Manuals+ — User Manuals Simplified.

JUNIPer O-RAN RAN Intelligent Controller Software User Guide

**O-RAN RAN Intelligent Controller Software
User Guide**

UNLOCKING INNOVATION AND VALUE IN THE RADIO ACCESS NETWORK
The Juniper O-RAN RAN Intelligent Controller brings new levels of service agility, automation, and operational efficiency to mobile networks.

Contents

EXECUTIVE SUMMARY

Open radio access networks promise to unlock massive innovation, creating new opportunities for service providers to deliver differentiated services to consumers, businesses, and governments.
A software-driven approach to the radio access network (RAN) fundamentally transforms how service providers create business value, improve the customer experience, and accelerate revenue streams from private 5G networks, edge computing, industrial automation, autonomous vehicles— and many more uses unimaginable

today. An open, standards-based approach frees mobile network operators from proprietary radio solutions and massive capital investments. Innovation is unlocked when operators can choose interoperable, best-in-class solutions for the RAN.

Innovation is why the world is converging on Open RAN. The O-RAN Alliance has more than 300 operators, vendors, and research and academic institutions—all members creating specifications and blueprints for an open, more agile radio access network. As of December 2021, 30 mobile network operators serving 4.5 billion subscribers, are committed to O-RAN. And many customer trials are already underway.

Juniper is applying our networking leadership to accelerate the development of the Open RAN ecosystem. Juniper is a leading contributor to the O-RAN Alliance and is developing innovative, standards-compliant O-RAN solutions, including a Service Management Orchestration (SMO) platform, which provides orchestration, management, and automation of RAN elements, as well as the RAN Intelligent Controller (RIC), which is responsible for controlling and optimizing RAN functions, and plays a key role in network functions like network slicing, high-bandwidth, low-latency applications, and prioritized communications.

This whitepaper focuses on the value that mobile network operators can unlock through Juniper's RIC platform and the vibrant ecosystem of O-RAN solutions.

Open RAN Unlocks Innovation in the Radio Access Network

Cloud innovation is transforming every part of the telco network, and with Open RAN, that innovation is applied to the radio access network. Open RAN creates a cloud-native foundation for greater agility, enabling network operators to accelerate service delivery and feature enhancements, reduce vendor lock-in, and cut costs.

The O-RAN Alliance specification describes a disaggregated, software-defined radio access network. Virtualizing the radio access functions brings the power of automated, cloud-native infrastructure to every part of the mobile network. Key functions are virtualized so they can run at any point in the operator's network, whether a cell site, edge cloud, central office, or data center. Interfaces among network functions are interoperable, programmable, and extensible.

The RIC, which controls and optimizes RAN functions, is a critical component that ultimately allows service providers to bring innovative new services and features to market faster. The RIC brings intelligence, agility, and programmability to radio access networks and enables third-party applications that automate and optimize RAN operations at scale while supporting innovative use cases. It plays a key role in network functions like network slicing, high bandwidth, low-latency applications, and prioritized communications.

Openness is the foundation for innovation. Network operators can choose from a growing ecosystem of third-party applications and commodity hardware. Instead of being locked into a limited selection of suppliers for the radio access network, network operators can choose best-fit solutions. Network operators are no longer tied to their chosen suppliers' product roadmaps and product rollouts.

It's also an unprecedented opportunity to reduce the high cost of the RAN, creating more margin for growth and profitability. Overall spending on RAN equipment and professional services is expected to reach $41 billion by 2025, according to Analysys Mason. Network operators expect a 10 to 25 percent CapEx and OpEx savings through the adoption of Open RAN networks, according to Heavy Reading research.

