Orchestrate, Automate, and Assure O-RAN with SMO

Saving Energy in the RAN, Optimizing Services with AI/ML, Deploying CNFs, and Other SMO Use Cases

SMO FRAMEWORK AT A GLANCE

The SMO framework from VMware lets you plan, deploy, orchestrate, and observe a multi-vendor, multi-cloud RAN with end-to-end automation, assurance, and optimization.

- Design and deploy infrastructure, cloud resources, VNFs, and CNFs.
- Rapidly integrate network functions and rApps from multiple vendors.
- Unlock and analyze O1 and O2 data.
- Get end-to-end visibility into all the layers of your network.
- Tap closed-loop automation and assurance to optimize a multi-layer network ranging from bare-metal servers to network slices.
- Support legacy RAN and O-RAN on a common, vendor-neutral platform.
- Simplify the management of VNFs, CNFs, and rApps with automated LCM and end-to-end observability.
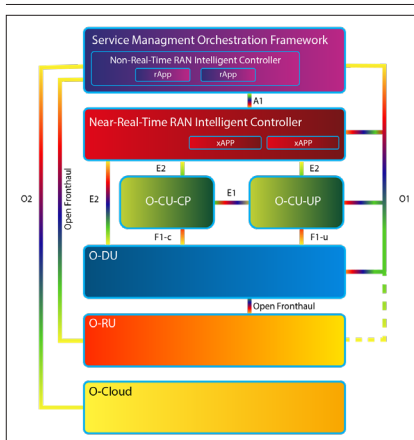- Optimize your network with AI/ML.

FIGURE 1: O-RAN architecture and interfaces; source: O-RAN Alliance.

Solving Monolithic Problems

The complexity, silos, fragmented management, and high operational costs of monolithic RAN systems are leading telcos to explore new ways to simplify the management of mobile networks.

Disaggregating the RAN begins to solve these problems. Open RAN is expected to reduce costs by boosting competition and giving you the power to select the best interoperable components for your network. With new solutions entering the RAN domain, interoperability is an important benchmark.

When a vendor-neutral, standards-based platform supports traditional RAN as well as virtualized systems, the components and services of various vendors can work in unison. A standards-based platform lets you modernize your network and streamline your operations by using common services, cloud-native technology, multi-layer automation, and analytics and assurance powered by machine learning and artificial intelligence.

Fostering a Multi-Vendor Ecosystem through Disaggregation

The O-RAN Alliance aims to create an open, multi-vendor ecosystem by disaggregating and virtualizing the radio access network. An essential part of that plan is Service Management and Orchestration, or SMO. In the O-RAN Alliance's architecture, the SMO layer manages the RAN domain. The key capabilities include the following SMO services:

- The interface to network functions for FCAPS
- The non-real-time RIC
- O-Cloud management
- Observability and assurance
- Network function orchestration and lifecycle management
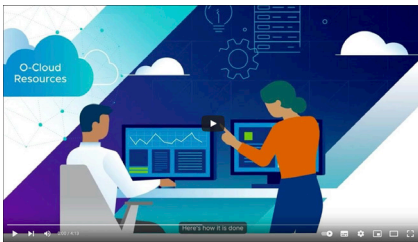
The SMO Framework from VMware

The Service Management and Orchestration framework from VMware delivers a comprehensive solution for streamlining operations in a virtualized, disaggregated RAN by delivering the following capabilities:

- Planning
- Orchestration
- Automation
- Analytics
- Observability
- Optimization

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SMO USE CASES

- Instantiation of CNFs and 5G services.
- Deployment and management of RAN applications from multiple vendors.
- Configuration management.
- Network and service optimization with artificial intelligence and machine learning.
- Centralized data collection for performance analytics, root-cause analysis, and closed-loop remediation.
- End-to-end O-RAN observability and assurance.

