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Open vRAN Orchestrates RAN Transition

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Report Snapshot

The evolution of Radio Access Network (RAN) architecture is accelerating to fulfill the present requirements of virtualized RAN (vRAN) and meet the future demands of Open RAN based on O-RAN Alliance interface standards.

The rapid pace of technological innovation makes the unification of RAN architecture types under one common orchestration and systems management umbrella critically important.

Netcracker's Open vRAN ecosystem offers the software, management and tools to simplify the complex network management and orchestration required to evolve to multi-RAN and multi-vendor systems.

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Overview - Open vRAN Demands a New System-Wide Approach

The evolution of Radio Access Network (RAN) architecture is accelerating to fulfill the present requirements of virtualized RAN (vRAN) and meet the future demands of Open RAN based on O-RAN Alliance interface standards. The RAN has historically been the blind spot in end-to-end (E2E) network and service management, and has been treated as an isolated operations domain within the mobile network operator (MNO) ecosystem. The rapid pace of technological innovation makes the unification of RAN architecture types under one common orchestration and systems management umbrella, critically important.

RAN Evolution Has Begun

Key recent developments include:

- ***Accelerated deployment of high-performance vRAN:*** By breaking up the legacy RAN into functional components, vRAN allows CSPs to deploy and scale each RAN function as needed. vRAN 1.0 can control *separate pools of intelligent central unit (CU) processors co-located with pools of baseband units (BBUs)* that communicate over a *proprietary fronthaul interface with groups of remote radio heads (RRHs)*. vRAN has now proven it can match the performance of legacy RAN architecture with greater flexibility and scalability for 4G and 5G densification.
- ***Growing availability of Open RAN:*** O-RAN Alliance and Open RAN interface standards are now being built and tested in multiple pre-commercial and limited commercial operator deployments. They use *non-proprietary and open interfaces for fronthaul connections, connections between the baseband processing units* — now referred to as distributed units (DUs) — *and their remote groups of radio units* (RUs), and the connections *between DUs and their CUs*.

> O-RAN Alliance has specified open interfaces between disaggregated RAN components that are still being tested

- ***3GPP MANO standards:*** Enhanced orchestration and management standards are now available for both 4G and 5G. These standards include both traditional RAN and New Radio (NR) technology in 3GPP Releases 15 and 16.
- ***E2E network slicing:*** The advent of RAN slicing in 5G delivers a key missing component for delivery of E2E network slicing services.

The Next Five Years Require a Multi-RAN Transition

Several important vRAN and Open RAN capabilities are still not commercially feasible. In 2022/2023, vRAN 2.0 should finally divide BBUs into *separate DUs and CUs* as general purpose processors (GPPs) and enhanced ASICs become available. **O-RAN-compliant DUs are waiting for similar processing horsepower** to achieve carrier-class performance and scalability. By 2024/2025, component volumes could be sufficient to increase performance and lower costs

Since the O-RAN Alliance primarily focused on interface specifications, formal and de facto standardization of functional interoperability is still in progress. New functionality for the O-RAN Controller - *RAN Intelligent Controller (RIC)* - with both non-real-time and near-real-time capabilities is rapidly evolving with an array of differentiated and even proprietary software (e.g. for service enablement).

In parallel, some aggressive vRAN suppliers aim to leverage the O-RAN interfaces that their customers demand (e.g. eCPRI fronthaul) to offer differentiated partially open vRAN solutions in 2021.

Communications service providers (CSPs) originally hoped that these major RAN advances would generate new suppliers of different RAN components for more open competition and lower costs. Some new suppliers have emerged but are struggling to match legacy and vRAN performance. Many CSPs are likely to buy available vRAN solutions as they wait for later generations of Open RAN solutions.

> The complexity of hybrid vRAN and Open RAN demands complete orchestration and systems management

As a result, traditional RAN suppliers with vRAN solutions are likely to capture initial savings from pooled processors, containerized software and commercial-off-the-shelf (COTS) hardware during the next two years of 5G deployment. New suppliers for Open RAN may not gain market share until 2023 or later.

CSPs are consequently confronted with a complex hybrid RAN transition from legacy deployments to both partially proprietary vRAN and open non-proprietary RAN. Common orchestration and systems management is essential for delivering interoperable services across the heterogeneous chaos of these RAN environments. However, that is an enormous task.

vRAN and Open RAN Introduce Operations Complexity

The adoption and integration of these new RAN capabilities are already creating significant operational complexity. That complexity is further escalated by the addition of:

- Hybrid 4G and 5G networks.
- Proprietary fiber and Carrier Ethernet transport connectivity.
- Multiple vendors for diverse combinations of CU, BBU/DU and RRH/RU components.
- Co-location of edge service processing at DUs or even RUs.
- Demand for multi-domain user services, such as public and private networking.