RAN Intelligent Controller Is the Operating System of the RAN

The RIC is like the operating system for the RAN. As a software-defined platform, the RIC brings intelligence, programmability, and extensibility to radio access networks. The RIC uses AI and machine learning (AI/ML) applications that automate RAN operations and support innovative use cases. With the RIC, network operators have a platform to deliver new functions and user experiences with greater agility and ease. Key elements of the RIC include the Non-Real-Time RIC (Non-RT), the Near-Real-Time RIC (Near-RT), and specialized applications called apps and xApps. The Non-RT RIC enables greater-than-one-second control and policy guidance over the RAN elements and their resources through apps. It also enables AI/ML capabilities for the RAN. The non-real-time RIC runs in the network operator's cloud.

The Near-RT RIC is responsible for fast-loop control of the RAN network functions. It provides less-than-one second control over the RAN nodes and resources which are driven by the non-real-time RIC. It can host and deploy specialized xApps.

The Non-RT RIC communicates with the Near-RT RIC over an A1 interface to provide policy-based guidance to the apps running on the Near-RT RIC to optimize RAN behavior, such as for capacity, customer-specific service levels, or energy efficiency. The Non-RT RIC uses long-term network data, such as performance metrics as well as enrichment data from external applications, to train and generate AI/ML-driven applications. Juniper's RIC

platform is based on a cloud-native microservices architecture and is fully compliant with the O-RAN specifications and interfaces (see Figure 1). It supports both an open API and a software development kit (SDK) for integration with any third-party O-RAN-compliant xApps or apps, giving network operators greater flexibility and choice of suppliers. Juniper's RIC integrates with Juniper's SMO as well as other service management orchestrator platforms. AI/ML support is delivered through the Marvis™ Virtual Network Assistant AI framework.
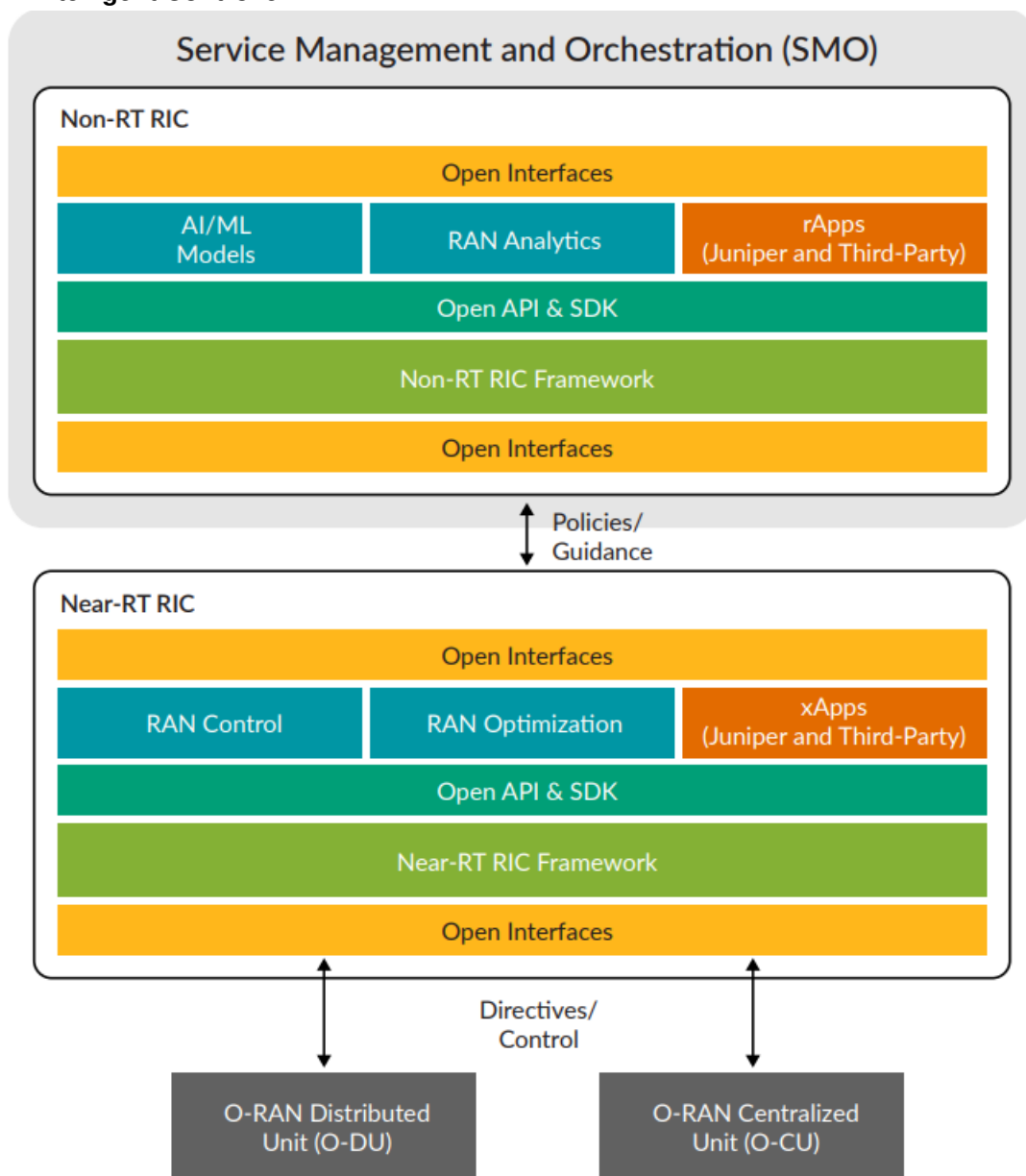
Juniper RAN Intelligent Controller