Demo Video: Managing a multi-vendor RAN ecosystem with the SMO framework from VMware

NWDAF USE CASES IN THE SMO LAYER

An SMO framework could connect with services of the Network Data Analytics Function, or NWDAF, that go beyond the RAN domain by using O-RAN's external enrichment interface. Here are examples of NWDAF use cases:

- Tapping analytics-driven automation that combines NWDAF functionality with RIC and SMO capabilities to perform user- and app-level optimizations, such as selecting the best network and radio band for each device based on real-time conditions.
- Using NWDAF to provide data collection services, APIs, and analytics services for 5G network functions and OSS.
- Network control enhancements, such as dynamic scaling and radio control based on network load predictions.
- Monetization through offerings like device security as-a-service based on anomaly detection and dynamic device profiling.
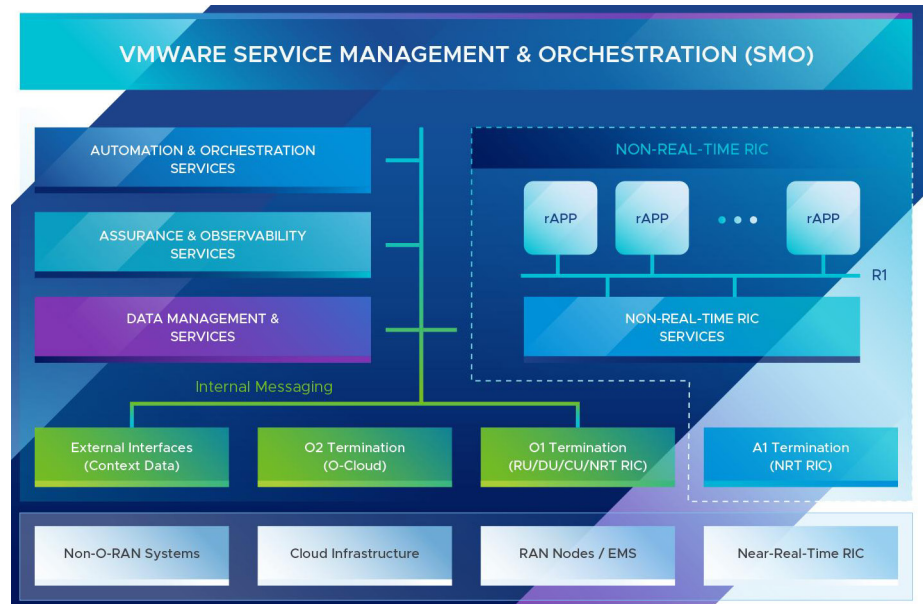

FIGURE 2: The Service Management and Orchestration framework from VMware. In this diagram, NRT denotes the near-real-time RIC.

The SMO framework from VMware lets you plan, deploy, and orchestrate a multi-vendor, multi-cloud 5G radio access network with end-to-end automation, assurance, and optimization. Full-stack, closed-loop automation and assurance empower you to control and optimize a multi-layer network ranging from bare-metal servers and network slices to containerized applications and 5G services.

Service-Based Architecture for Modularity and Extensibility

To deliver end-to-end automation and assurance across services, applications, and components from multiple vendors, an SMO solution needs to be scalable, extensible, and modular. At the core of the SMO framework from VMware is an open service-based architecture that is fully automated and programmable to enable you to manage cloud resources, network functions, and 5G services with ease.

As an O-RAN Alliance contributor, VMware is poised to deliver an SMO framework that covers automation, orchestration, assurance, analytics, and optimization with a common data collection and management service. The SMO framework from VMware supports both legacy RAN and O-RAN on a common, vendor-neutral platform that runs VNFs, CNFs, and rApps — all managed with automated lifecycle management and end-to-end observability.

The result simplifies management, reduces OpEx, establishes a multi-vendor ecosystem, delivers AI/ML pipelines, drives efficiency, and optimizes your network. New opportunities open up for differentiation, cost savings, and innovation.

VMware Telco Cloud Products Forming the SMO Framework

The SMO layer from VMware ties three products together with a common data collection and management framework:

- *VMware Telco Cloud Automation* performs lifecycle management for the containers as a service (CaaS) layer, containerized network functions (CNFs), virtual network functions (VNFs), and rApps. VMware Telco Cloud Automation™ can deploy and update network functions from various vendors to support a multi-vendor RAN.

