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xAPPs, RIC and SMO

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Member At Ngkore

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What is SMO?

- The SMO also referred to as Service Management and Orchestration (SMO).
- It is an intelligent automation platform which applies automation at scale to simplify the complexity of networks, as well as improve network performance, enhance customer experience and minimise RAN OPEX & CAPEX.
- It plays a crucial role in network management and enhancement, particularly within the framework of the Open Radio Access Network (O-RAN) architecture.
- Hierarchically, it is a component of the operational support system (OSS), used for managing the network's operational aspects

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NEED FOR SMO

- Service Management and Orchestration (SMO) plays a critical role in the O-RAN (Open Radio Access Network) architecture for several reasons

Multi-Vendor Interoperability:

- O-RAN promotes a disaggregated architecture with interoperable components from different vendors.
- SMO abstracts the underlying complexity and provides standardized interfaces, enabling seamless communication and control between diverse network elements. This fosters an open and competitive ecosystem, encouraging innovation and flexibility.

Dynamic Service Management

- O-RAN is designed to support various services with different requirements, such as enhanced mobile broadband (eMBB), ultra-reliable low-latency communication (URLLC), and massive machine-type communication (mMTC).
- SMO facilitates the dynamic management of these services throughout their life cycle, from creation to termination, ensuring efficient delivery and meeting specific quality of service (QoS) and service level agreement (SLA) requirements.

Resource Orchestration

- O-RAN relies on virtualization and cloud-native principles. SMO coordinates the allocation and optimization of computing, storage, and networking resources across the RAN.
- It ensures that resources are dynamically allocated based on service demands and network conditions, enhancing overall network efficiency and scalability.

Network Slicing

- O-RAN embraces network slicing, allowing operators to create virtual networks optimized for specific use cases. Each slice is tailored to meet the needs of different services and applications.
- SMO is responsible for the creation, allocation, and management of these network slices, enabling efficient resource utilization and isolated service delivery.

Policy Enforcement and Automation

- SMO enforces policies to govern network behaviour based on defined rules and guidelines. Policies can cover aspects like QoS, traffic prioritization, security, and network slicing parameters.
- With the help of artificial intelligence and machine learning, SMO can automate decision-making, allowing for real-time optimizations and proactive management.

Self-Healing and Fault Management:

- In an O-RAN environment, SMO is responsible for monitoring the health and performance of network elements.
- When issues or faults are detected, SMO can trigger self-healing mechanisms or initiate corrective actions, leading to improved network reliability and resilience.

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Openness and Flexibility

- SMO aligns with the principles of openness and flexibility that are core to the O-RAN architecture.
- It enables network operators to easily onboard new services, adapt to changing demands, and evolve their networks with minimal disruption, fostering a more agile and future-proof infrastructure.

FCAPS Support

- FCAPS is an acronym representing the five functional areas of network management: Fault Management, Configuration Management, Accounting (or Asset) Management, Performance Management, and Security Management.
- SMO provides FCAPS Support by integrating these management functions to efficiently operate and maintain the O-RAN network. It helps to identify and handle network faults, track configuration changes, manage network resources, monitor performance metrics, and enforce security policies.