Figure 1: Juniper's RIC is fully compliant with O-RAN specifications and interfaces, supporting both an open API and SDK for integration with third-party apps and apps. It also leverages the Marvis AI framework for AI and machine learning.

AI-Driven Apps Are the Foundation of RAN Innovation

rApps and xApps are the foundation for innovation and agility in the RAN. These specialized, AI-driven applications, available from Juniper and other vendors, allow operators to enable new business models, personalize the service experience, and optimize CapEx and OpEx.

Key use cases include RAN slice SLA assurance, tenant- and slice-aware admission control, traffic steering, energy efficiency, M-MIMO optimization, and quality of experience (QoE) optimization (see Figure 2).
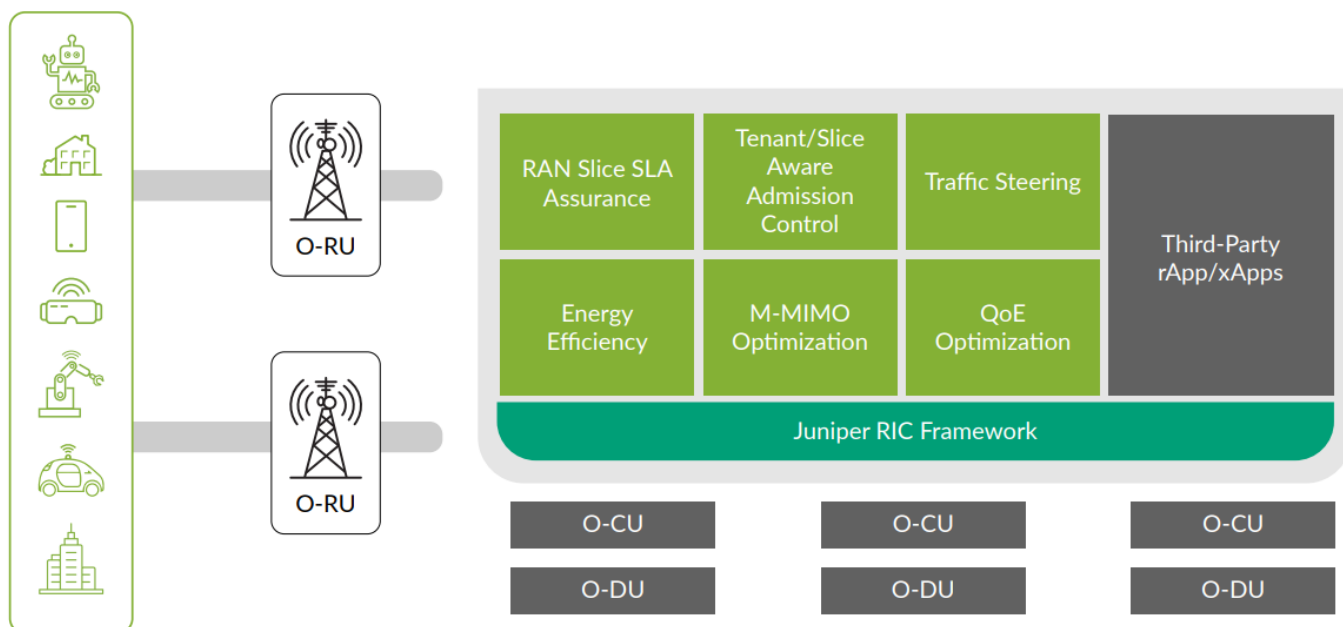
Figure 2: rApps and xApps are the foundation for innovation and agility in the RAN. Available from Juniper and other vendors, these specialized, AI-driven applications allow operators to enable new business models, personalize the service experience, and optimize operational efficiency.