## USE CASE: DEPLOYING AND MANAGING RAPPS FROM A CENTRAL LOCATION

One general use case for the SMO layer is managing multiple RAN applications, en masse and at scale, from a single dashboard. The SMO becomes, in effect, a foundational layer for deploying RAN applications from a multitude of vendors — which helps make the kind of multi-vendor ecosystem envisioned by the O-RAN Alliance an operational reality. Here are video demonstrations of rApps that can be managed through the SMO framework from VMware.
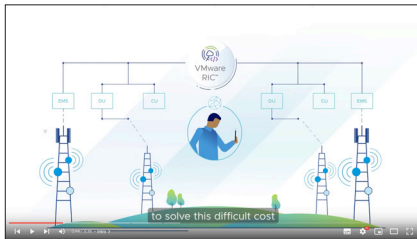
Reducing RAN operating costs with the energy savings rApp from VMware
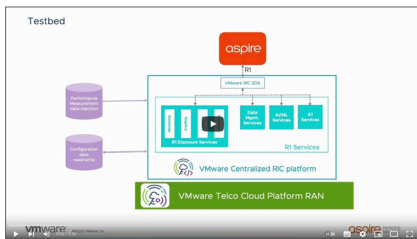
Running Aspire's rApp on VMware Centralized RIC to oversee configuration management
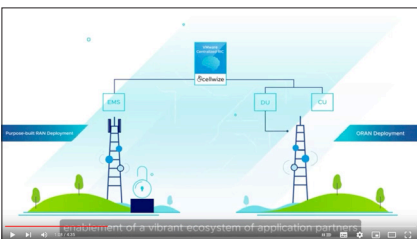
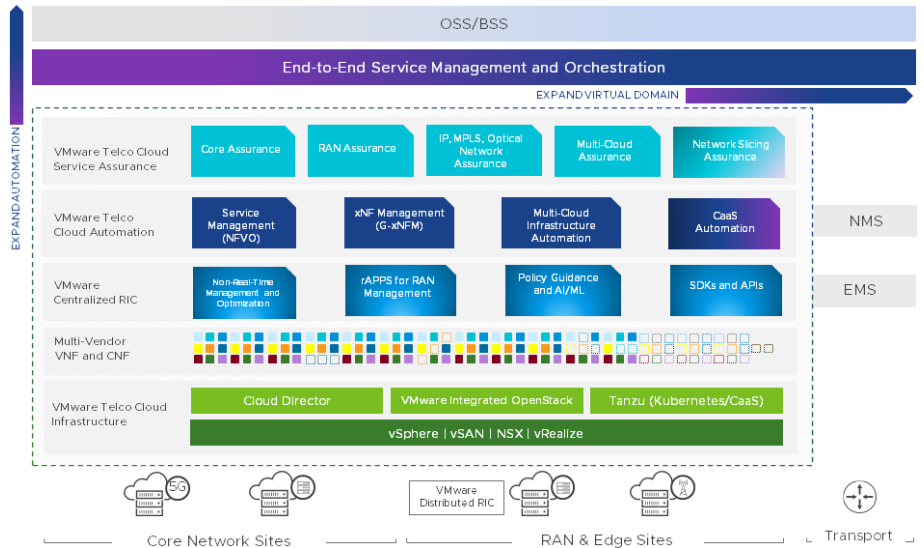*Using AI/ML for RAN optimization with the Cellwize rApp on VMware RIC*

FIGURE 3: The products and capabilities tied to the SMO framework from VMware.

- *VMware Centralized RIC* is an implementation of the non-real-time RIC in the O-RAN Alliance reference architecture. VMware Centralized RIC supports policy-based guidance, data analytics, AI/ML model management, and enrichment information for RAN elements. It exposes open northbound APIs for RAN management-plane applications (rApps) from various vendors. Because it supports traditional RAN, virtualized RAN, and O-RAN environments, VMware Centralized RIC lets you reap the benefits of rApps on your existing RAN architecture without having to implement other elements of an open RAN architecture.
- *VMware Telco Cloud Service Assurance* delivers RAN observability and assurance by monitoring O-RAN resources and functions from a centralized location in the SMO layer. VMware Telco Cloud Service Assurance™ uses machine learning to automatically find and fix network and service issues. After a root cause is identified, the system can trigger a series of actions, from identifying business impacts to initiating closed-loop remediation. The solution can integrate with FCAPS systems from VMware partners to support a multi-vendor RAN.

This combination unites three fundamental functions in one overarching SMO layer:

- Automation and orchestration, including lifecycle management (LCM) for network functions from various vendors
- Analytics and observability
- RAN programmability and optimization

The result is a powerful SMO framework for managing open RAN deployments:

- Gain multi-cloud and multi-vendor support and access to a broad ecosystem
- Use the non-real-time RIC to work with traditional RAN and open RAN
- Tap a common data collection framework for observability and analysis in a single dashboard
- Use AI/ML at various points in a RAN architecture

The SMO framework is, in effect, the centralized basis for implementing, automating, observing, and optimizing a multi-vendor open RAN at scale. The framework radically simplifies multi-app management, reduces complexity, eradicates silos, improves flexibility, and streamlines 5G RAN deployments. The following use case — saving energy by running an rApp on the non-real-time RIC — demonstrates these benefits.

