Capgemini engineering

Presentation

Open RAN India 2021 Virtual Conference

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Agenda

1. Why Open RAN?
2. Rising adoption of Open RAN globally
3. Emerging Architectures For Telco Open RAN
4. Disaggregation increased Interface and Interop Complexity
5. System Integrator: Role in O-RAN Environment
6. O-RAN Organizational Transformation Themes
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Open RAN - Overview

The Radio Access Network (RAN) is a crucial technology for connecting users or enterprises, to a mobile network over the radio waves. RAN acts as a bridge to access all the key applications on the web.

O-RAN Alliance (O-RAN) is a group that defines specifications for radio access networks.

Founded in 2018, this global alliance now comprises of around 30 operators and over 200 vendor companies.

Key elements of Open RAN

- Hardware and software disaggregation
- Machine Learning capabilities
- RAN applications as cloud-native functions
- Higher layer split defined by 3GPP
- Open management and orchestration
- Inter-node communication
- RAN automation interfaces
- O-RAN lower layer split
- Use external Artificial Intelligence and
- Near-Real Time RIC

Answering “Why Open RAN?”

7 ACCELERATED INNOVATION

It encourages third-party development of AI/machine learning–driven solutions, which can help operators deal with an increasing array of bandwidth-intensive applications and the exponentially increasing data.

6 LOWER OPERATING COSTS

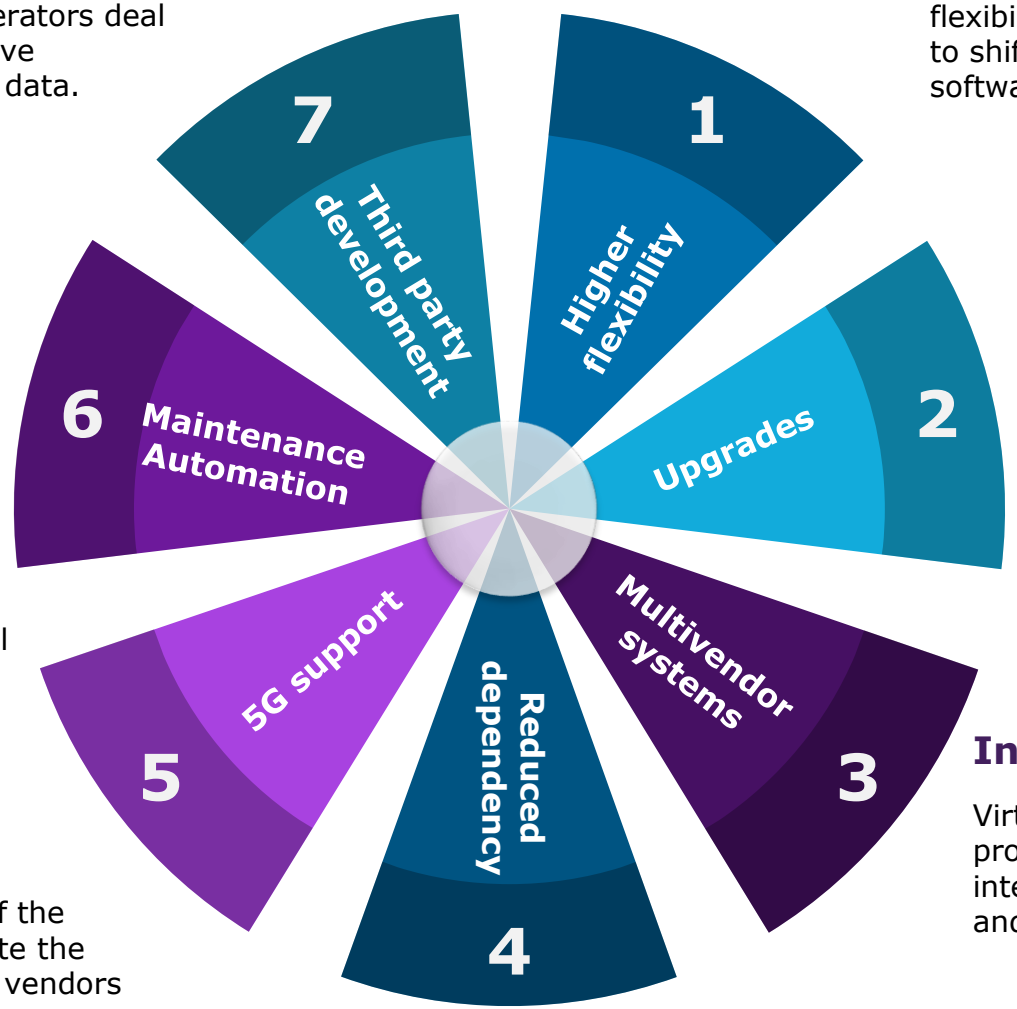
Operating expenses will be lowered as Open RAN will possibly reduce ongoing network operating and maintenance expenses.