Let's look at each of these use cases.

Network Slicing—Network slicing is a key advance in 5G networks, with end-to-end connectivity and data processing tailored to specific customer requirements or workloads. The service levels are guaranteed and must be continuously assured across the delivery chain. rApps/xApps can continuously monitor each slice and collect slice-specific performance metrics. If the application detects an SLA violation, it can immediately initiate corrective action by making the appropriate configuration changes to the centralized and distributed units (CUs and DUs) and updating the policy accordingly. The changes are monitored and confirmed as meeting the specified service levels (see Figure 3).

Tenant- and Slice-Aware Admission Control—This application allows for real-time tracking and enforcement of radio resources such as packed data units (PDUs) per slice, and user equipment per slice. This use case is required to provide priority services for hospitals, schools, public safety, and other high-priority users to ensure that communications are delivered with efficiency and predictability.
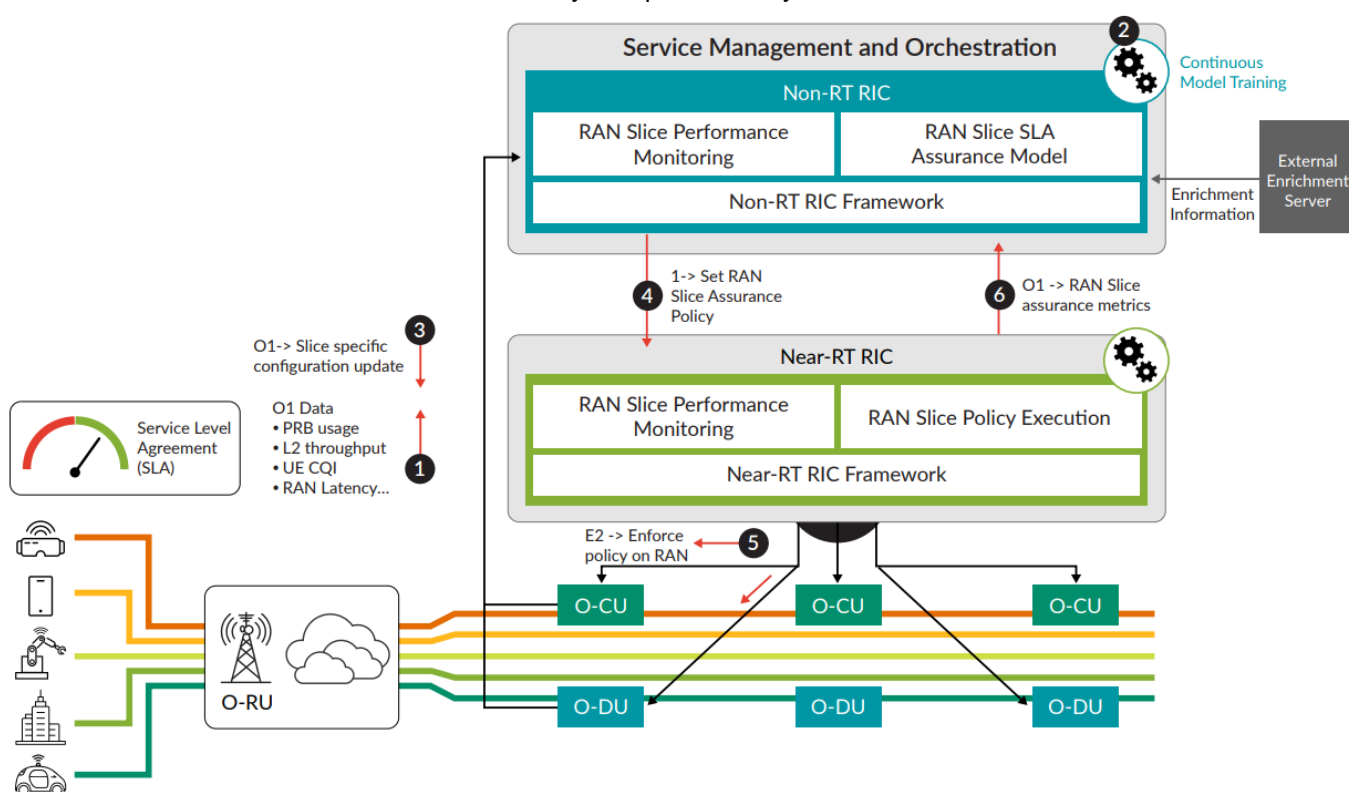
Figure 3: The network slicing use case allows for continuous monitoring and assurance of service levels for each network slice.

Traffic Steering—Traffic steering allows operators to meet capacity demands while avoiding additional capital investments. The RIC and the associated apps can monitor the dynamically changing network load, using AI/ ML-based steering algorithms to distribute the load to different frequencies within the same base station, to neighboring base stations, or even to different radio access technologies, resulting in efficient utilization of operator resources.