E2E Lifecycle Management (LCM) is critical in managing this complexity. It must provide simultaneous support of the RAN, core and fronthaul and backhaul transport network functions in near real-time with an *active inventory*. The active inventory must be part of a system that is able to:

- Track live resources.
- Achieve instantaneous configuration management.
- Provide assurance monitoring for service quality.
- Deliver inputs for machine learning (ML), analytics and automation.

vRAN Challenges

Despite their virtualization advantages, vRAN systems today often remain vendor-specific with separate element management systems (EMS) and separate onboarding and software upgrade processes. Each vendor also has its own policy control rules and mechanisms to manage and scale both vRAN and legacy resources dynamically across both 4G and 5G.

Open RAN/O-RAN Challenges

Open RAN avoids the problems of proprietary interfaces. However, it can be even more complex than vRAN because its non-proprietary CU-DU and DU-RU interfaces are often supplied by *multiple vendors from outside the pre-tested integrated interoperable ecosystem.*

Furthermore, Open RAN specifications are still evolving due to rival specifications for the DU-RU interface. Small Cell Forum (SCF) believes that for small cells (e.g. for indoor CBRS) the Split *6* specification may be better, but O-RAN Alliance prefers Split 7.2. for 4G and 5G macrocell densification. Both specifications will likely be important in the future[1]. Qualcomm, as a small cell and RAN component supplier, is hedging its bets by designing for both specifications and even future 7.x variations[2].

Open vRAN Provides a Transitional Solution

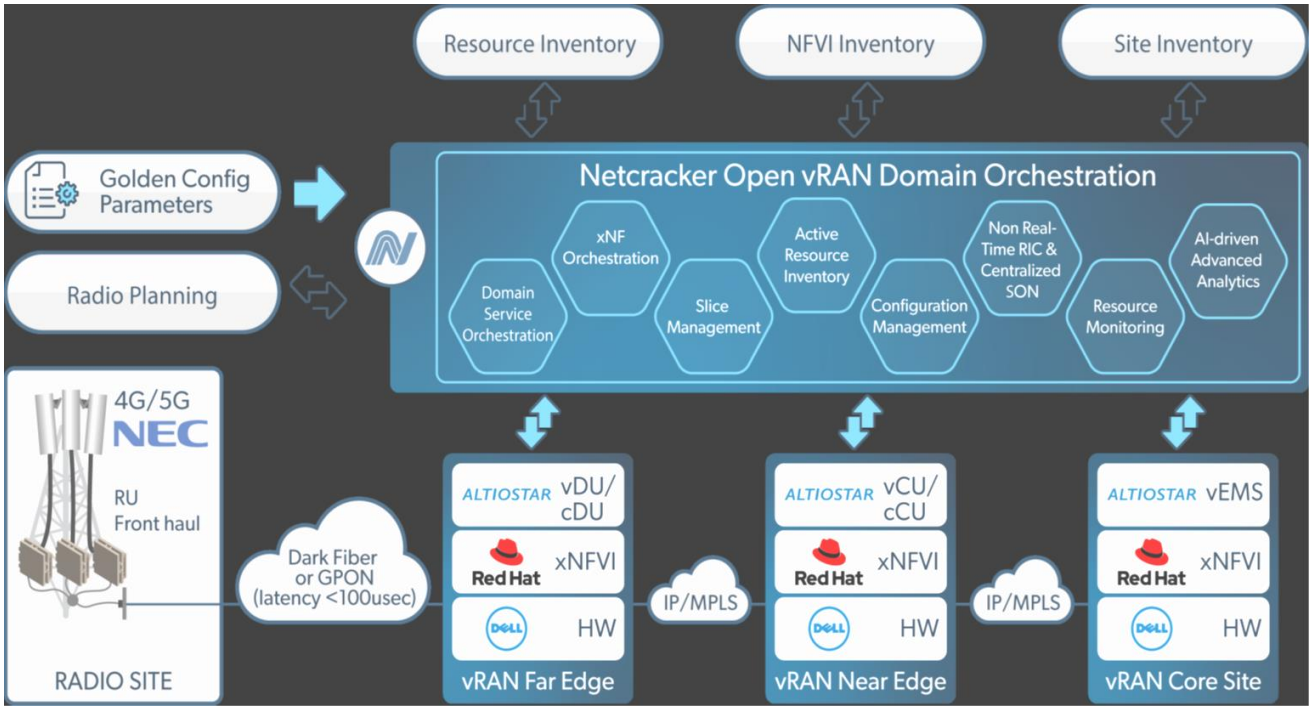
To address these challenges, NEC, Dell, Red Hat Altiostar and Netcracker partnered to create and test an Open vRAN reference design[3]. Netcracker's Open vRAN Domain Orchestration with its E2E operations environment anchor the reference design with:

- NEC's infrastructure.
- Dell's open hardware.
- Red Hat's OpenStack.
- Altiostar's Open vRAN virtualized eNodeB software.

