AARNA NETWORKS

Aarna Networks Webinar Series

The O-RAN Opportunity: Advanced Features & Use Cases

May 3, 2023

Today's Speakers

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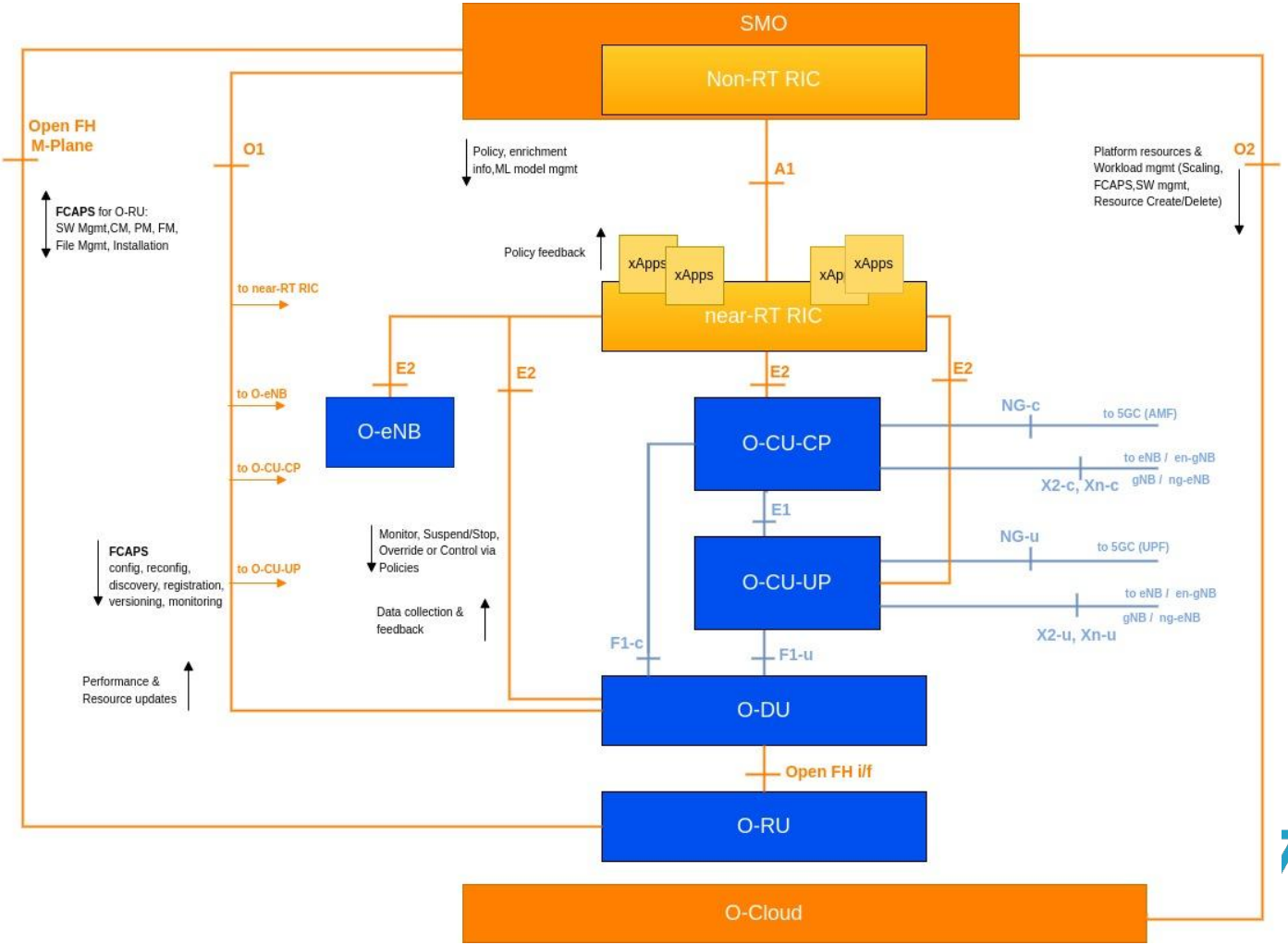
O-RAN Architecture Overview

O-RAN Overview



O-RAN Community

O-RAN Alliance & LF : O-RAN Software Community

(De-facto Largest Community based Project)