VMWARE RIC AT A GLANCE

VMware RIC lets you programmatically manage and control your radio access network. The RAN intelligent controllers from VMware enable third-party application developers to tap and process network data to modify RAN behavior.

VMware Distributed RIC hosts near-real-time applications (xApps), and VMware Centralized RIC runs non-real-time applications (rApps). These apps introduce new use cases — automation, optimization, and service customization — that fuel innovation across a telecommunications network.

KEY BENEFITS

• **Multi-vendor interoperability and a vibrant partner ecosystem** – use a vendor- and technology-agnostic platform and tap pioneering solutions.

• **Network optimization** – gain network-wide observability and automate optimization with AI/ML.

• **Efficiency** – reduce energy consumption and improve spectrum utilization by using applications from various partners.

RAN PROGRAMMABILITY

The RAN intelligent controller gives applications from different vendors access to the functions running in the control and management planes of your radio access network, empowering you to program and optimize your RAN by using methods like artificial intelligence and machine learning.

Demo Video: Activating Network Programmability with VMware RIC

Example Use Case: Managing an Energy Savings rApp

One way to reduce costs is to save energy. This use case illustrates how the SMO framework from VMware helps save energy by correlating data from O-Cloud resources and applications.

The SMO framework and an energy savings rApp use automation to orchestrate power-saving mechanisms across the RAN and the underlying infrastructure. The VMware RIC SDK helps the rApp manage energy usage across diverse infrastructure. Here's how it works:

The SMO framework's unified dashboard lets you launch common services, such as those for assurance. Next, the dashboard is used to onboard the energy-saving rApp from a network function catalog and instantiate it.

The rApp and the SMO framework from VMware work together to save power by measuring energy consumption, displaying energy usage in the dashboard, and implementing mechanisms such as symbol shutdown, cell switch-off, RF transceiver switch-off, O-CU and O-DU hardware sleep mode, CPU C-states and P-states, and dynamic reallocation of active workloads.

The SMO framework also lets you manage the lifecycle of the energy savings rApp by, for example, updating it to the latest version.

Meanwhile, the common data management framework gathers information from various vendors' equipment spread across the layers of physical infrastructure, virtual machines and hypervisors, containers as a service, and CNFs. Topology information and key performance indicators are collected. In the dashboard, you can see information about such things as the setup success rate, throughput, and connected user equipment.

The data is also consumed by the observability and assurance service as well as the analytics and optimization platform services, which provide end-to-end monitoring and RAN performance metrics. Trace data is ingested from other network functions. The network's energy consumption is managed by analyzing traffic and resource utilization, among other data.

In addition, the platform notifies you of performance degradation and furnishes root-cause analysis. Notifications are sent to the orchestration engine, which can automatically perform remediation.

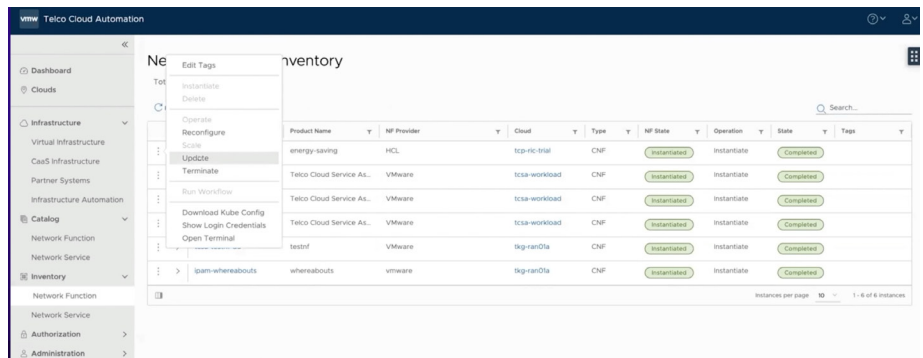For more information about the energy savings rApp from VMware, see this *video demonstration on YouTube*.

