Open RAN:

Lessons from commercial deployments

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Key RAN terminology

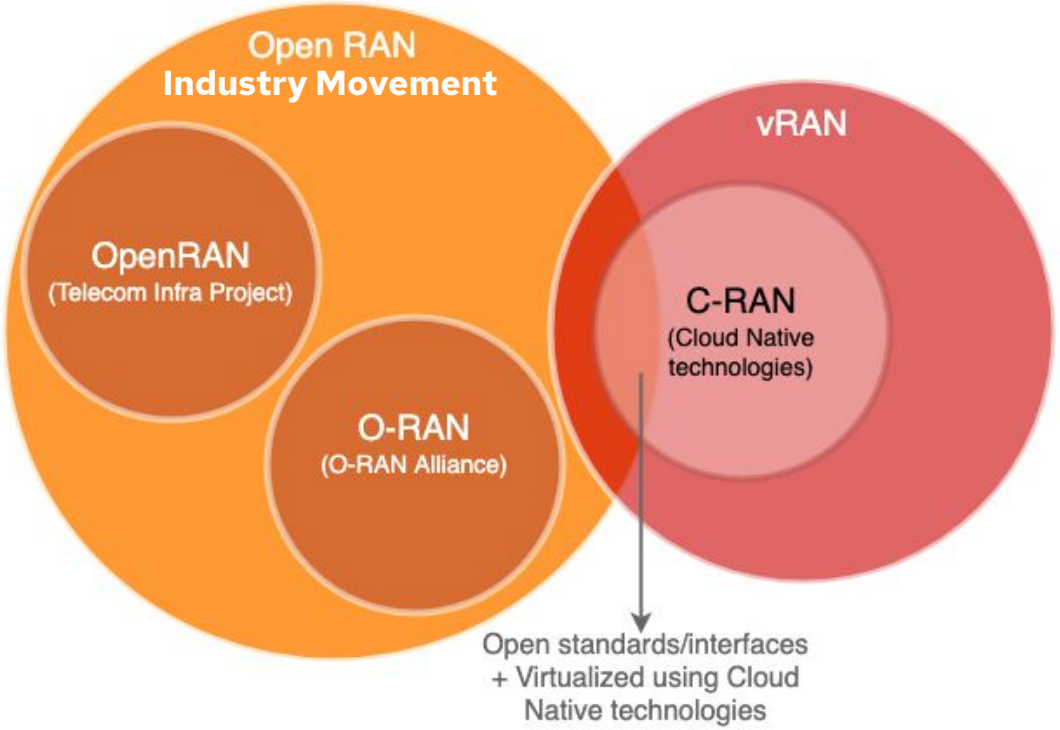
1. **Open RAN** is a generic term that refers to industry movement and open RAN architectures including open interfaces, virtualization / containerization and use of AI/ML, etc.

2. **OpenRAN** is a project initiated by the Telecom Infra Project (TIP). It's an attempt to realize the Open RAN concept on its own part. Its work covers 2G/3G/4G/5G. As inputs, OpenRAN uses 3GPP and O-RAN Alliance specifications.

3. **O-RAN** (ORAN) refers to the O-RAN Alliance or standards created by the O-RAN Alliance, which complements 3GPP specifications by defining interface profiles, new open interfaces and new nodes.

4. **vRAN (Virtualized RAN)**: Whereas Open RAN focuses on openness, vRAN is really about decoupling software from

5. **Cloud RAN (C-RAN)** is vRAN built on cloud native technologies, such as microservices, containers and CI/CD.



Source:Devopedia

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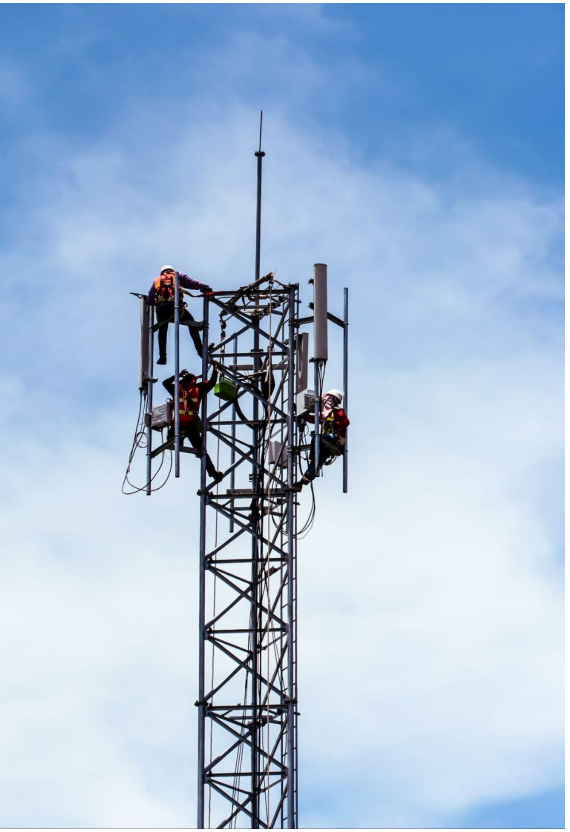

When will Open RAN become mainstream?