The design automates VNF deployment, configurations, LCM, and radio resource optimization across edge locations. NEC, Netcracker's parent company, has already been **selected by Rakuten in Japan as a supplier** and a **global partner for 5G Open RAN**. It provided the radio units and acted as systems integrator in this design to unify the overall Open vRAN ecosystem as a secure, mission-critical carrier-grade network.

The components of this design are shown in Chart 1 below.

Chart 1. Open vRAN design handles Hybrid vRAN and O-RAN Domains



Source: 'Netcracker Open vRAN Domain Orchestration Solution Brief' Netcracker 2021

Automating Multi-RAN Management

Like most network diagrams, Chart 1 greatly oversimplifies the complexity and variety of tasks to be performed — many in near real-time. In live network environments, tens of thousands of parameters must be monitored and adjusted almost instantaneously. This can no longer be done manually, and it is critical that most processes be automated.

The flexible Open vRAN architecture not only allows CSPs to seamlessly handle both vRAN and Open RAN domains, but also makes it possible to automate onboarding and ongoing operations, including scaling, healing and continuous network optimization. Netcracker's Open vRAN system was designed from the ground up to integrate RAN and network functions, event information and more with:

- Service orchestration **to enable automated service provisioning and service lifecycle management across the Open vRAN domain with a single pane of glass**.
- xNF orchestration **to instantiate vRAN software and provide NS/VNF/CNF lifecycle management (LCM)**.
- Active inventory with real-time resource and topology data **to automate and optimize E2E assurance and lifecycle events and provide real-time visualization of geographic views.**
- vRAN network assurance telemetry and metrics to **enable automated root cause analysis, auto healing and closed-loop control.**
- Configuration management **to automate the configuration of physical and virtual network elements and continuously compare eNodeB/gNodeB configurations with their ideal parameters.**

- Non-Real-Time RIC inputs from multiple sources for intelligent management of a centralized self-organizing network (CSON) **to optimize RAN performance with AI-driven advanced analytics.**
- AI-driven predictive analytics **to identify potential options for RAN optimization based on KPIs and financial parameters.**
- Slice management for provisioning and assurance of RAN slice subnets **to enable E2E 5G network slicing.**

The system is also **extensible for future resource optimization**. It can be extended to dynamically optimize distributed storage and compute resource requirements for diverse scenarios. These include future distribution of *cloud-native service functions at CU or DU locations or processing end-user edge services at DU locations* for low latency responses.

'All Roads Lead to Rome'

There are many paths to Open RAN, and Open vRAN supports them all

As CSPs evolve their RAN deployments over the next five years, they will employ diverse approaches to optimize the cost efficiency, scalability and performance of Open RAN solutions. There are a variety of possible approaches, including *4G macrocell densification with Open RAN, 5G/CBRS indoor small cells, or the* **DISH** *approach with early deployment of fiber-connected 5G DUs*. However, every path through this complex transition will require both seamless management and an orchestrated ecosystem.

Solution Summary

Netcracker's Open vRAN Domain Orchestration solution offers a future-proof system for CSPs to manage the evolution to vRAN and O-RAN implementations.

Netcracker has worked with industry leaders to create and publish the Open vRAN reference design and has extended its proven Digital OSS portfolio with a full implementation of the design. The system goes beyond network management and orchestration to provide a common ***automated operations environment*** for 4G and 5G RAN, including eNodeB/gNodeB and 5G RRHs/RUs. It also enables automated *Open vRAN LCM* throughout planning, design, deployment, activation, assurance and network optimization.

Netcracker's Open vRAN Domain Orchestration approach offers the software, management and tools to simplify and automate the operations of complex vRAN and Open RAN systems.

> Netcracker's Open vRAN ecosystem offers the software, management and tools to simplify the complex network management and orchestration required for multi-RAN and multi-vendor systems

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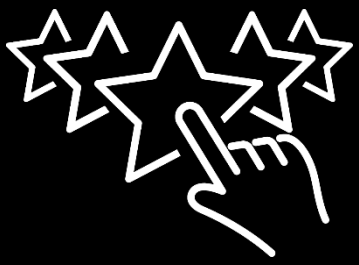

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