FIGURE 4: Using the unified SMO dashboard to update an energy-savings rApp, which is shown in the Network Function Inventory.
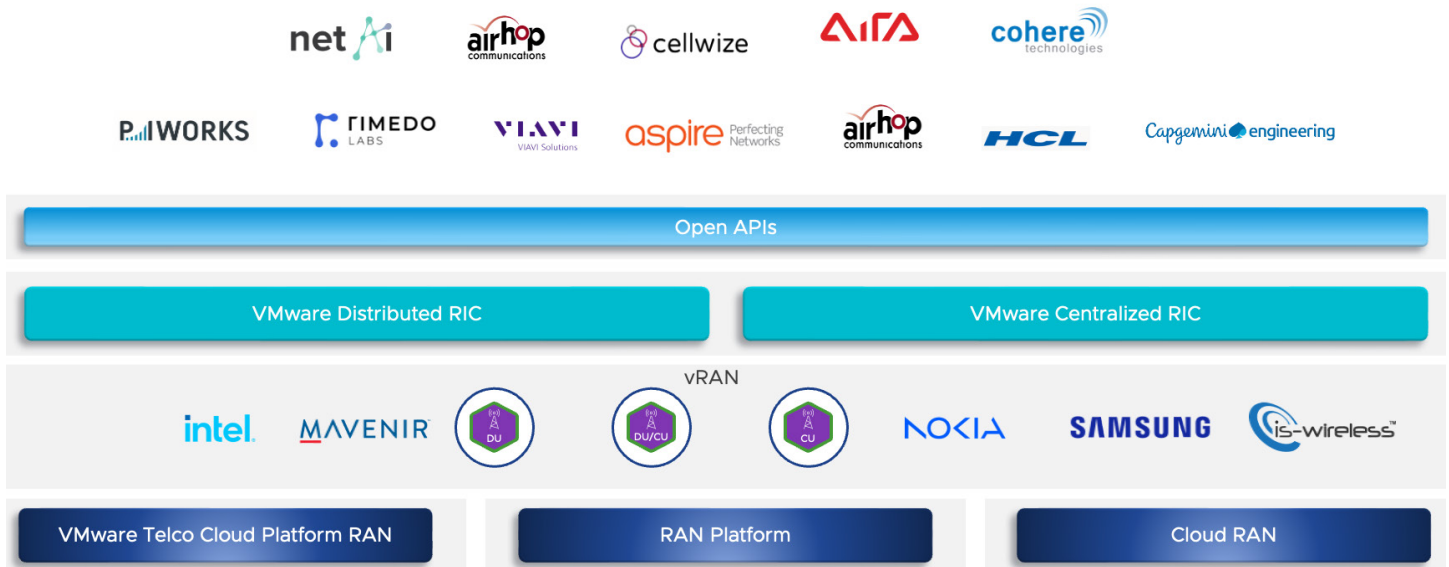
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FIGURE 5: Some of the many partners in the VMware partner programs for RAN applications, services, and infrastructure. The SMO framework from VMware empowers you to deploy and manage applications from various vendors.

RIC SDK PARTNER PROGRAM

A rich developer ecosystem is critical to the successful adoption of open RAN technology. The VMware RIC SDK Partner Program expands access to and simplifies the development of RIC applications. The program gives partners access to RIC SDKs as well as training videos and app developer support. To find out more, visit *https://techpartnerhub.vmware.com/ programs/vmware-ric*

Empowering partners to rapidly build O-RAN apps with the RIC SDK

LEARN MORE

For more information about the SMO framework from VMware, call 1-877-VMWARE (outside North America, dial +1-650-427-5000) or visit *https://telco.vmware.com/*

Example Use Case: Managing Applications from Multiple Vendors

Another immediately viable use case for the SMO layer is deploying, instantiating, and managing CNFs, 5G services, and RAN applications from a multitude of vendors. By using a unified dashboard and automation, the SMO framework from VMware lets you view an inventory of network functions. You can not only instantiate network functions but also manage their lifecycle from a centralized location.

Deploying and managing RAN applications, CNFs, and VNFs from a unified dashboard radically simplifies operations and eases the complexity that would otherwise accompany a multi-vendor ecosystem.

Simplifying the Operations of a Multi-Vendor RAN

The Service Management and Orchestration framework from VMware delivers a comprehensive solution for streamlining RAN operations in a virtualized, disaggregated multi-vendor open RAN ecosystem by providing capabilities — including AI/ML — for the following functions:

• Planning

• Orchestration

• Automation

• Analytics

• Observability

• Optimization

The SMO use cases in this paper demonstrate these functions in action.

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