2024	2028
8%	25%

Source: ABI research News

Source: Dell'Oro Report (August 2024)

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Open RAN is an **evolution**, not a revolution

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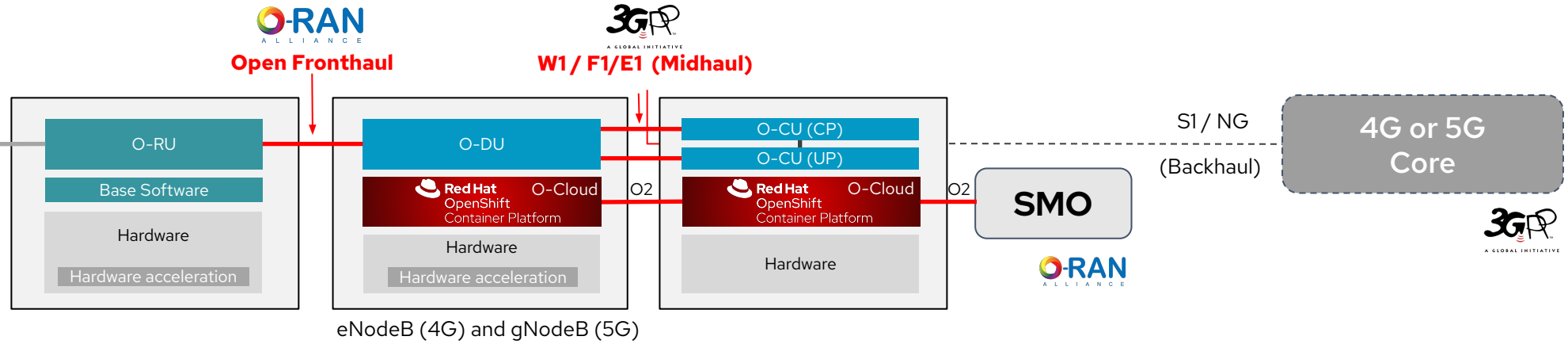
RAN evolution: Open RAN model aligned with O-RAN Alliance



- Goal: truly multi vendor solution
- Standardised open interfaces
- Vertical and horizontal disaggregation
- Three O-RAN Alliance RAN functions: O-RU, O-DU, O-CU (CP and UP)
- Other key elements: RIC and SMO
- O-RAN Alliance nomenclature for Cloud Platform: O-Cloud

NOTE: There are many other ORAN / 3GPP interfaces than these

O-RU = Radio unit
O-DU = Distributed unit
O-CU = Centralized unit
UP = User plane
CP = Control plane
S1 = 4G RAN and EPC interface
NG = Next-generation logical interface
RIC= RAN Intelligent Controller
SMO =Service Management & Orchestration