TIP ROMA 2.0

TELECOM INFRA
PROJECT

- With the goal to foster Open RAN orchestration and management automation (ROMA) product & solution maturity, a functional testbed, consisting of O-RAN partner RU,CU,DU and 5GC running on commodity hardware
- This is to help operators understand the implications of ROMA requirements and the ecosystem's maturity
- At the end, vendors learned how to test ROMA products and solutions

i14y Lab

- Participated in O-RAN Global PlugFest Fall 2022 through Interoperability Lab (i14y lab)
- Partnered with CapGemini Engineering to demonstrate both O1 and O2 interface of the Aarna AMCOP SMO through specific use cases like:
    - gNB NS Orchestration
    - gNB NS Monitoring
    - Data path validation
    - LCM of gNB NS

Advanced Features & Use Cases

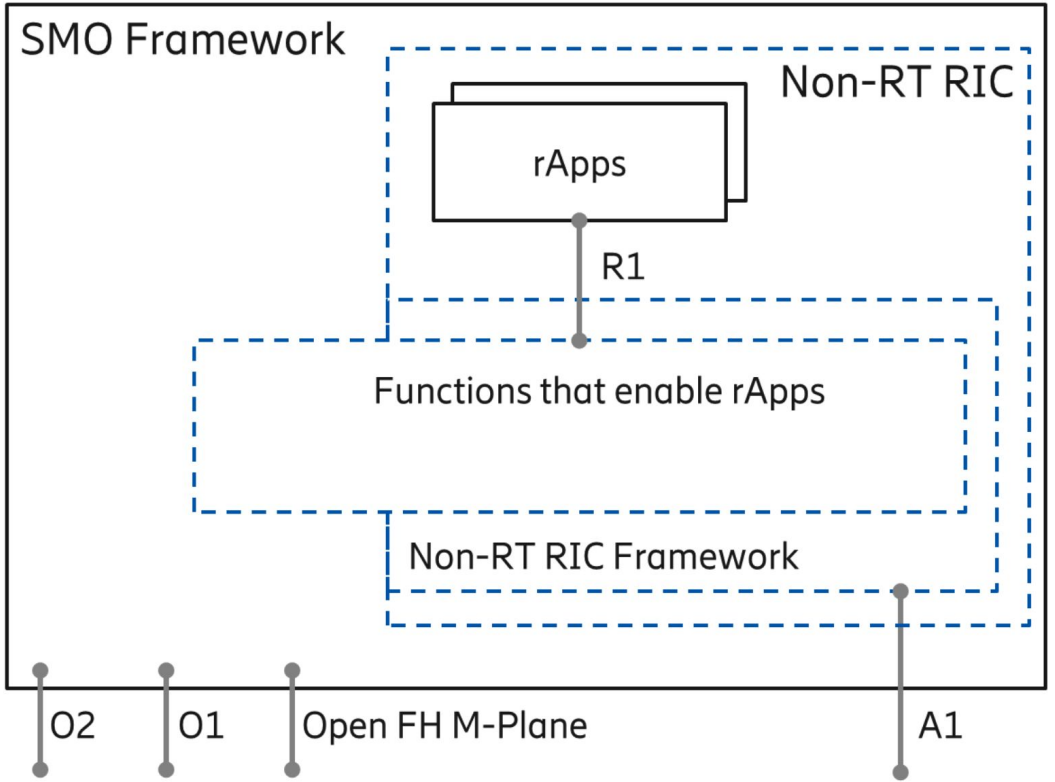
NonRTRIC & rApps

NonRTRIC

- Internal to SMO
- A1 interface termination
- Expose R1 services to rApps

rApps

- Values added services
- Radio Resource management, Da Analytics, EI
- AI/ML models



 Source: O-RAN specification

Use Cases

- Traffic steering use case
- QoE use case
- QoS based resource optimization
- Context based dynamic handover management for V2X
- RAN slice SLA Assurance
- Massive MIMO Optimization use case

Traffic Steering Use Case

- 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
- Steer the traffic in a balanced distribution
- Predict network and UE performance
- Switch and split the traffic across access technologies in radio and applications

