Optimize RAN Operations using RIC

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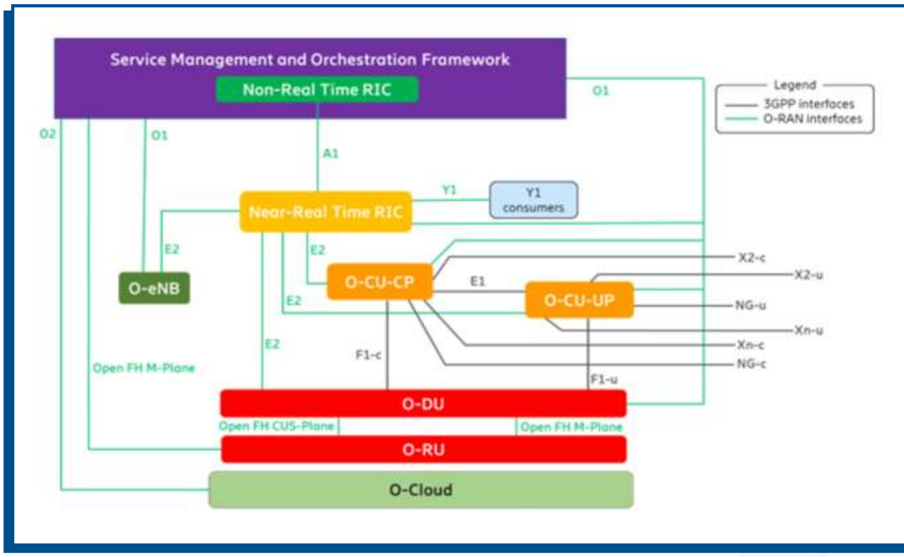
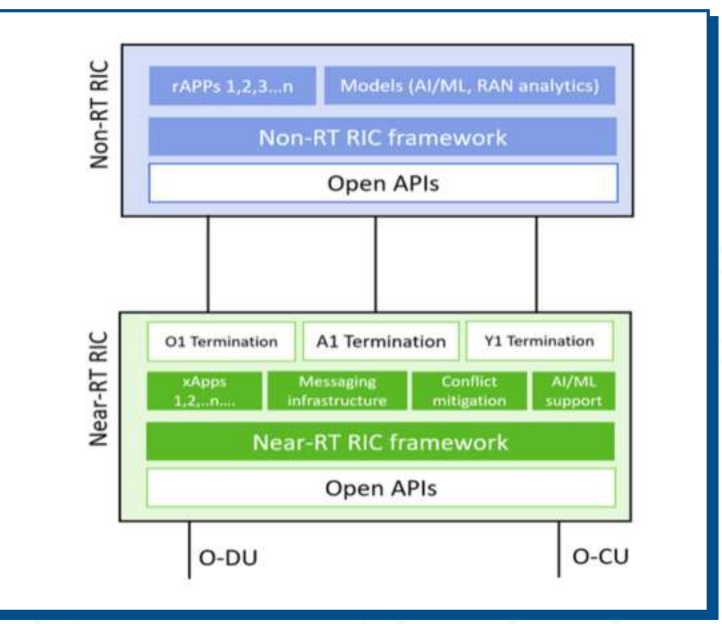
When we talk of ORAN, we immediately think of Split RAN architecture, multivendor solution, general purpose hardware and software dominant solution. However, these do not imply any significant benefits to the Operators or end-users. As a matter of fact, they translate into interoperability complications and deployment challenges.



The ability to manage RAN resources optimally by monitoring the radio network and orchestrating the resources dynamically is the real value proposition of ORAN. Till date, efficient and intelligent data processing innovations were limited to the Core, for example the user-data plane separation, virtualization of network functions, network slice, etc. However, this did not make much of a difference to the radio access network, which is the heart of a Mobile Network. Most of the challenges and expenses of a Mobile Network are related to the radio. RAN Intelligent Controller (RIC) is one of the critical elements of the ORAN architecture. It provides the ability to intelligently utilize the RAN and ensure application specific on-demand quality.



The RIC is a framework with well-defined services. These services enable RAN components to register, specify its capabilities, and provide various operational reports. There are xApps and rApps that can be deployed on the RIC to utilize these parameters and take non-realtime and realtime decisions on the RAN. Let us take a closer look at the RIC and what it offers.