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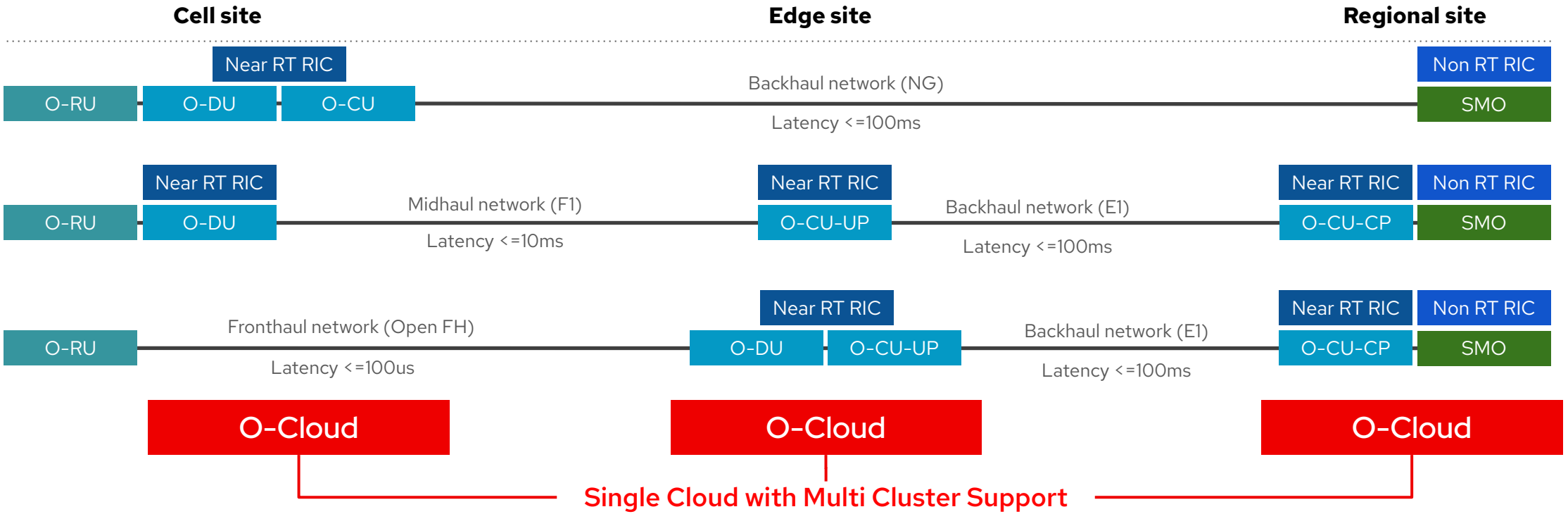
Open RAN deployment examples



Key O-RU = Radio unit O-DU = Distributed unit O-CU = Centralized unit UP = User plane CP = Control plane RIC = RAN intelligent Controller RT = Real Time

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O-Cloud platform telco requirements

Networking

- High Performance Data Plane
- Multiple Networking Interfaces
- High Throughput
- Low Latency
- Load Balancer
- Acceleration Hardware

Deployment & Scale

- Remote Distributed Deployments
- Single node and HA clusters
- Field upgradability
- Zero-touch-provisioning
- Automation assisted by AI/ML
- O2 interface (IMS, DMS)

Real-Time, Latency and Sync

- Time Synchronization
- Real-Time Determinism
- CPU Affinity and Isolation
- Topology Management
- Node Feature Discovery

Lessons learned (so far)...

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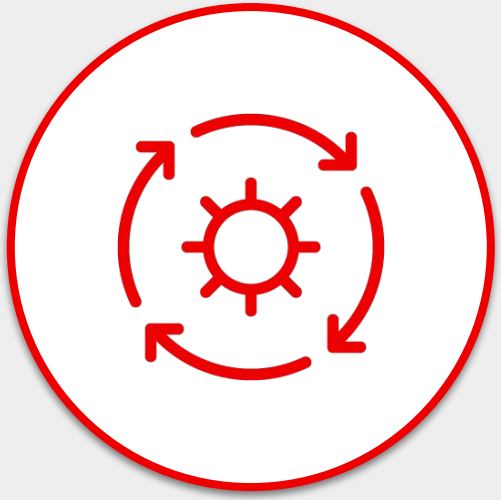
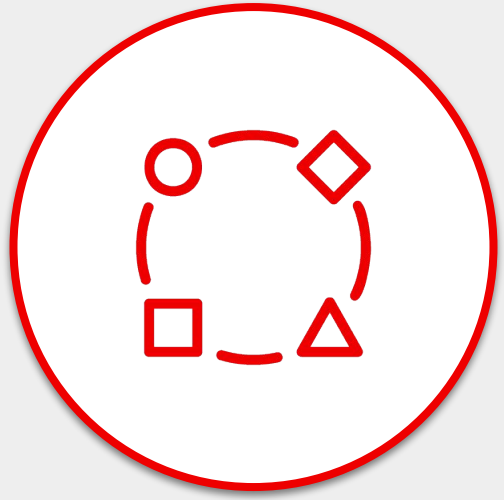
Open RAN lessons learned (so far...)