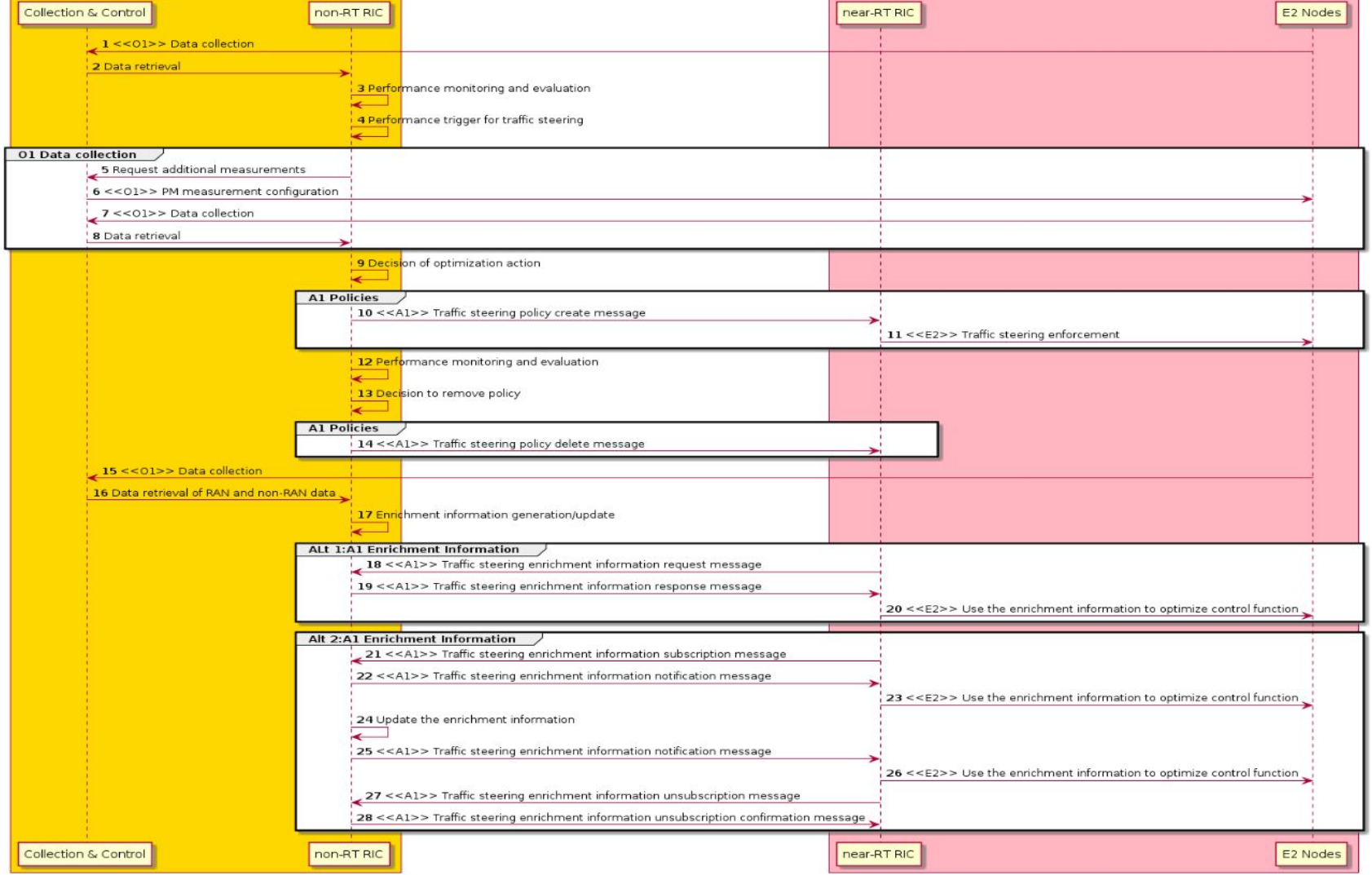
Models & Data

Models

- cell load prediction/user traffic volume prediction
- generate relevant A1 policies to provide guidance on the traffic steering preferences
- time-series prediction of individual performance metrics or counters
- QoE prediction at each neighbor cell for a given targeted user

Input data

- Load related counters, e.g., UL/DL PRB occupation
- user traffic data, counters and KPIs
- Measurement reports with RSRP/RSRQ/CQI information for serving and neighboring cells
- UE connection and mobility/handover statistics with indication of successful and failed handovers
- Cell load statistics such as number of active users or connections, number of scheduled active users per TTI, PRB utilization, and CCE utilization
- Per user performance statistics such as PDCP throughput, RLC or MAC layer latency, DL throughput