Energy Efficiency—AI-driven predictions and controls can be used to optimize energy efficiency of the RAN, switching off antennas as needed to increase energy efficiency. Insight into traffic, coverage, interference, and other factors can also be factored in to identify long-term trends and enable strategic planning.

Massive MIMO Coverage—A key advantage of 5G, massive multiple input and multiple outputs (M-MIMO) provides greater capacity and minimizes interference. By applying AI/ML and decision-making in real-time, the RIC can proactively and continuously improve the subscriber's experience even in dense areas or at times when demand is surging, such as in crowded cities or entertainment venues.

Quality of Experience (QoS)—Intelligent, real-time controls allow a better user experience for latency-sensitive or bandwidth-intensive applications like cloud virtual reality, drones, or autonomous vehicles. The RIC and associated applications can use analytics to take policy-based actions, ensuring that priority users maintain a satisfactory QoS
even during peak loads.

Juniper Is a Leader in O-RAN Innovation

At Juniper, we deliver network solutions that simplify the operator experience and deliver a superior user experience. We are proud of our leadership in cloud and networking, and we are committed to enabling a clear path toward open, intelligent, and automated networks. That vision extends to the RAN. Juniper's RIC is an open and interoperable platform. As a RAN-neutral vendor, we view the RIC platform as the operating system that provides network operators with flexibility and agility to create new business models, personalize service experiences, and optimize CapEx and OpEx. Juniper is developing its own portfolio of xApps/ rApps, including tenant-aware admission control and RAN slice SLA assurance.