Management & Automation

Energy Savings

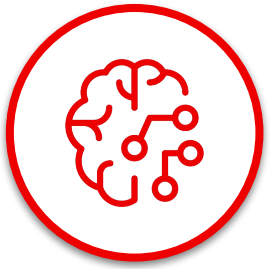


Ecosystem

Open RAN lessons learned: Management and automation

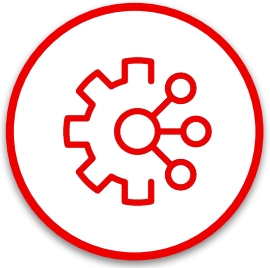
Automation at scale

- e2e domain automation
- Declarative models
- Managing and provisioning through code



Open RAN hyper-automation

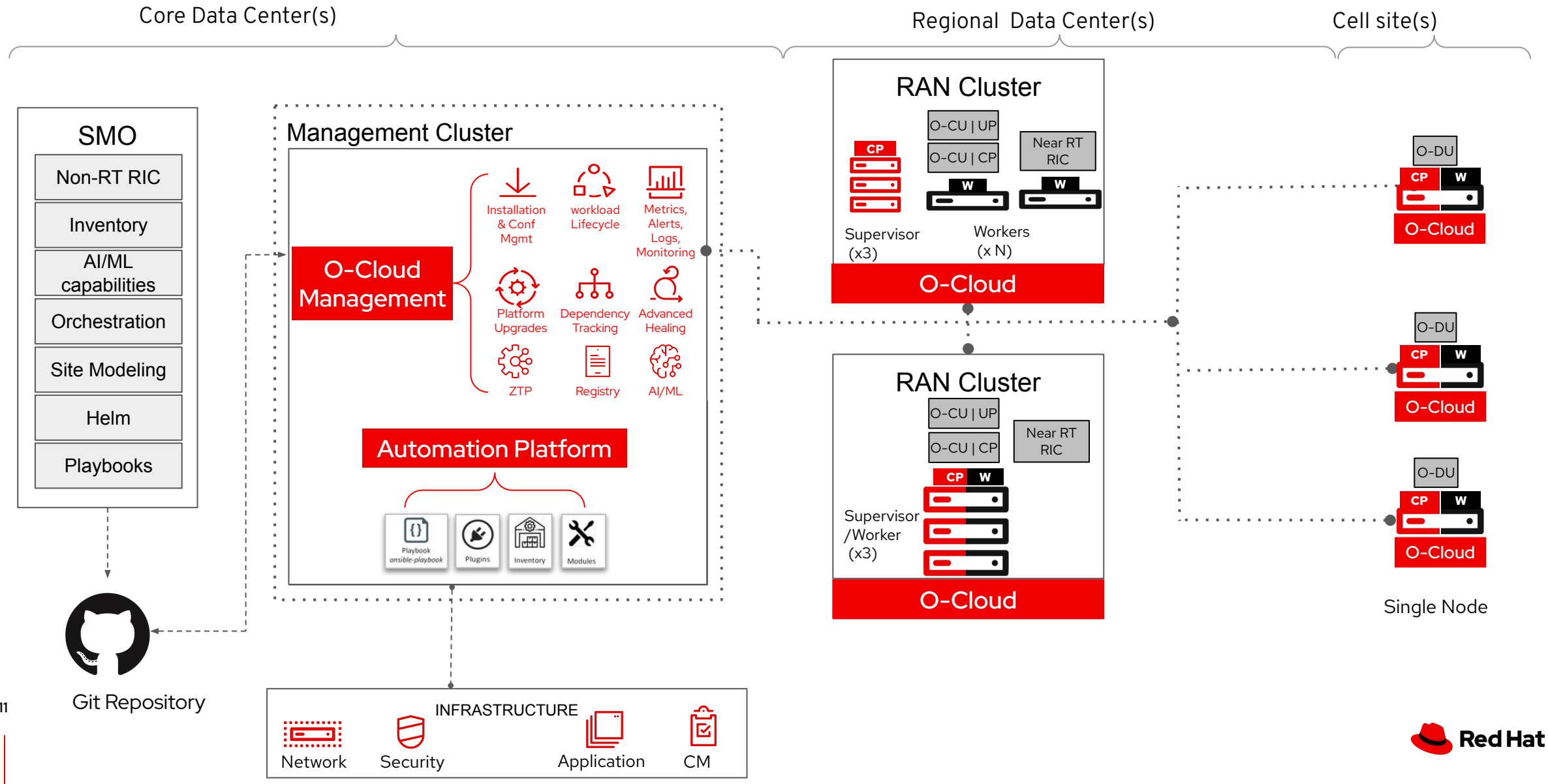
- Actionable intelligence: RIC, SMO and O-Cloud
- Natural language processing (NLP) for Network Operation
- AI/ML real time predictions



Autonomous operations

- Autonomous adaptation to the network demand in real time
- Security and resilience in autonomous Systems
- Transforming operations towards zero touch with efficient use of AI/ML