Collection & Control
non-RT RIC
near-RT RIC
E2 Nodes
1 <<O1>> Data collection
2 Data retrieval
3 Performance monitoring and evaluation
4 Performance trigger for traffic steering
O1 Data collection
5 Request additional measurements
6 <<O1>> PM measurement configuration
7 <<O1>> Data collection
8 Data retrieval
9 Decision of optimization action
A1 Policies
10 <<A1>> Traffic steering policy create message
11 <<E2>> Traffic steering enforcement
12 Performance monitoring and evaluation
13 Decision to remove policy
A1 Policies
14 <<A1>> Traffic steering policy delete message
15 <<O1>> Data collection
16 Data retrieval of RAN and non-RAN data
17 Enrichment information generation/update
ALt 1:A1 Enrichment Information
18 <<A1>> Traffic steering enrichment information request message
19 <<A1>> Traffic steering enrichment information response message
20 <<E2>> Use the enrichment information to optimize control function
Alt 2:A1 Enrichment Information
21 <<A1>> Traffic steering enrichment information subscription message
22 <<A1>> Traffic steering enrichment information notification message
23 <<E2>> Use the enrichment information to optimize control function
24 Update the enrichment information
25 <<A1>> Traffic steering enrichment information notification message
26 <<E2>> Use the enrichment information to optimize control function
27 <<A1>> Traffic steering enrichment information unsubscription message
28 <<A1>> Traffic steering enrichment information unsubscription confirmation message
Collection & Control
non-RT RIC
near-RT RIC
E2 Nodes

Traffic Steering Sample Policies

```
{
   "policy_id": "1",
   "scope": {
   "ue_id": "1",
   "slice_id": "1",
   "qos_id": "9",
   "cell_id": "X"
   },
   "statement": {
   "cell_id_list ": {"B", "A"},
   "preference": "Avoid",
   "primary": false
   },
   "statement": {
   "cell_id_list": {"C", "D"},
   "preference": "Prefer",
   "primary": false
   }
}
```

Cell Related Policy: X is A,B,C,D. Avoid MBB on Cell A&B. Prefer MBB C&D

```
{
   "policy_id": "2",
   "scope": {
   "ue_id": "2",
   "slice_id": "2",
   "traffic distribution": "X"
   },
   "statement": {
   "cell_id_list": {"A"},
   "preference": "Prefer",
   "minimum": "50%",
   "maximum": "70%",
   }
}
```

Traffic distribution Policy: Prefer 50 to 70% traffic on cell A for this UE.

PolicyTypeId: ORAN_TrafficSteeringPreference_x.x.x

 Source: O-RAN specification

QoE Use Case

1. Highly demanding 5G native applications, Traffic sensitive and highly interactive applications.
2. QoE estimation/prediction from application level can help deal with such uncertainty and improve the efficiency of radio resources, and eventually improve user experience.
3. Multi-dimensional data(user traffic data, QoE measurements, network measurement report) can be acquired and processed via ML algorithms to support traffic recognition, QoE prediction, and QoS enforcement decisions.