Juniper's RIC platform works with any O-RAN-compliant network functions, such as O-RAN centralized unit (O-CU) and O-RAN distributed unit (O-DU). Our RIC platform gives network operators the power to run a broad variety of rApps/xApps from Juniper and third-parties available in an O-RAN app store. And, Juniper solutions are architected with open interfaces on the northbound and southbound sides for easier integration with partner solutions in the Open RAN ecosystem (see Figure 4).

	Open and Interoperable RIC Platform	• Multivendor • Onboard third-party rApps/xApps. • Interoperability with Juniper and third party Service Management Orchestration Support for the network- and SDK-based API • SaaS or on-premises. Supporting public, private or hybrid environments
	Industry and Ecosystem Leadership	• Partnerships with leading RU/DU/CU vendors, rApp/xApp vendors and systems integrators • Contributions to six out of 10 O-RAN Alliance workgroups • Co-chair of Use Case Task Group • Chair of Slicing Task Group
	E2E Network Slicing and Orchestration Expertise	• Multicloud, multidomain, multitenant and multivendor network slicing and orchestration • Network slicing engagements with Tier-1 service providers
	AI Driven Networking Experience	• Leadership in AI-driven networking with Marvis AI Engine • 2021 Gartner Magic Quadrant Leader for Wired and Wireless LAN Infrastructure

Figure 4: Juniper is championing Open RAN, with an open, interoperable RIC platform and industry and ecosystem leadership as well as deep expertise in network slicing, orchestration expertise, and AI-driven networking experience.

Applying Our AI-Driven Networking Experience to the RAN

Juniper is applying its AI, machine learning, and data science expertise from the enterprise to the RIC. Juniper is a recognized leader in AI-driven networks in the enterprise. Gartner named Juniper Furthest in Vision and Highest in Execution in the 2021 Gartner® Magic uadrant™ for Enterprise Wired & Wireless LAN Infrastructure.
1 In the enterprise, Mist AI™ is used to optimize user experiences from client to cloud, including automated event correlation, root cause identification, Self-Driving Network™ operations, network assurance, proactive anomaly detection, and more.

