

# RAN Intelligent Controller

## Simplifying Multi-Vendor RAN Operations through Openness and Programmability with VMware RIC

### AT A GLANCE

VMware RIC™ is a multi-RAN, multi-cloud platform that simplifies the operations of the underlying RAN infrastructure through programmability and intelligence. The platform can host both near-real-time applications (xApps) and non-real-time applications (rApps). These apps introduce new use cases — automation, optimization, and service customization — that fuel innovation across a telco network.

### KEY BENEFITS

- **Multi-vendor interoperability** – provide a vendor- and technology-agnostic platform for both existing and new RAN vendors.
- **RAN programmability** – enable flexibility and agility to dynamically support new applications and services.
- **Network optimization** – gain network-wide observability and perform automated optimization using AI/ML algorithms.
- **Efficiency** – reduce energy consumption and improve spectrum utilization through applications from an ecosystem of partners.

### Light Up the Path to Open RAN

The modernization of the 5G RAN comes with significant challenges. As the radio access network’s architecture becomes more complex, innovating fast while reducing cost and increasing operational efficiency are becoming top-of-mind for service providers.

Against this backdrop, communications service providers are looking to open RAN as a way to restructure how the RAN is run and future-proof it for long-term innovation. The vision of the industry-led O-RAN Alliance is to decouple the control and management functions of the RAN infrastructure from its data plane functions, thereby abstracting the complexities inherent in the underlying RAN infrastructure and enabling programmability of the RAN by introducing the RAN Intelligent Controller, or RIC.

Through the implementation of the RIC, the RAN becomes more open and disaggregated, fostering greater choice in a traditionally closed market. These changes will establish a strong foundation for communications service providers (CSPs) and their partners to offer more innovative solutions to enterprise and consumer customers. With the shift to the O-RAN architecture, you can obtain a return on your existing 4G and new 5G investments and monetize your network by launching new applications and services, especially at the edge.

### Modernize the Radio Access Network

VMware RIC modernizes the RAN to be open and modular, built with innovative solutions from a vibrant ecosystem of partners, while optimizing the RAN to ensure that all the solutions work harmoniously.

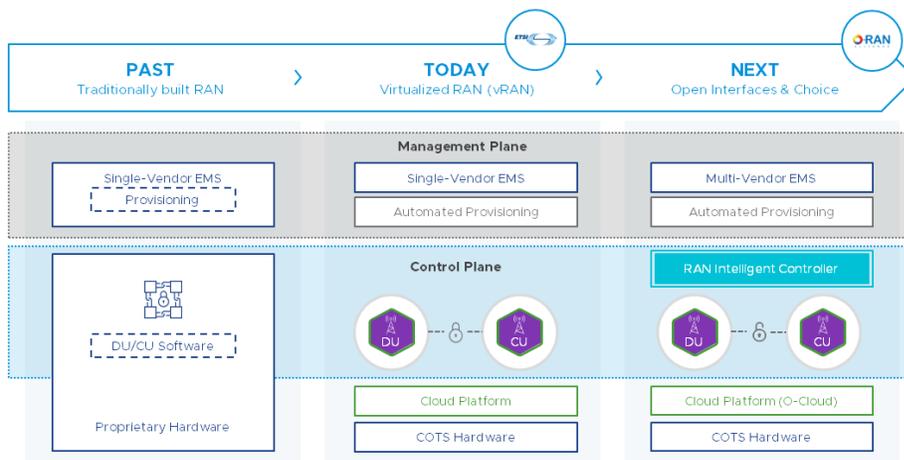


FIGURE 1: The evolution from a traditional RAN architecture to open RAN.

**THE RIC POWERS AN OPEN, MULTI-VENDOR RAN**

As open interfaces began to be specified and standardized, the telecommunications industry quickly realized that such interfaces can be used to build and deploy value-added capabilities in the RAN.

In other words, the RIC can become a platform for deploying innovative RAN capabilities that enhance the performance and experience of OTT applications and edge services. In essence, the RIC enables you to build a multi-vendor RAN, diversify its supply chain, and boost your agility.

**RAN PROGRAMMABILITY**



*Demo Video: Activating Network Programmability with VMware RIC*

**VMWARE DISTRIBUTED RIC**

VMware Distributed RIC can be considered a control plane entity. It hosts external RAN-focused applications, referred to as xApps, that have control functions with response times of less than 1 second, typically on the order of tens of milliseconds.