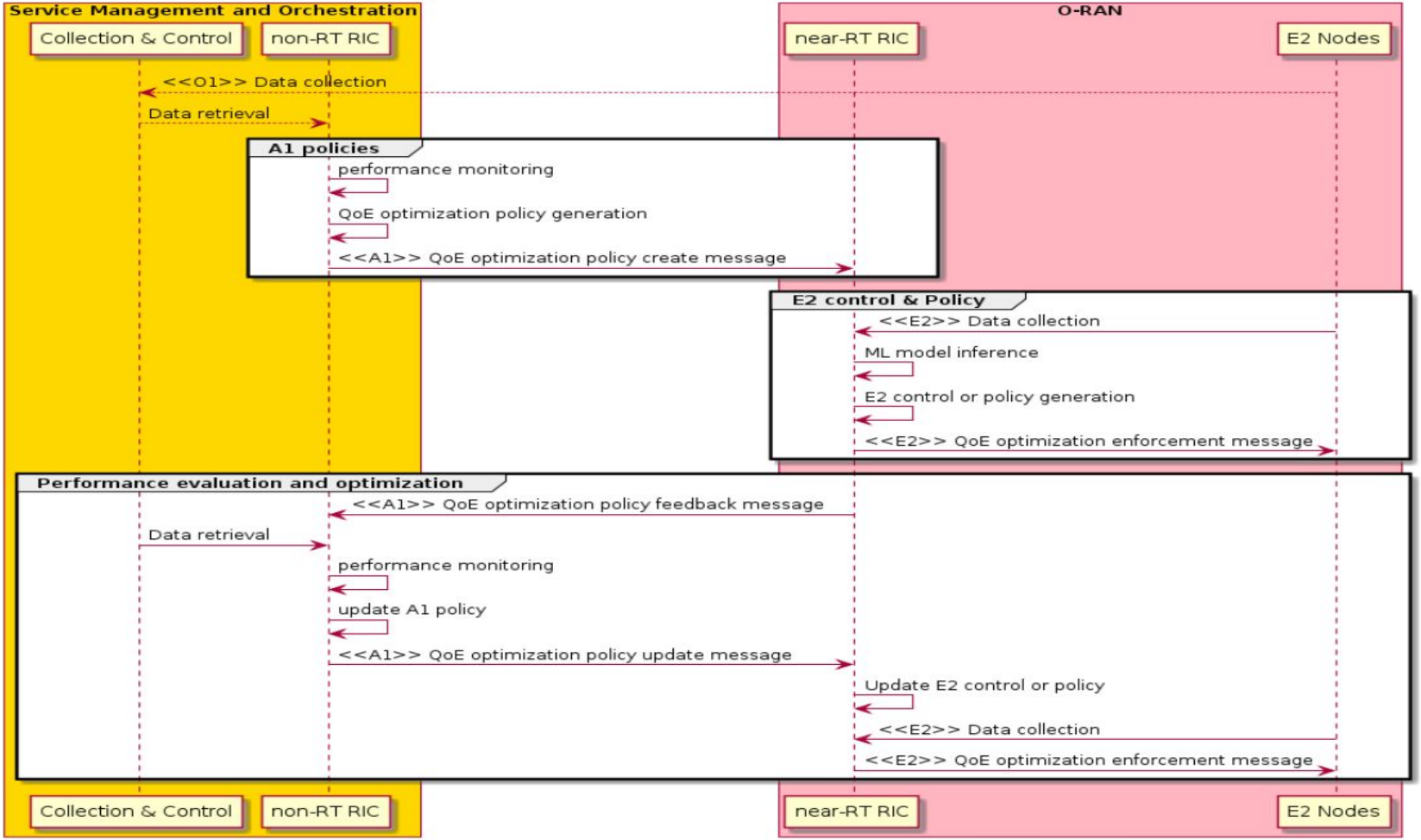
QoE Models & Data

Models

- QoE prediction model
- QoE policy model
- Available BW prediction model

Input Data

- Network level measurement report like UE level (radio, mobility metrics).
- Traffic pattern(throughput, latency, pps), RAN(PDCP buffer), Cell level(Dl/RL PRB)
- QoE related measurement metrics collected from SMO
- User traffic data


Service Management and Orchestration
Collection & Control
non-RT RIC
O-RAN
near-RT RIC
E2 Nodes
<<O1>> Data collection
Data retrieval
A1 policies
performance monitoring
QoE optimization policy generation
<<A1>> QoE optimization policy create message
E2 control & Policy
<<E2>> Data collection
ML model inference
E2 control or policy generation
<<E2>> QoE optimization enforcement message
Performance evaluation and optimization
<<A1>> QoE optimization policy feedback message
Data retrieval
performance monitoring
update A1 policy
<<A1>> QoE optimization policy update message
Update E2 control or policy
<<E2>> Data collection
<<E2>> QoE optimization enforcement message
Collection & Control
non-RT RIC
near-RT RIC
E2 Nodes

QoE Sample Policies

```
{
    "policy_id": "2",
    "scope": {
    "ue_id": "101",
    "slice_id": "1",
    "qos_id ": "51"
    },
    "qoeObjectives": {
    "initial_buffering": “2”,
    "reBuffFreq":“2”,
    "stallRatio": “5”
    }
}
```

UE optimization policy: Initial buffering within 2 sec, rebuffering freq is 2 times, stalling ratio is 5%