Network Slicing and Service Management Orchestration Expertise

Our RIC platform is also central to our vision to build an SMO platform that delivers:
• Multicloud orchestration across edge data centers, regional data centers, national data centers, and public clouds
• Multidomain orchestration across the RAN and transport and core network domains
• Multitenant orchestration across different mobile virtual network operators (MVNOs), enterprises, neutral hosts, and other entities1 "Juniper Networks Named a Leader in 021 Gartner® Magic Quadrant™ for Enterprise Wired and Wireless LAN Infrastructure for Second Consecutive Year, Furthest in Completeness of Vision and Ability to Execute, November 8, 2021, **https://newsroom.juniper.net/news/news-details/2021/Juniper-Networks-Named-a-Leader-in-2021-Gartner-Magic-Quadrant-forEnterprise-Wired-and-Wireless-LAN-Infrastructure-for-Second-Consecutive-Year-Furthest-in-Completeness-of-Vision-and-Ability-to-Execute/default.aspx**
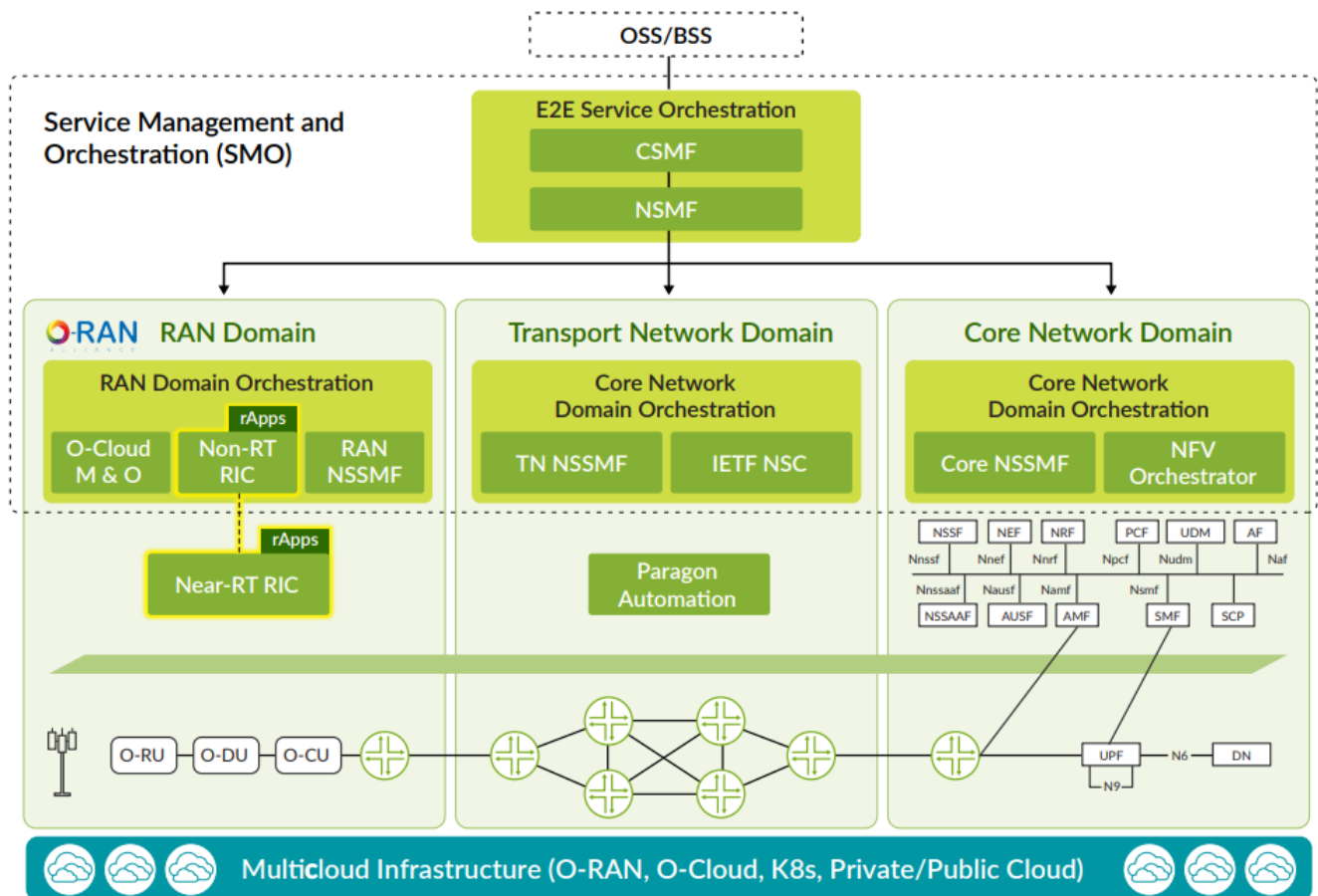Gartner Disclaimer: Gartner Magic Quadrant for Enterprise Wired and Wireless LAN Infrastructure, Mike Toussaint, Christian Canales, Tim Zimmerman, 15 November 2021.
Gartner does not endorse any vendor, product or service depicted in its research publications and does not advise technology users to select only those vendors with the highest ratings or other designation. Gartner research publications consist of the opinions of Gartner's Research & Advisory organization and should not be construed

The Juniper SMO delivers end-to-end network slicing with support for prescribed SLAs across the RAN and transport and core networks (see Figure 5). Juniper's SMO implementation supports the 3GPP-defined Communication Service Management Function (CSMF), Network Slice Management Function (NSMF), and Network Slice Subnet Management Function (NSF) standards.