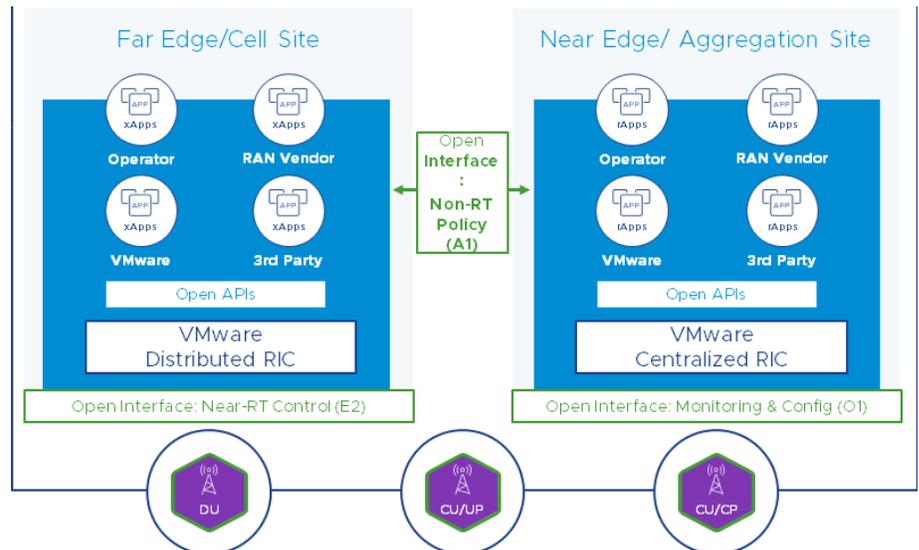


FIGURE 2: The VMware RIC solution includes VMware Distributed RIC and VMware Centralized RIC.

To be vendor-neutral, VMware RIC integrates with RAN centralized units (CUs) and distributed units (DUs) and runs xApps and iApps from a large ecosystem of partners. This vendor-neutral vision helps you maximize the full benefits of an open virtualized RAN by giving you the freedom to choose your RAN vendors according to your unique requirements and priorities.

VMware RIC is a modern cloud-native software platform that uses a microservices architecture designed to run on Kubernetes infrastructure, such as VMware Tanzu™ and Amazon Elastic Kubernetes Service (EKS).

VMware RIC consists of two products: VMware Distributed RIC™ and VMware Centralized RIC™. VMware Distributed RIC and VMware Centralized RIC are responsible for the control and management functions of a disaggregated open RAN as defined by the O-RAN Alliance, decoupling the control and management functions of the RAN infrastructure from its data plane functions.

**VMware Distributed RIC**

VMware Distributed RIC is an implementation of the near-real-time RAN intelligent controller (near-RT RIC) in the O-RAN Alliance reference architecture. VMware Distributed RIC uses the southbound E2 interface to control the RAN data plane, that is, the RAN baseband software that includes the centralized unit control plane (CU-CP), the centralized unit user plane (CU-UP), and the DU. It exposes open northbound APIs for third parties to run RAN control-plane applications known as xApps.

**Key Features of VMware Distributed RIC**

- E2-related services: Supports procedures for observing and controlling the RAN.
- FCAPS service: Collects performance and health metrics from RIC services and xApps.
- xApp lifecycle management service: Supports lifecycle management of xApps.
- Shared data layer service: Supports the reading and writing of network data and application states from xApps.
- A1 services: Interfaces with the non-real-time RIC.

**VMWARE CENTRALIZED RIC**

VMware Centralized RIC can be considered a management plane entity. It hosts external RAN-focused applications, referred to as rApps, that have control functions with response times greater than 1 second.

**VMware Centralized RIC**

VMware Centralized RIC is an implementation of the non-real-time RAN intelligent controller (non-real-time RIC) in the O-RAN Alliance reference architecture.

VMware Centralized RIC supports automated RAN optimization by providing policy-based guidance, data analytics, AI/ML model management, and enrichment information to underlying O-RAN elements.

**Key Features of VMware Centralized RIC**

Here are the key features of VMware Centralized RIC:

- R1 exposure services: Support communication between rApps and VMware Centralized RIC.
- O1-related services: Support APIs to read performance management counters and read/write configuration management parameters.
- FCAPS services: Collects performance and health metrics from RIC services and rApps.
- rApp lifecycle management services: Support lifecycle management of rApps.
- A1-related services: Interfaces with near-real-time RIC.