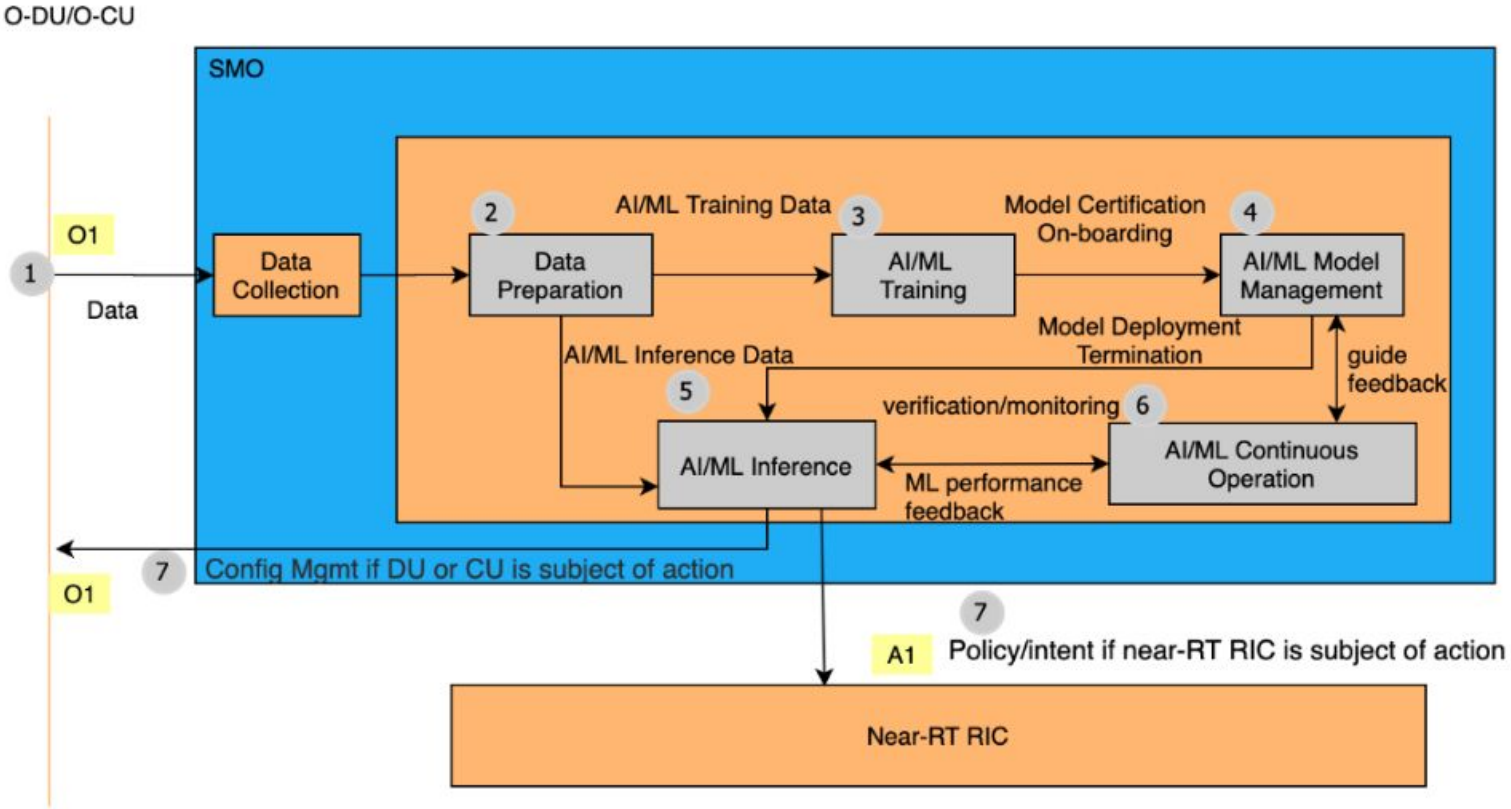
```
{
    "scope": {
        "sliceId": {
        "sst": 11,
        "sd": "456DEF",
        "plmnId": {
            "mcc":"248",
            "mnc":"35"
        }}
    },
    "qoeObjectives": {
        "qoeScore": 5
    }
}
```

slice optimization policy: QoE score should be 5 for the slice

PolicyTypeId:
ORAN_QoEandTSP_2.0.0

Source: O-RAN specification

AI/ML Model Training & Deployment



 Source: O-RAN specification

The O-RAN Opportunity: Business Advantages

Next Webinar: May 10th, 8:00 AM PT

- Speakers: Sriram Rupanagunta and Brandon Wick
- Learn about:
  - The seismic shift that O-RAN represents for today's networks – both public and private.
  - How the industry is transforming through open source and standards, 5G, edge, AI/ML, and cloud native approaches that combine economic drivers with rapid innovation.
  - Using an open source, vendor neutral SMO
  - New opportunities in O-RAN to increase RAN utilization, reduce power consumption, and bringing AI/ML and predictive analytics to the edge
- Register here: https://us02web.zoom.us/webinar/register/5216813944699/WNejsmqYeKT9KugW8l6gW5BA

Open Discussion & Q&A

Thank You!