Zero-touch provisioning and automation



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Open RAN lessons learned: Energy savings

Monitor power use effectively at scale

- Use tools for monitoring and optimizing power consumption, like Kepler
- Limit power consumption and improve power-per-watt use
- Make informed decisions, optimize resource allocation
- Use advanced software solutions to further reduce power consumption

Enhance operational efficiency

- Manage power consumption levels dynamically based on network requirements
- Achieving more efficient power usage without sacrificing service quality
- Streamlining operations with powerful network automation tools like Ansible
- Automatically scale workloads based on specific power consumption metrics

Deploy energy-efficient hardware

- Advanced central processing units (CPUs) and systems on a chip (SoCs)
- New architectures for Open RAN: arm
- Exploring alternatives processing units: DPU or GPU

Monitor power use effectively at scale: Project Kepler

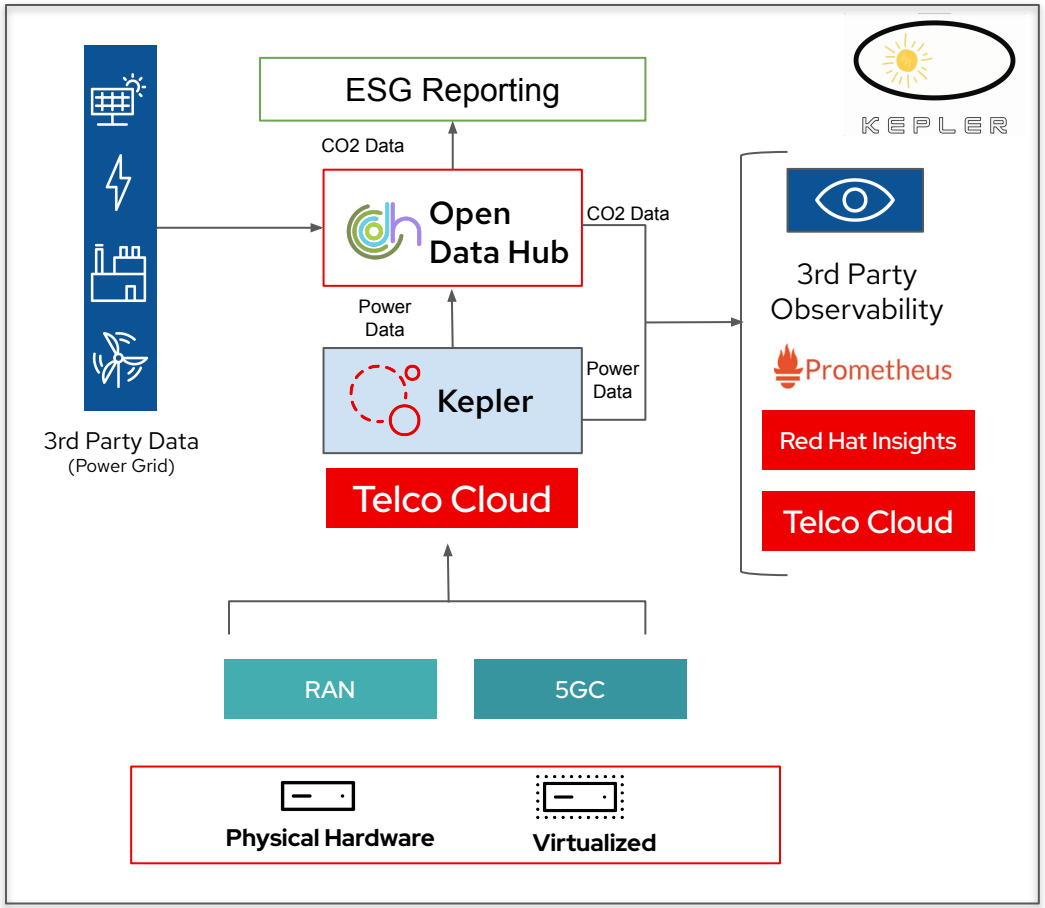
Drive energy cost down and contribute to achieve sustainability goals

Power monitoring with Kepler

- Uses eBPF to probe energy related system stats and exports as Prometheus metrics that can be leveraged for workload scheduler and auto-scaling and drive CI/CD pipelines

Project scope

- Monitor/Report Energy Costs and CO2 Emissions
- Hybrid Cloud Energy and CO2 Monitoring and Reporting
- Data/Analytics for Energy Optimization
- Data/Analytics for Green IT and Green (Re)-Engineering
- Data for ESG reporting