**Supporting Traditional and Virtualized RAN**

One of the key capabilities of VMware Centralized RIC is its ability to support traditional RAN and virtualized RAN environments, which lets you take advantage of newly introduced RAN innovation in the form of rApps now, without making significant changes to your existing RAN architecture.

As a result, you can take the first step toward a disaggregated RAN and ultimately to an open RAN, making the RAN transition as smooth as possible.

VMware Centralized RIC uses the southbound O1 and A1 interfaces to manage the RAN data plane (that is, the RAN baseband software that includes the CU-CP, CU-UP, and DU) and the RAN control plane (Near-RT RIC) respectively. It exposes open northbound APIs for third parties to provide various RAN management-plane applications, known as rApps.

**KEY INTERFACES IN THE O-RAN ARCHITECTURE**

- A1 interface: Allows the non-real-time RIC to deploy policy-based guidance for the near-real-time RIC to, for example, set high-level optimization goals.
- E2 interface: Allows the near-real-time RIC to control the procedures and functionality of the E2 nodes.
- O1 interface: Allows the SMO and non-real-time RIC to connect to O-RAN managed elements and support management services.
- O2 interface: Supports orchestration of O-Cloud infrastructure and deployment of network functions.
- R1 interface: Designed to support the portability of multi-vendor rApps and provide services to rApp developers.

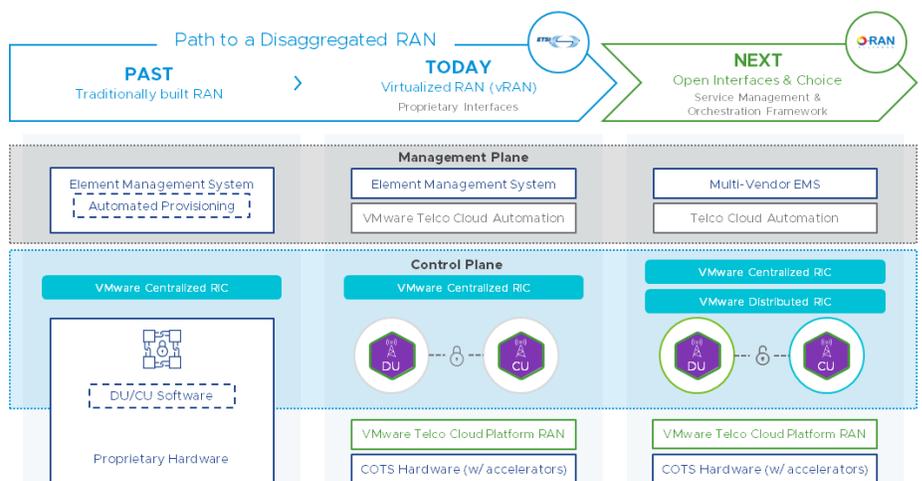


FIGURE 3: VMware RIC puts you on a fast path to a disaggregated RAN.

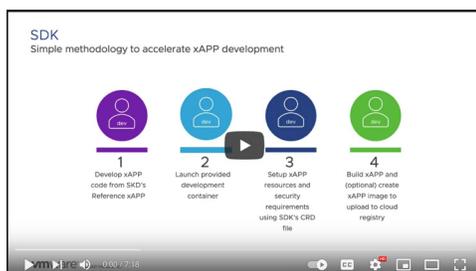
### RIC SDK PARTNER PROGRAM

VMware RIC SDK Partner Program gives developers access to VMware Centralized RIC SDK and VMware Distributed RIC SDK, both of which include sample code that helps jump-start and accelerate app development.

VMware RIC runs on various types of cloud infrastructure, providing app developers with the confidence that developing their applications for VMware RIC will have broad industry appeal and interest.

For more information, visit the [RIC SDK partner program](#).

### RIC SDK DEMO VIDEO



[Accelerating app development by using the VMware RIC SDK](#)

### WHAT IS INCLUDED IN THE RIC SDK?

- Architecture overview
- Open API specifications
- Kubernetes Custom Resource Definition (CRD)
- Sample rApp or xApp and libraries

### Service Management and Orchestration

The O-RAN Alliance has defined a new RAN management plane, the Service Management and Orchestration (SMO) framework, which is responsible for the orchestration and automation of the O-Cloud and Open RAN nodes. The non-real-time RIC is a logical function in the SMO that enables the control and optimization of RAN nodes and resources. The SMO lets you manage the RAN more effectively and efficiently by using automation, programmability, and artificial intelligence.