Non-RT RIC is a logical function within SMO that enables non-real-time control and optimization of RAN elements and resources. It applies AI/ML workflows including model training and updates, and provides policy-based guidance for applications to Near-RT RIC. It is comprised of the Non-RT RIC Framework and the Non-RT RIC Applications(rApps). Typical execution time for use cases involving the Non-RT control loops are 1 second or more.

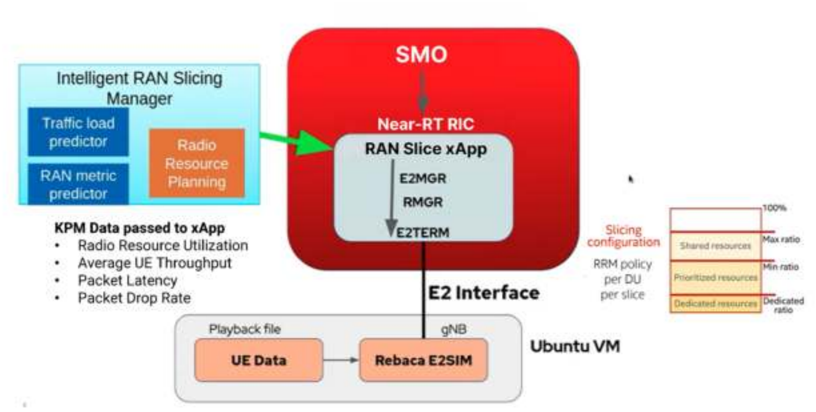
Near-RT RIC is a logical function that enables near-real-time control and optimization of RAN elements and resources via fine-grained data collection from CU/DU nodes and send actions over E2 interface. It is comprised of the Near-RT RIC framework and near-RT RIC Applications(xApps). Execution time of Near-RT control loops are in the order of 10 milliseconds or more.

This combination of non-RT RIC and near-RT RIC enables onboarding of third-party applications using ORAN standards specific interfaces. These enable automation and optimization of RAN operations at scale while supporting innovative use cases.

Some optimization scenarios defined in ORAN WG1 Use Case Detailed Specification(R003) that can be addressed by the combination of non-RT RIC and near-RT RIC are as follows:

➢ RAN Slice SLA Assurance

The 5G ecosystem includes network slicing as a prominent feature which provides end-to-end connectivity and data processing tailored to specific business requirements. These requirements include customizable network capabilities such as the support of very high data rates, traffic densities, service availability and very low latency. These capabilities are always provided based on a Service Level Agreement (SLA) between the mobile operator and the business customer. The objective of this Use Case is to develop a mechanism to ensure Slice SLAs and prevents possible violation(s). The input KPM data processed by the RIC to generate new PRB configurations is as follows:



a. Radio Resource(PRB) Utilization
b. Average UE Throughput
c. Overall Data Volume per slice
d. Packet Latency
e. Packet Drop Rate

➢ Traffic Steering for optimal RAN Resource Utilization and User Experience

The rapid traffic growth and multiple frequency bands utilized in a commercial network make it challenging to steer the traffic in a balanced distribution. Non-optimal traffic management, due to various factors such as an inability to select the right set of UEs, can result in non-optimal system and UE performance, such as reduced throughput and increased handover failures. The main objective of this use case is to allow operators to flexibly configure the desired optimization policies, utilize the right performance criteria, and leverage machine learning to enable intelligent and proactive traffic management. The required input data for RIC components is as follows.

a. Measurement reports with RSRP/RSRQ/CQI information for serving and neighboring cells
b. UE connection and mobility/handover statistics with indication of successful and failed handovers
c. Cell load statistics such as information in the form of number of active users or connections, number of scheduled active users per TTI, PRB utilization, and CCE utilization
d. Per user performance statistics such as PDCP throughput, RLC or MAC layer latency, DL throughput thresholds to trigger traffic management.

➢ Context-based dynamic handover management for V2X

V2X communication allows for numerous potential benefits such as increasing the overall road safety, reducing emissions, and saving time. As vehicles traverse along a highway, due to their high speed and the heterogeneous natural environment V2X UEs are handed over frequently, at times in a suboptimal way, which can cause handover(HO) anomalies, such as short stay, ping pong and so on. The primary objective of this Use Case is to evolve a mechanism to avoid problematic HO scenarios by using past navigation and radio statistics in order to customize HO sequences on a UE level. Some of the relevant KPMs that are analysed for mobility/handover of UEs to nearby cells are as follows.

a. Measurement reports with RSRP/RSRQ/CQI information for serving and neighbouring cells
b. UE connection and mobility/handover statistics with indication of successful and failed handovers and error codes
c. V2X related data like position, velocity, direction, navigation data, CAMs.