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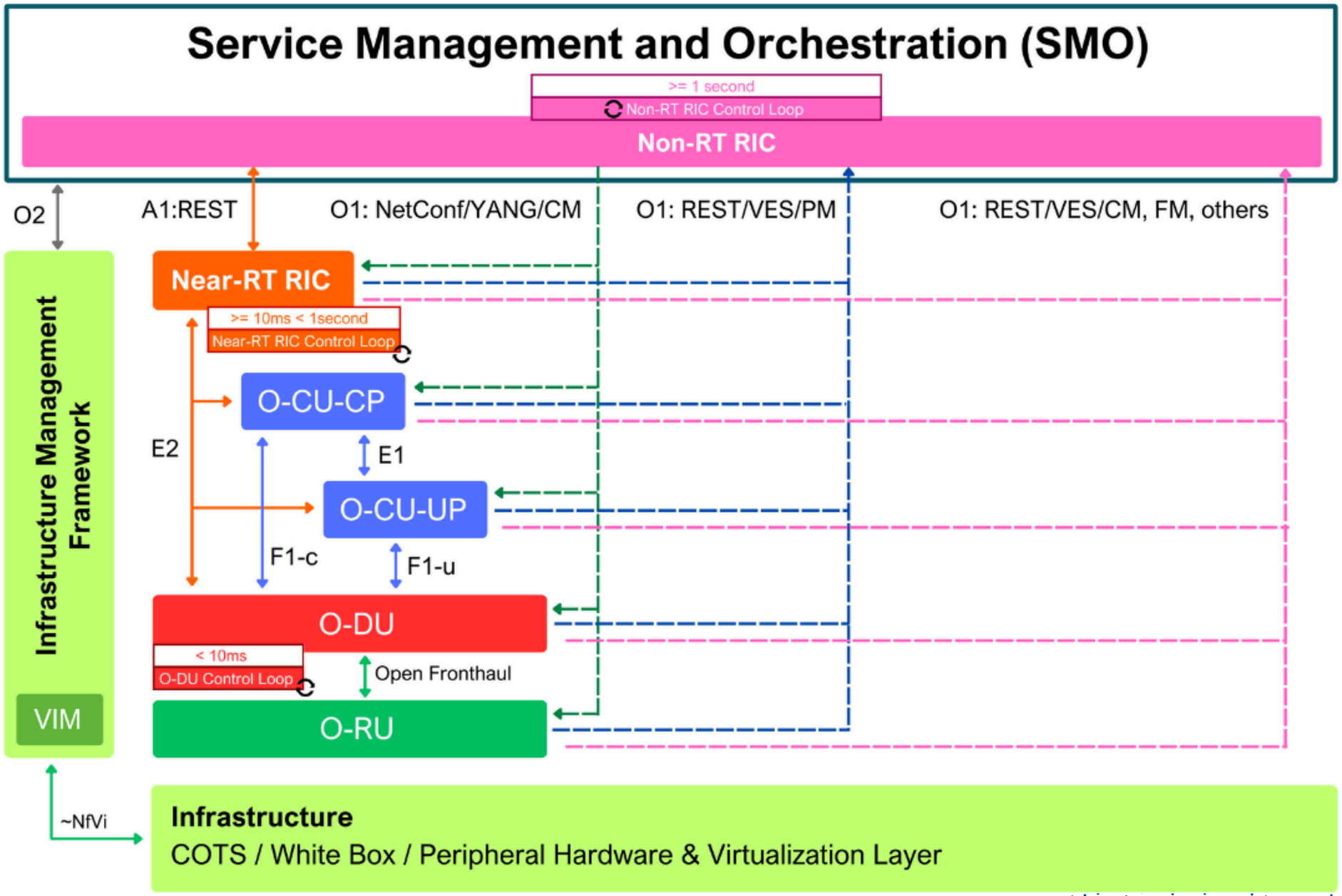
SMO ARCHITECTURE


Service Management and Orchestration (SMO)
>= 1 second
Non-RT RIC Control Loop
Non-RT RIC
O2
A1:REST
O1: NetConf/YANG/CM
O1: REST/VES/PM
O1: REST/VES/CM, FM, others
Infrastructure Management Framework
VIM
Near-RT RIC
>= 10ms < 1second
Near-RT RIC Control Loop
O-CU-CP
E2
E1
O-CU-UP
F1-c
F1-u
O-DU
< 10ms
O-DU Control Loop
Open Fronthaul
O-RU
~NfVi
Infrastructure
COTS / White Box / Peripheral Hardware & Virtualization Layer

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Non RT RIC

- The non-RT RIC manages events and resources with a response time of one second or more.
- It is usually deployed centrally
- It utilises rApps, which are specialised apps built on trained data models to enhance performance
- It applies policies and data models on Near-RT RIC
- We can run rapps to check policies applied in the SMO framework and number of near RT RIC connected.

Near RT RIC

- The near RT RIC manages events and resources requiring a faster response down to 10 milliseconds (ms).
- It is usually deployed near the edge.
- It utilises xapps, which are specialised apps to translate policies (applied by Non RT RIC) into real-time decisions.
- xApps controls our RAN in real time.
- We can make xapps for each service we want to add.

A1 Interface – Between RICs for RAN Optimizations.

- The A1 interface connects multiple RICs (RAN Intelligent Controllers) within the O-RAN architecture.
- RICs are responsible for real-time network optimizations, and the A1 interface allows them to exchange information related to radio resource management and other optimization parameters.
- Through this interface, RICs can **collaborate and collectively enhance** the performance of the Radio Access Network (RAN) by dynamically adjusting parameters based on real-time conditions.

O1 Interface – for FCAPS Support.