5 LOWER CAPITAL COSTS

Open RAN will lower capital costs for the optimal deployment of next-generation 5G wireless networks. This is crucial since 5G will require the addition of around three to four times more cell sites for enhanced coverage, capacity, speed, and low latency.

4 REDUCED DEPENDENCIES

Open RAN eliminates the proprietary nature of the equipment and interfaces and therefore liberate the MNOs from the existing relationships with the vendors of traditional RANs.



1 STANDARDS-BASED PLATFORM

High costs, constrained vendor choice and limited flexibility are prompting mobile network operators to shift towards more open, standards-based, software-centric virtual platforms.

2 FASTER UPGRADES

Open RAN makes it easier to upgrade or change to the wireless network, which requires replacing physical hardware throughout the network— and thereby makes the process cheaper and less time-consuming.

3 Interoperability

Virtualizing the RAN and substituting proprietary interfaces with standards-based interfaces facilitates equipment interoperability and multivendor RAN deployments.

Rising adoption of Open RAN globally

DISH is planning on building their 5G network and covering 50% of the US population by 2023, based on Open RAN.

In APAC, we see Open RAN gaining momentum for greenfield deployment with Rakuten. Smartfren, Ooredo among others plan on using Open RAN.

US operators like Inland Cellular that are already expanding their 4G networks with Open RAN, proving that it is a strong contender for any RAN replacements.

Telefonica's initiative Internet para Todos (IpT) aims to connect the approximately 100 million unconnected people in the LATAM region using Open RAN to enable economic inclusion.

The world's largest Open RAN deployment, Source: Parallel Wireless

Leading businesses are increasing investments in Open RAN

Vodafone has handed a contract to Samsung Electronics, NEC, Dell and Wind River to build Europe's first commercial "open RAN" network.

Capgemini and Keysight Technologies of the US will work on network integration.

Rakuten and NEC are jointly developing Rakuten Mobile's containerized 5G Stand Alone core network.

The collaboration will provide 5G and 4G Radios and engineering services for Open RAN systems aligned with O-RAN specifications for global markets.

Deutsche Telekom, a founding member of the O-RAN Alliance, is undertaking initial deployment of disaggregated radio access network equipment at 25 "O-RAN compatible sites" for 4G and 5G services.

Dell, Fujitsu, NEC, Nokia, Mavenir are tech partners.

NTT DoCoMo has agreed to work with 12 companies for a "5G Open RAN Ecosystem."

The partnering firms include Dell Technologies Japan, Fujitsu Limited, Intel K.K., Mavenir, NEC Corporation, NTT DATA Corporation, NVIDIA, Qualcomm Technologies, Red Hat, VMware K.K., Wind River and Xilinx.