This information is utilised by the non-RT RIC to generate enrichment data for the near-RT RIC. The ultimate objective is to dynamically generate UE specific NRTs for pushing down to the E2 nodes.

➢ Massive MIMO Beamforming Optimization

Massive MIMO (mMIMO) is among the key levers to increase performance and QoS in 5G networks. Capacity enhancement is obtained by means of beamforming of the transmitted signals, and by spatially multiplexing MIMO data streams. The objective of this Use Case is for the RIC to optimize the Massive MIMO beamforming configuration. The required data that enables the RIC to perform AI/ML analysis and determine the optimal beamforming configuration is as follows.

a. Environment data: Cell site information (location), inter-site distance, BS system configuration, complete set of Massive-MIMO configurations
b. Measurement reports with RSRP/RSRQ/CQI/SINR per beam information
c. Network KPIs: e.g. cell downlink/uplink traffic load, RRC connection attempts, average RRC connected UE, maximum RRC connected UE, average active connections, DL/UL throughput, NI (Noise Interference), beam resource usage, beam based handover and beam failure statistics.

➢ Radio Network Energy Optimization

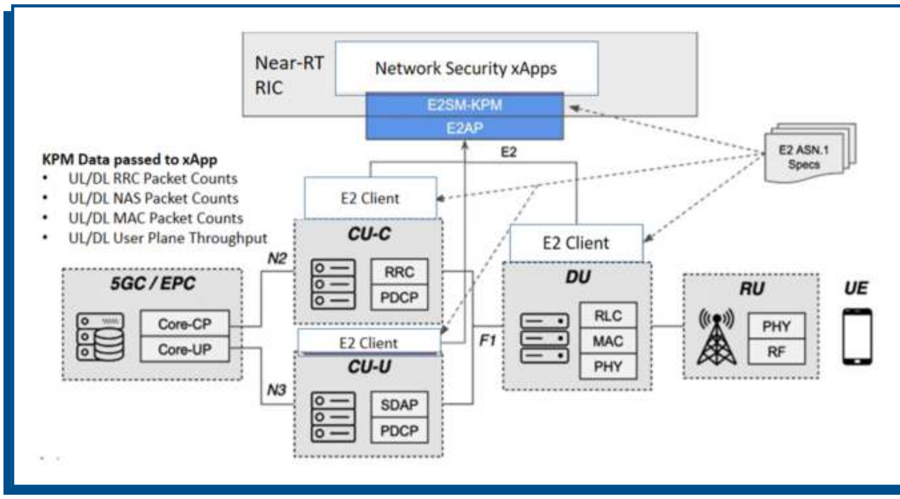
The RAN is responsible for a major part of the Energy Consumption (EC) of a mobile network, and the O-RU accounts for the largest part of the energy consumption of the RAN. Reduction of EC is a strategic topic for network operators, in addition of being a significant component of the operators' OPEX. This Use Case defines multiple mechanisms of Energy Savings(ES), one of which is to switch off one or more carriers or cells depending on load characteristics. Relevant input data (KPM values) is as follows.

a. Load statistics per cell and per carrier, such as number of active users, average number of RRC connections, average number of scheduled active users per TTI, PRB utilization, DL/UL throughput
b. UE mobility information including cell or beam level measurements (e.g., UE RSRP, RSRQ, SINR)
c. Latency statistics per cell
d. Power consumption metrics: Mean total/per carrier power consumption, mean total/per carrier transmit power.

➢ Network Security Threat Detection and Mitigation

UE-generated security threats can be identified by monitoring control and data plane UE traffic and identify anomalies. The following KPM values are commonly used for network security threat identification.

a. RRC Packet Count (per UE)
b. NAS Packet Count
c. MAC Packets Count
d. UL/DL Data Throughput



The RIC can specify threshold values while subscribing to the above KPM values from the E2 node. This ensures that the RIC receives KPM values only for errant UEs and can take focussed action on specific UE(s) by sending E2 control messages to the relevant E2 node.