- The O1 interface enables FCAPS (Fault, Configuration, Accounting, Performance, Security) support in the O-RAN architecture.
- It connects the SMO to other network management entities, facilitating the exchange of information and management actions related to these functional areas.
- SMO uses the O1 interface to handle fault monitoring, configuration management, performance monitoring, accounting/asset management, and enforcing security policies in the O-RAN network.

O2 Interface – for Platform Resources and Workload Management:

- The O2 interface is responsible for platform resources and workload management within the O-RAN architecture.
- It connects the SMO to the underlying cloud-native infrastructure where virtualized network functions (VNFs) and applications are deployed. Through the O2 interface, SMO can allocate resources, manage VNF lifecycle, scale resources up or down based on demand, and monitor resource utilization, ensuring efficient operation and optimal performance of network functions.

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Project Maintainer
At Ngkore & Magma India

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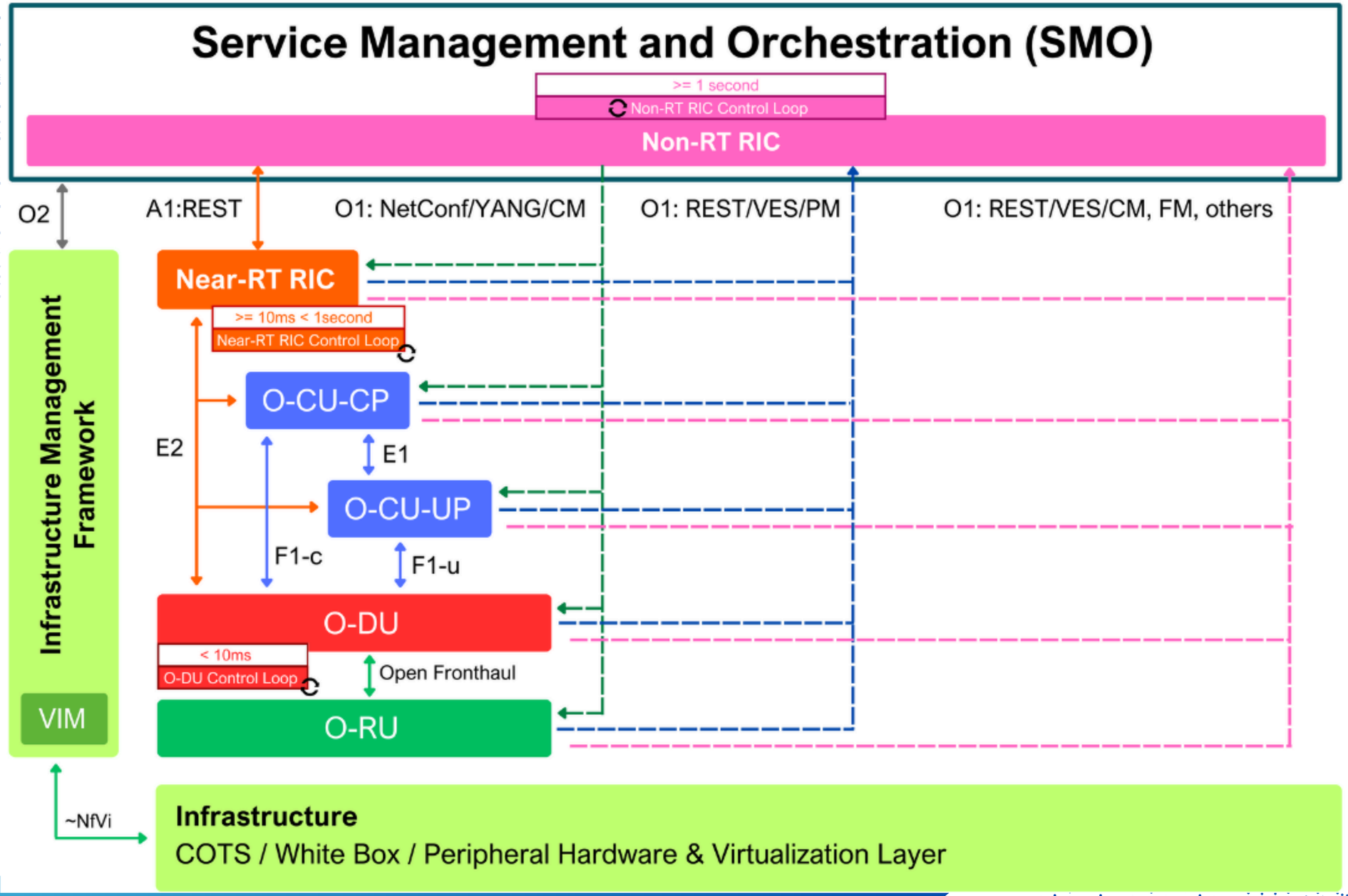
AI/ML FRAMEWORK IN SMO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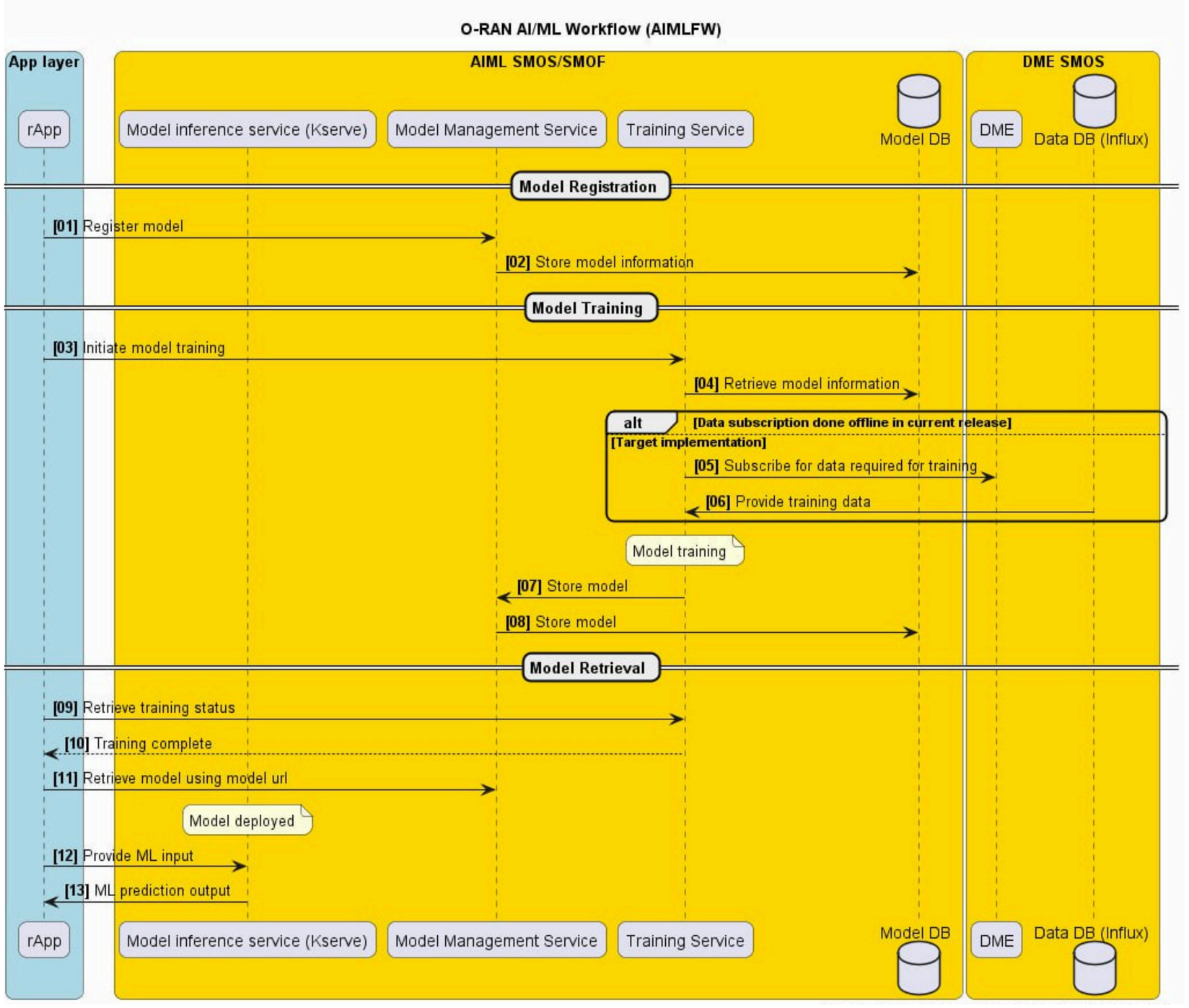
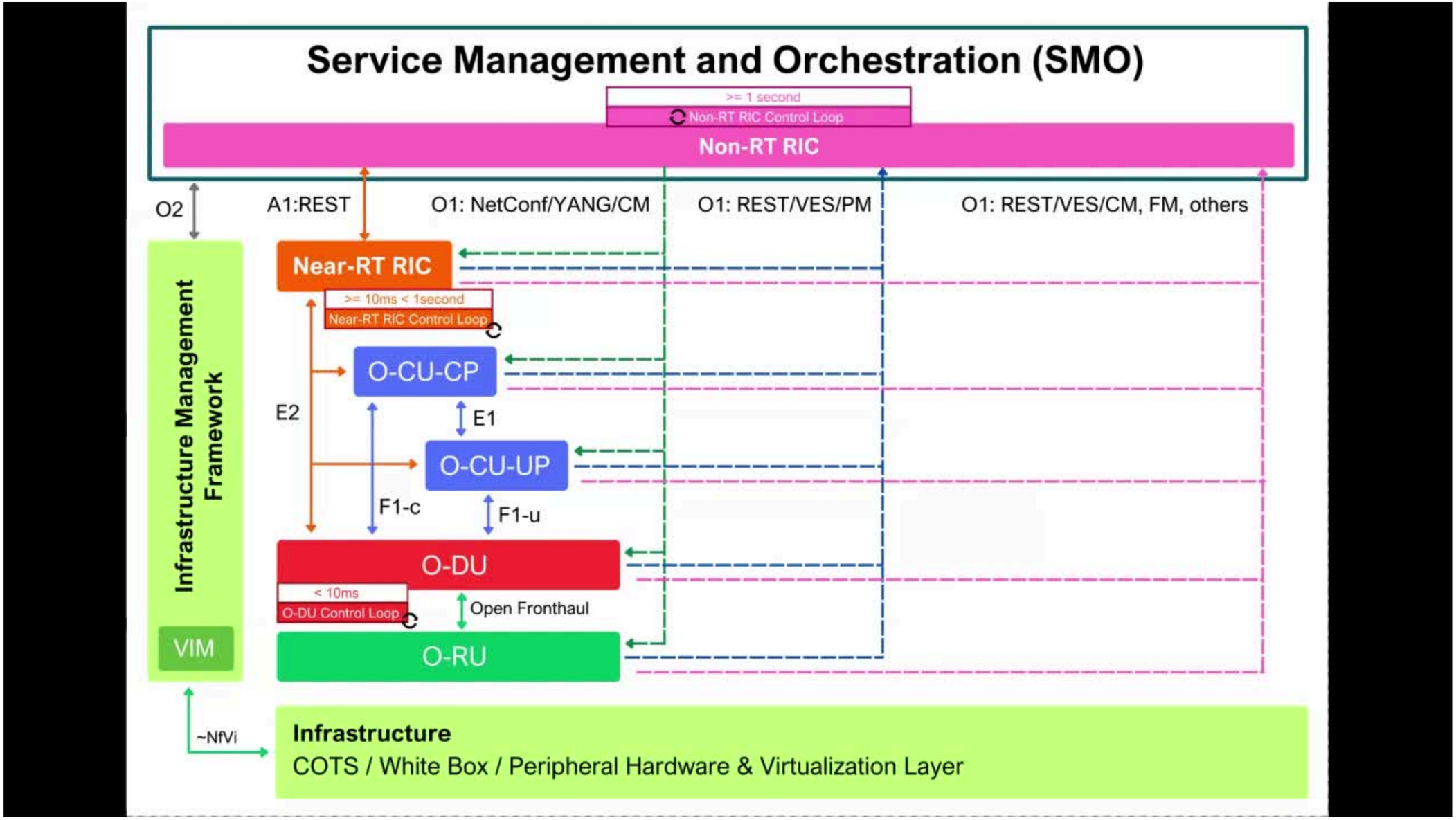

O-RAN AI/ML Workflow (AIMLFW)
App layer
AIML SMOS/SMOF
DME SMOS
rApp
Model inference service (Kserve)
Model Management Service
Training Service
Model DB
DME
Data DB (Influx)
Model Registration
[01] Register model
[02] Store model information
Model Training
[03] Initiate model training
[04] Retrieve model information
alt
[Data subscription done offline in current release]
[Target implementation]
[05] Subscribe for data required for training
[06] Provide training data
Model training
[07] Store model
[08] Store model
Model Retrieval
[09] Retrieve training status
[10] Training complete
[11] Retrieve model using model url
Model deployed
[12] Provide ML input
[13] ML prediction output
rApp
Model inference service (Kserve)
Model Management Service
Training Service
Model DB
DME
Data DB (Influx)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THANK YOU !

LET’S CONNECT