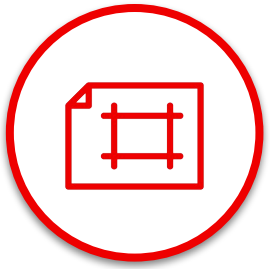


Kepler was accepted to CNCF on May 17, 2023 and is at the Sandbox project maturity level: https://www.cncf.io/projects/kepler/ https://github.com/sustainable-computing-io/kepler

Open RAN lessons learned: Ecosystem

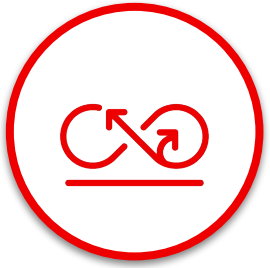
Broad partner ecosystem

- Allows telco operators to select the best-in-class solution
- Promote a truly multi-vendor landscape
- Innovation and rapid deployment of new technologies



From ref architecture to blueprint

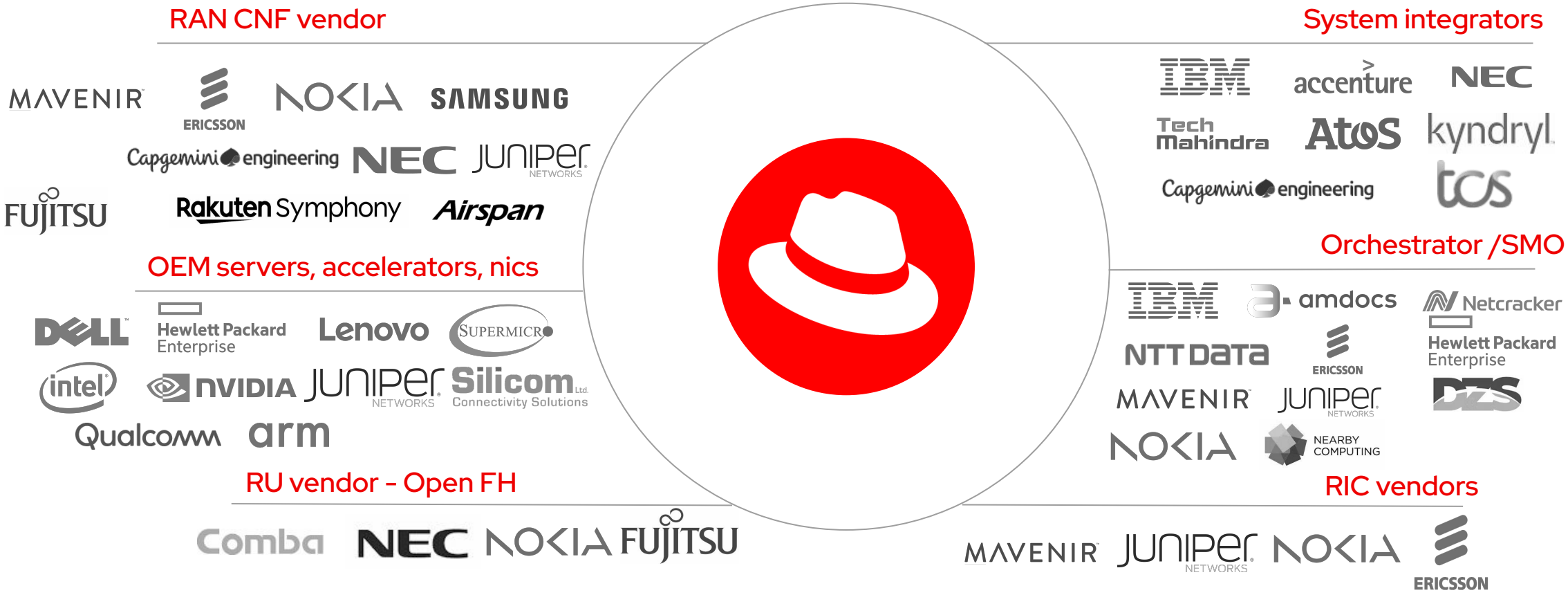
- Define the O-Cloud Reference Architecture
- Deliver Blueprints with partners and telco operators
- Blueprints should be suitable for greenfield and brownfield scenarios



Continuous System Verification

- Implement a System Verification program per key RAN partners
- Define the System Verification program's roadmap
- Significant commercial deployment's time and cost reduction

Building Red Hat's Open RAN ecosystem



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