The Juniper SMO delivers end-to-end network slicing with support for prescribed SLAs across the RAN and transport and core networks (see Figure 5). Juniper's SMO implementation supports the 3GPP-defined Communication Service Management Function (CSMF), Network Slice Management Function (NSMF), and Network Slice Subnet Management Function (NSF) standards.

Fostering an Open Ecosystem

Joint innovation is critical to the creation of an ecosystem of best-in-class solutions and to accelerate deployment. Juniper is working across the community—with mobile operators, platform providers, equipment vendors, RIC application vendors, and system integrators—to deliver Open RAN.

Juniper's RIC architecture supports both an open API and an SDK for simplified integration with third-party applications and systems. Juniper's approach is designed to simplify application portability, giving developers and customers more options. When developing xApps/rApps for the RIC, developers can choose to use a network-based API, which eliminates compile-time dependencies, or an SDK-based API that leverages the Juniper Support Library.

Juniper partnered with Rakuten and Intel to offer integrated routing and Open RAN in a single platform, which creates cost and operational benefits for service providers. **Rakuten Symphony, Intel and Juniper Networks introduce nextgeneration distributed RAN and transport solution to further simplify Open RAN deployments at scale | Juniper Networks Inc.**.

Juniper and Intel are collaborating on RIC platform-specific apps to improve customer experience, maximize ROI, and drive ecosystem innovation. Juniper and Intel are also working together to develop the Juniper RIC. The Intel FlexRAN platform will be pre-integrated and pre-validated to speed innovation and time-to-value.

Juniper and AirHop are collaborating to integrate AirHop's field-hardened RAN automation and optimization applications on Juniper's RIC. The integration will accelerate and simplify 4G and 5G network deployments and increase spectral efficiency. **Learn more about the AirHop integration**.

Several global tier-one network operators are conducting trials of Juniper's SMO and RIC solutions. Juniper is demonstrating the Admission Control use case at a Tier-1 European mobile operator with **Parallel Wireless** RAN. Juniper is also demonstrating RAN Domain Orchestration and network slicing at another Tier-1 European mobile operator with **Casa Systems** providing the CU/DU/RU.

Juniper is a champion of Open RAN and a founding member of the O-RAN Alliance. We contribute to six working groups and serve as the chair and co-chair of the slicing and use-case task groups. Juniper is also an editor of the RIC specifications within the O-RAN Alliance. We continue to actively participate in and contribute to other O-RAN
Alliance workgroups.

Conclusion

Private 5G networks, stadium networks, telemedicine, smart vehicles, drones, robots: The future is limitless, and many more use cases will be dreamed up and turned into reality. It's time to unleash 5G innovation with Juniper. With Juniper's RIC and its AI-driven apps as the brains of innovation, service providers will have the agility to maximize the 5G opportunity, deliver optimized user experiences, and increase operational efficiency.

Next Steps

To learn more about Juniper solutions for Open RAN, visit **www.juniper.net/us/en/solutions/5g-networking/openran.html.**

About Juniper Networks

At Juniper Networks, we are dedicated to dramatically simplifying network operations and driving superior experiences for end users. Our solutions deliver industry-leading insight, automation, security, and AI to drive real business results. We believe that powering connections will bring us closer together while empowering us all to solve the world's greatest challenges of well-being, sustainability and equality.

JUNIPER NETWORKS | **Driven by Experience**™

Corporate and Sales Headquarters
Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, CA 94089 USA
Phone: 888.JUNIPER (888.586.4737)
or +1.408.745.2000
www.juniper.net
APAC and EMEA Headquarters
Juniper Networks International B.V.
Boeing Avenue 240
1119 PZ Schiphol-Rijk
Amsterdam, The Netherlands
Phone: +31.207.125.700

Documents / Resources

JUNIPer O-RAN RAN Intelligent Controller Software [pdf] User Guide
O-RAN RAN Intelligent Controller Software, O-RAN RAN Intelligent Controller Software, Controller Software, Software