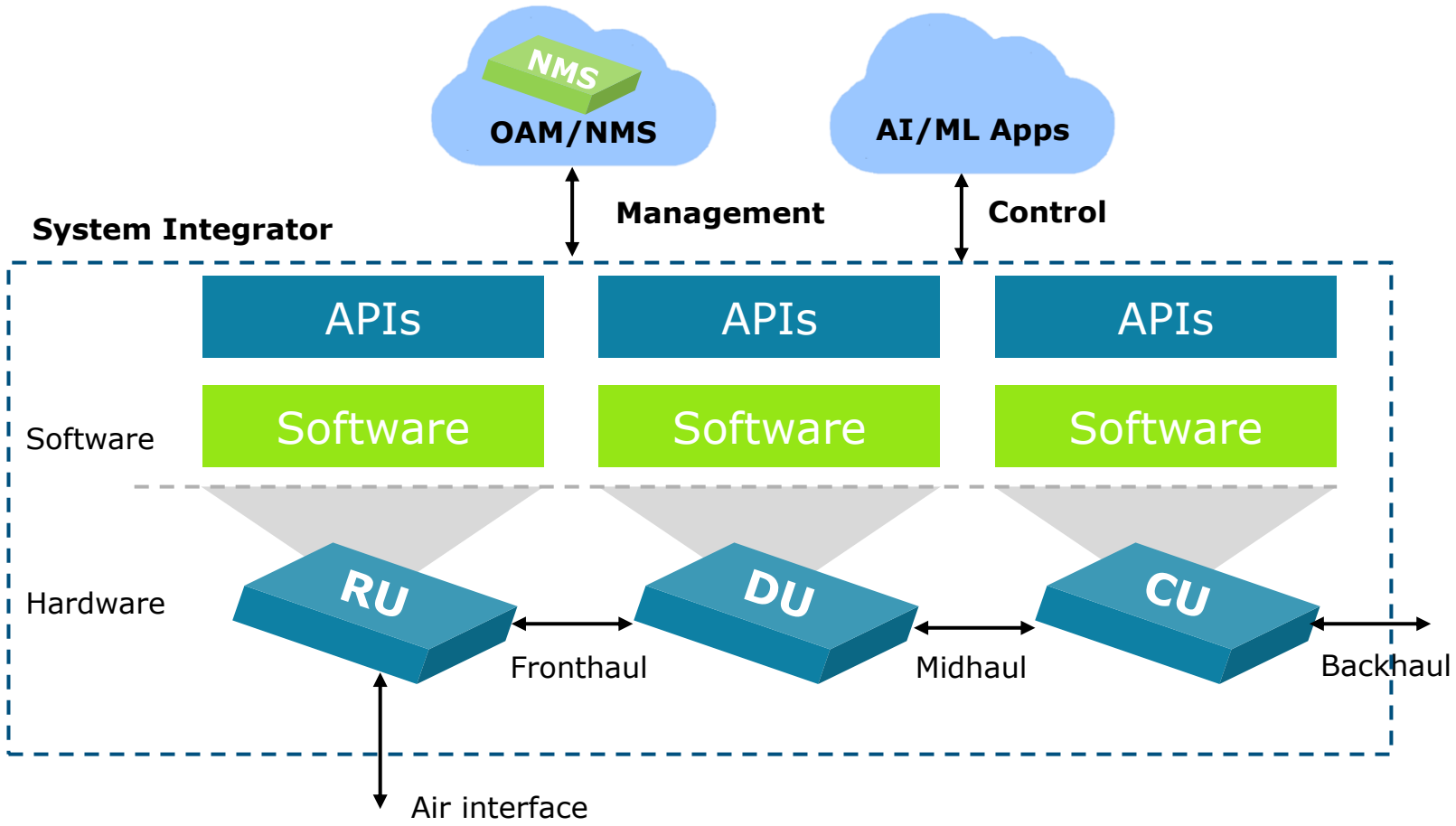
Verizon plans to use open RAN equipment to construct a 5G network in its millimeter wave (mmWave) and C-band spectrum holdings.

Verizon has also announced it will spend $10 billion over the next three years to construct a 5G network in the $53 billion worth of C-band spectrum Verizon purchased in an FCC auction.

AT&T and Samsung have developed 5G Lab in Redmond, where Samsung 39 GHz End-to-End solution using eCPRI interface has been demonstrated.

eCPRI is an efficient interface for the "fronthaul," which is the link between the Radio Unit (RU) and the BBU.