The three main functions of the SMO are as follows:

- O-Cloud management and orchestration
- FCAPS management
- Non-real-time RIC

Several solutions combine to form an *SMO framework from VMware*:

- VMware Telco Cloud Automation™ manages and orchestrates O-Cloud infrastructure.
- VMware Telco Cloud Service Assurance™ provides FCAPS capability for the operation of the RAN.
- VMware Centralized RIC optimizes the RAN through policy-based guidance stemming from data analytics and AI/ML algorithms.

### Speed Up Application Development with the VMware RIC SDK

With VMware RIC SDK partners can jump-start their applications development by removing the complexities associated with networking and communicating with different elements of an O-RAN deployment. VMware Centralized RIC and VMware Distributed RIC are key to unlocking openness and monetization of the RAN because they provide the abstraction that removes the challenges of having to directly integrate applications with the underlying data plane.

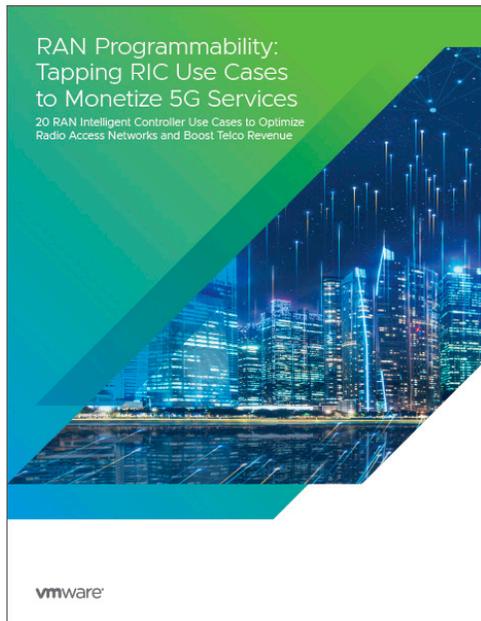
VMware RIC SDK provides a set of resources, tools, and services that help accelerate xApp and rApp development, enhance portability, and improve security. It allows our ecosystem of partners to focus on developing and bringing new applications to the market faster.

### Benefits of VMware RIC

VMware RIC modernizes the RAN to be programmable so you can build an open RAN with solutions from a vibrant ecosystem of partners. Here are some key capabilities and benefits of VMware RIC:

- Flexibility – VMware RIC is a vendor-neutral platform and can be deployed in traditional and virtualized RAN environments.
- Simplicity – Leverage AI and ML algorithms to automate and simplify RAN operations and optimizes network utilization.
- Programmability – Reduces operational complexity by running RAN control and management functions with open standards.
- Monetization – The VMware RIC SDKs empower you to create new and innovative services that maximize business growth.
- Security – VMware RIC includes inherent safeguards to protect applications and to help drive conformance with industry security standards from the O-RAN Alliance, 3GPP, and ETSI.
- Ecosystem – A broad ecosystem of partners that spark innovation.

## E-BOOKS ON RAN PROGRAMMABILITY



- *E-Book: 20 RIC Use Cases to Optimize Radio Access Networks and Boost Telco Revenue*
- *E-Book: Leading the Way to a Open, Programmable RAN*

„We’re proving that RIC is already capable of running complex features like MU-MIMO. We can already benefit from this today by deploying this use case as an xApp in the VMware RIC and make this a differentiator for Vodafone.”

CARLOS UBEDA,  
HEAD OF RAN SOFTWARE DEVELOPMENT,  
VODAFONE

### Example Use Cases Enabled by App Ecosystem Partners

VMware is working with a broad set of partners to drive innovation in the RAN in the form of xApps and rApps and to take advantage of the opportunities that the RIC represents. These apps spark innovation through automation, optimization, and service customization.

The following examples demonstrate how the RIC, together with rApps and xApps, can overcome some of the challenges in the RAN.

#### Automated O-RAN Optimization with AirHop

As the demand for more data services drives the need for network densification and more cells, configuration, operation, and optimization of the radio access network become more challenging.

Current methods and tools for frequency planning, conflict mitigation and optimization are proving to be costly and time-consuming, leading to slower deployments of new cells, launch of new services and decrease in performance of existing ones.

Deployed with VMware Centralized RIC, AirHop Communications’ PCI rApp efficiently detects PCI confusion and collisions during critical operational scenarios and automatically issues resolution commands to drive optimal performance for the RAN.

