoS constraints. The networking should be adaptable to accommodate future upgrades and should work with the current technology. The network shouldn't put an excessive amount of strain on the backhaul and need to be computationally simple [3].

In case of energy consumption and saving energy resources the base stations usually are powered up all time while not in use they waste the energy and it also produces load on the base stations. ORAN does facilitate openness but for issues that arise during one base station at busy hour to model to next one with that adaptability from one vendor hardware to other vendor software and hardware traffic analysis it's tough to adapt within cells and base stations without complexity. This complexity also owes to different KPIs and timers standards used by various wireless providers.

VI. FUTURE INTERACTIONS

- Deploying strategies for the RIC near-RT and non-real time control loop while taking ecological and economical considerations into account is difficult.
- With the use of contemporary instructional strategies, synchronization, updating, and teaching are challenging. (ML and AI, etc.)
- Managing data—particularly cross-layer data—to enable the requested task and safeguard other core functions is difficult [3].

➢ In the event that deployments do not complement one another effectively, effective risk techniques should be in existence. The hazards of incompatibility amongst radios and controlling products from various manufacturers should therefore be identified.

➢ End to end service orchestration does pose a new challenge as with openness it must support adoption for legacy architectures and ORAN.

VII. CONCLUSIONS

The ORAN Architecture provides a platform for unification of services by various vendors. The ORAN architecture focuses on coalition of Software Defined Networking and Network Function Virtualization where the different slices can be produced based upon requirements and maintaining the QoS needs plus to focus on spinning up the slices as needed for 5G use cases can be realized but pose a great challenge with maintaining the proper functional slices and introduce new ones without service disruption and also looking for QoE aspects.

REFERENCES

[1] Michele Polese, Leonardo Bonati, Salvatore D'Oro, Stefano Basagni, Tommaso Melodia, "Understanding O-RAN: Architecture, Interfaces, Algorithms, Security, and Research Challenges", ResearchGate, February 2022.

[2] Solmaz Niknam, Abhishek Roy, Harpreet S. Dhillon, Sukhdeep Singh, Rahul Banerji, Jeffery H. Reed, Navrati Saxena, and Seungil Yoon, "Intelligent O-RAN for Beyond 5G and 6G Wireless Networks", ResaerchGate, May 2020.

[3] Sameer Kumar Singh, Rohit Singh and Brijesh Kumbhani, "The Evolution of Radio Access Network Towards Open-RAN: Challenges And Opportunities", IEEE Xplore 2020.

[4] Tse-Han Wang, Yen-Cheng Chen, Sin-Jie Huang, Kai-Sheng Hsu, Chung-Hua Hu, "Design of a Network Management System for 5G Open RAN", IEEE Xplore 2021

[5] Pedro Tavares, Pedro Sanguinho, "The Open Future of Radio Access Networks", Deloitte 2021