Emerging Architectures For Telco Open RAN



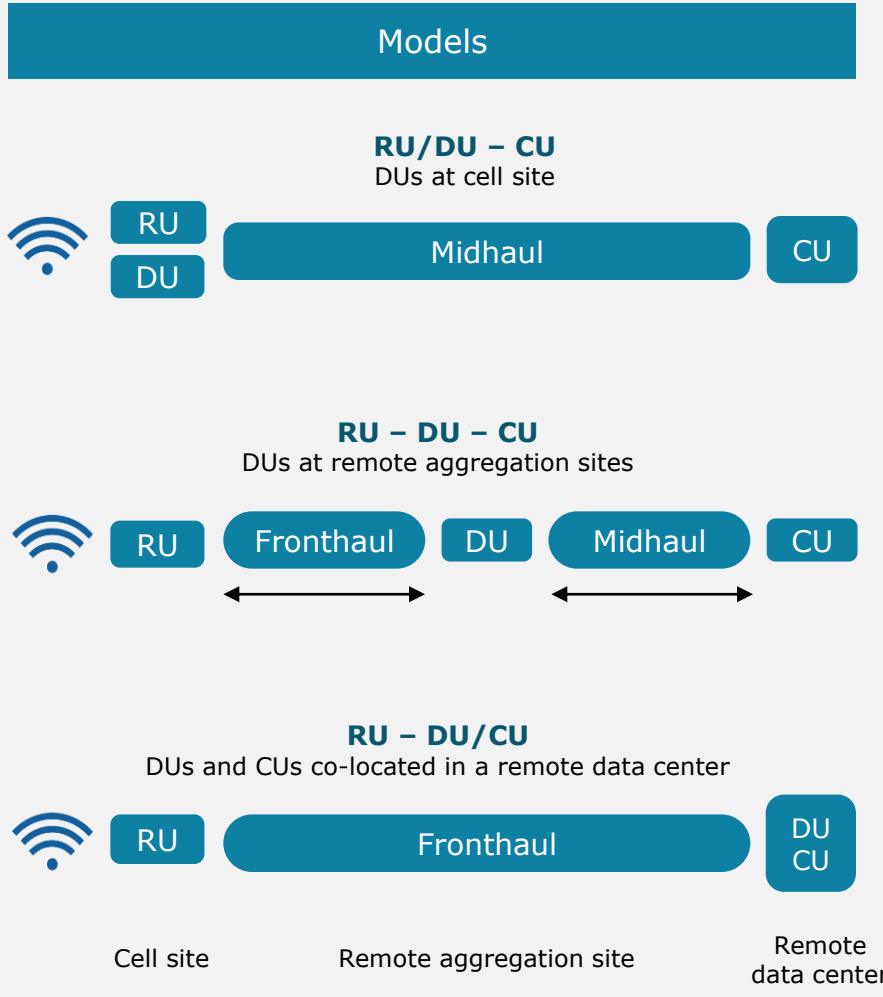
Key principles of Open RAN

- **Disaggregation** of RAN HW & SW on vendor neutral, GPP-based platforms
- **Implementations using open interface specifications** between components with vendor neutral hardware and software
- **Multiple Architecture Options**
- **Flexibility** of multi vendor solutions enabling a diverse ecosystem for the operators
- Solutions implemented on either Bare Metal or Virtualized or Containerized Platforms
- **Innovation** via Adoption of New Technologies (AI/ML, CI/CD…)
- **Supply Chain Diversity**

Emerging Architectures For Telco Open RAN

Key Insights

- More distributed Open RAN topology may be the initial choice, which will have DU initially at the cell site, and eventually relocated to remote data center with the CUs
- DUs at the cell site reduce the transport costs, as DUs located at the cell site need a lower-capacity Midhaul (MH) link to connect to the CUs at a central location
- Owner of fiber network is likely to co-locate DUs and CUs in a remote data center from the beginning – most cost-effective option.
- For operators having low-cost access to fiber for FH over the 7.2 split, scenario 1 is the most cost-effective for cumulative TCO cost reduction from 36% to 42%
- The cost savings are highest for the cell with the lowest capacity (cell profile 1, 20 MHz), because the pooling-gains difference between the two scenarios is the largest