#### Purpose-Built RAN Monetization with Cellwize

The RIC helps transform the RAN into a 5G multi-services hub to develop and deploy custom 5G applications alongside vRAN functions while delivering carrier-grade quality 5G services and customer experiences that can monetize the RAN.

But while the inherent nature of the O-RAN architecture, with its open interfaces and disaggregated infrastructure, works well when the RIC fosters network programmability, purpose-built RAN deployments that are composed mostly of proprietary solutions limit the activation of programmability and block revenue growth.

VMware Centralized RIC has integrated Cellwize’s CHIME Platform Data Mediation and AI services to connect to various types of RAN deployments (O-RAN or purpose-built) and activate programmability. The result unlocks modernization and monetization of the radio access network.

#### Multiplying Spectrum Efficiency with Cohere Technologies

MU-MIMO boosts the capacity or spectrum efficiency of a cell by communicating with multiple users simultaneously in the same time and frequency slots. This allows a cell to push more bits per time and frequency, and thus improve the efficiency of the most valuable resource in the RAN — the spectrum.

However, activating MU-MIMO in existing deployments is often seen as unsustainable because it would call for a drastic change in radios and an increase in the number of deployed antennas, leading to an exponential rise in the total cost of ownership.

Powered by VMware Distributed RIC, Cohere Technologies’ software-based MU-MIMO Spectrum Multiplier xApp uses Delay-Doppler channel estimation and channel prediction to double mobile bandwidth on 4G and 5G networks (both FDD and TDD). It does so without changes to existing handsets, antennas, or radios.

For more information, see [Boosting 5G Capacity with VMware RIC and Cohere](#).

## rApp and xApp Partner Use Cases

APP	DESCRIPTION
Aira's Channel Prediction rApp	Aira's Channel Prediction xApp and VMware Distributed RIC increase the effectiveness of MU-MIMO by predicting the evolution of the channel between base station and user, allowing the base station to direct energy effectively, even to users who are highly mobile at the edge of the cell. For more information, see <a href="#">Boosting MU-MIMO Performance</a> .
AirHop's Energy Savings rApp	AirHop's rApp leverages AI-based learning and RAN programmability to predict traffic changes in the network, and automatically turns RAN elements off or on in the capacity carriers to save energy without compromising user experience. For more information, see <a href="#">Saving Energy Dynamically in the RAN with the Auptim rApp</a> .
Aspire's Anomaly Detection rApp	Aspire's anomaly detection rApp provides early identification of network degradation, allowing faster resolution of issues. Early intervention will reduce the number of network parameter rollbacks, leading to greater application operating efficiency and providing OpEx savings. For more information, see <a href="#">Detecting Anomalies with AI to Improve RAN Performance</a> .
HCLSoftware's Energy Savings rApp	HCLSoftware's Intelligent Dynamic Energy Saving (iDES) rApp uses AI/ML to proactively configure the network to cut energy costs without impacting service quality for subscribers. For more information, see <a href="#">Maximizing Energy Efficiency in the RAN</a> .
Net AI's Traffic Forecasting xApp	Net AI's xUPscaler running on VMware Distributed RIC uses artificial intelligence to predict traffic levels across the RAN, allowing accurate allocation of computational resources to meet demand. For more information, see <a href="#">Forecasting RAN Traffic and Autoscaling Resources with AI</a> .
Rimedo's Traffic Steering xApp	Rimedo's Policy-Controlled Traffic Steering xApp running on the VMware Distributed RIC incorporates both service and mobility load balancing to avoid congestion, improve user experience and make network more energy efficient. For more information, see <a href="#">Steering Traffic Intelligently to Optimizing Resource Utilization</a> .
VIAVI's Geolocation xApp	By using mobile cellular signaling data as the primary input for its location technology and pairing it with network configuration management data, radio site information, and subscriber digital geospatial information, VIAVI's xApp accurately locates subscribers 24/7 and makes this information available for consumption by other RIC applications in the near-real-time domain. See <a href="#">Harnessing the Power of Location Intelligence for the RAN</a> .
P.I. Works's PCI Optimizer rApp	P.I. Works PCI Optimizer rApp resolves existing PCI code conflicts and uses algorithms to proactively detect and resolve potential future clashes. It is integrated with VMware Centralized RIC through the standard R1 interface. For more information, see <a href="#">Intelligently Detecting Physical Cell ID Collision and Confusion</a> .