Key Inferences

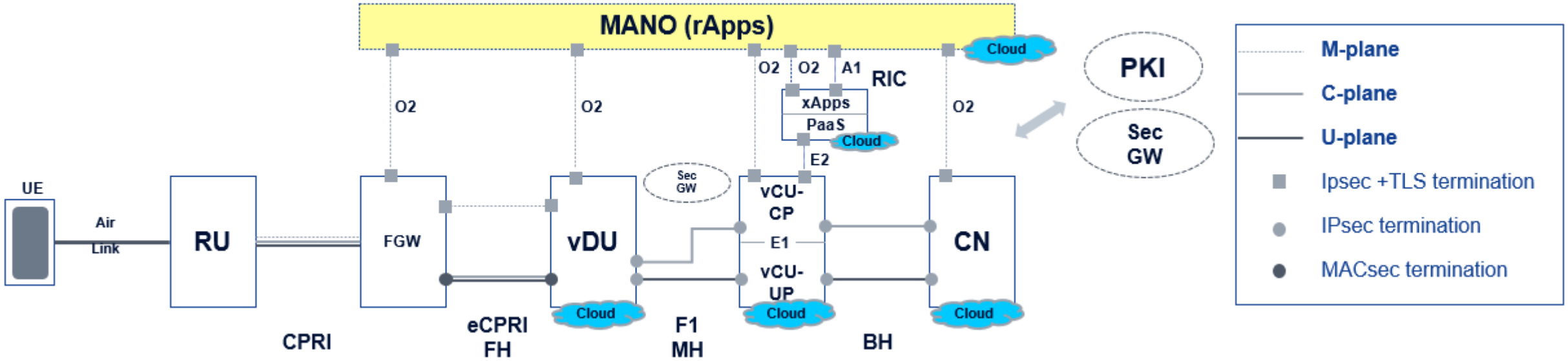
For an operator with relatively high transport costs (HTC), a distributed topology is more cost effective.

Scenario 1 reduces the transport requirements but increases equipment and operating costs for the DUs.

DU-driven costs are higher as equipment at cell site is typically more expensive to install and operate and because there are no pooling benefits.

If increase in DU-related costs is lower than rise in transport costs, as it is in our model, then the DU should be at the cell site.

Disaggregation increased Interface and Interop Complexity



Component Interfaces

In O-RAN and VRAN components (RU, DU, CU, FHG, RIC) and interfaces (eCPRI, F1, E2, E1,O1,O2) increases the point of attack

Virtualized Architecture

Virtualized components (vDU, vCU, RIC, ONAP) and open interfaces are more prone to attacks