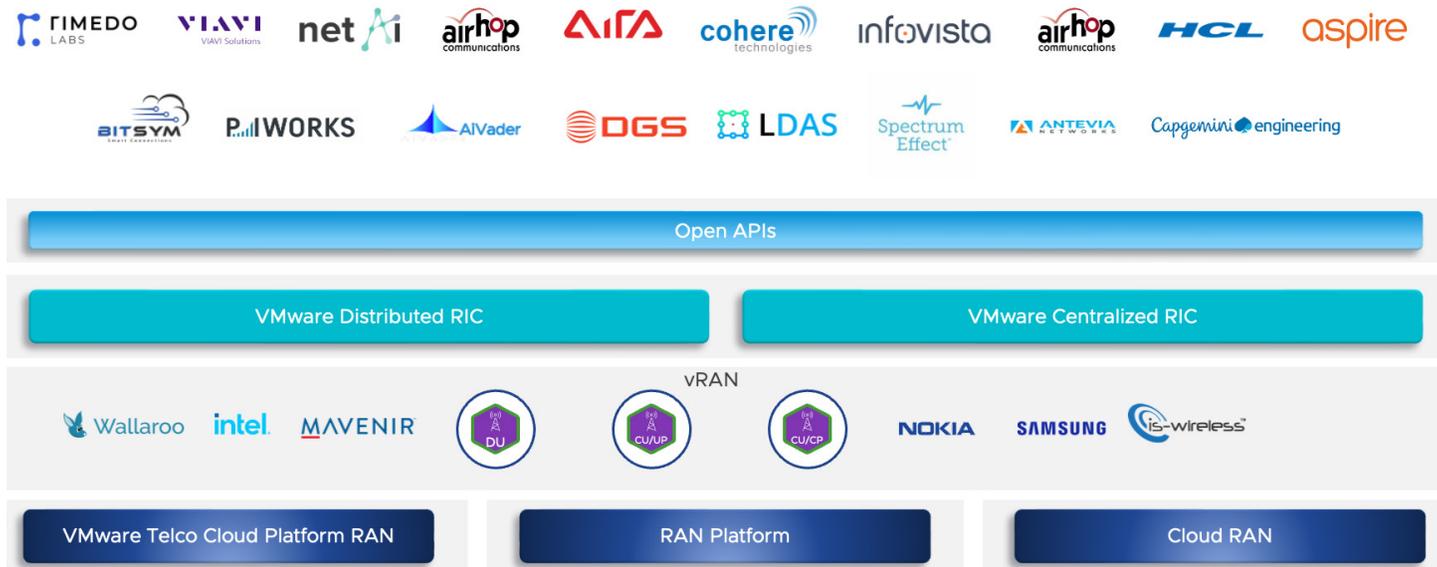


FIGURE 4: Solutions from a vibrant ecosystem of partners put open RAN use cases into action so you can program and optimize your 5G network.

**WHY CHOOSE VMWARE RIC?**

- Furnishes a common platform for RAN management and programmability
- Provides multi-vendor interoperability with a vendor-neutral design
- Works with traditional RAN infrastructure as well as vRAN and O-RAN infrastructure
- Delivers a service-based architecture for extensibility
- Handles device- and subscriber-level KPI monitoring
- Supports a variety of use cases
- Includes SDKs with open APIs and sample code to jump-start app development; for details, visit the [RIC SDK partner program](#).

**Network Slicing**

Network slicing enables agile end-to-end network deployment connectivity for different services with a specific set of requirements, such as quality of service (QoS), low latency, throughput, and service availability. Although network slicing involves end-to-end network programmability that encompasses the core, transport, and RAN domains, the RICs play a critical role in the RAN aspects of slicing. Slicing-related policies for the RAN are managed through VMware Centralized RIC and then implemented and enforced in the RAN nodes through VMware Distributed RIC.

Here are the benefits of using the RIC for network slicing:

- Perform policy-driven closed-loop control of RAN slices.
- Track slice performance in relation to SLAs.
- Monitor long-term trends and patterns for RAN slice subnets' performance.
- Employ AI/ML methods to perform corrective actions through the SMO framework.
- Modify and update slice configurations in near real time to meet SLAs.

VMware RIC plays a critical role in maintaining the slice once it is instantiated and operational. VMware RIC ingests and monitors telemetry data for each slice. AI/ML techniques furnish closed-loop automation for SLA assurance. With automation powered by VMware RIC, you can deliver unique products and services at scale.

**LEARN MORE**

For more information about VMware RIC, call 1-877-VMWARE (outside North America, dial +1-650-427-5000) or visit <https://telco.vmware.com/>