Interface to be Protected

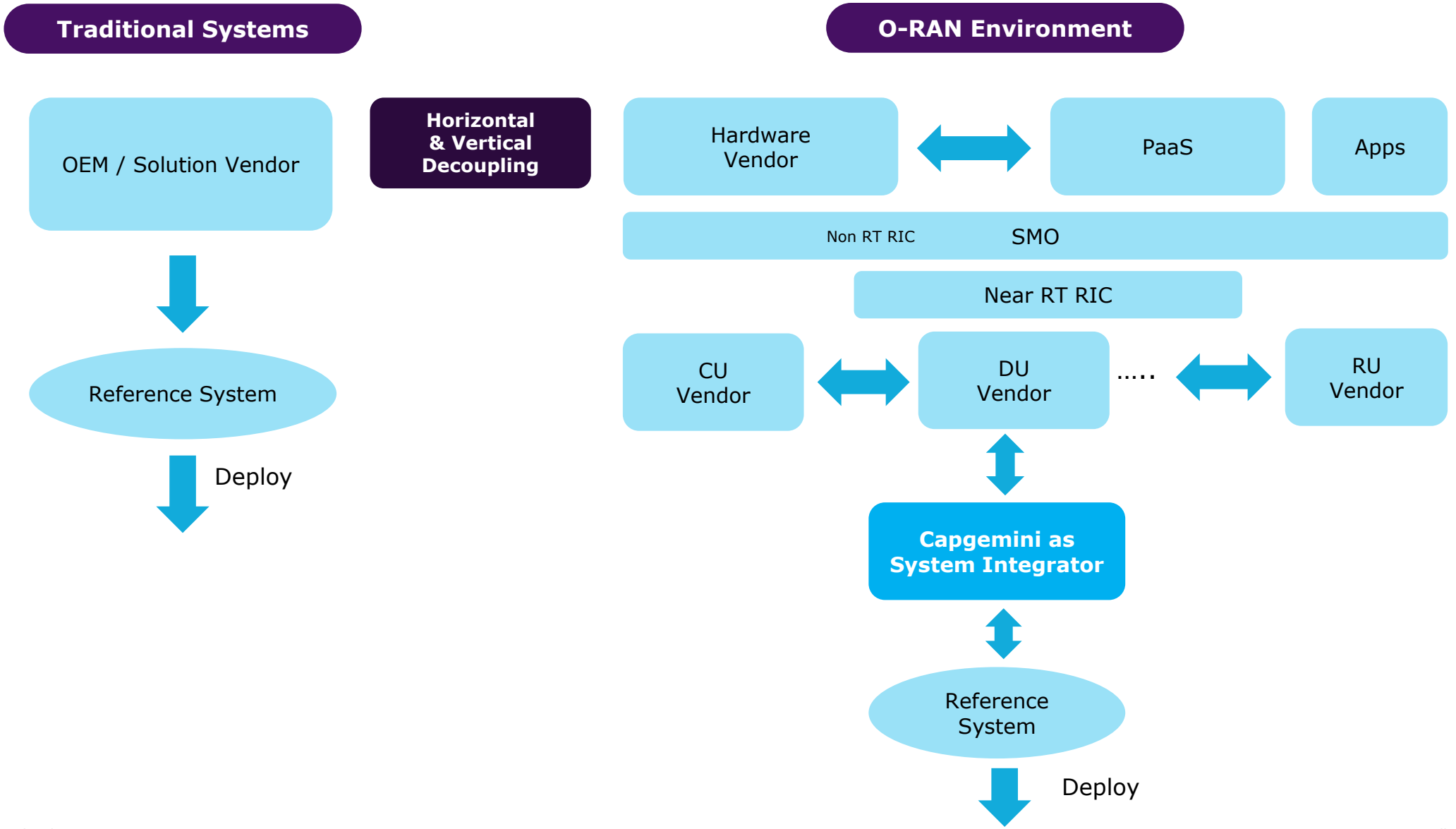
Interfaces should be encrypted, and integrity protected by FirewalI, Psec, MACsec, TLS and Sec GW mechanisms

Platform Hardening and Cloud Infra security

Secured NVI , PaaS and CaaS

- **OS hardening**
- **OAM security**
- **Transport security**
- **RRM security**

System Integrator: Role in O-RAN Environment



O-RAN Organizational Transformation Themes

Network Service Experience

- Increased automation that dynamically manages and orchestrates services
- Improved service availability with 'self-aware' and 'self-managed' network functions
- Focus on end-to-end network service experience, not just network availability

Changing Organizational Culture

- Org culture changes **from Hardware to Software-focused**, combining best of Network and IT worlds
- **Agile/DevSecOps and Automation** emerge as key organizational transformation themes, to realize network service agility benefits

Continuous Delivery

- Integration and delivery as **continuous cycle**, with network functions downloaded directly from OEM software repositories, integrated into service lifecycle, and deployed in a highly automated manner
- New processes for continuous delivery and **multi-vendor responsibilities** in case of issues and maintenance.

Re-skilling & Role Development

- New IT and Software roles – Site Reliability Engineers, DevOps Specialists, Automation Engineers, Lab Blueprint Managers, etc.
- New SW-related skills: Continuous Integration, Build and Release Management, Deployment using Kubernetes Helm charts

Rapid Service Introduction

- Management of 'telecom equipment' as a **software workload**, and associated process improvements
- New Product Management for **Service Lifecycle as a DevSecOps process**, and new Service introduction through highly automated network function service chaining

Disaggregation of KPI / SLA Governance

- New KPI & SLA definitions, considering **disaggregation of software workloads** and underlying COTS hardware, flexible deployment / split architectures, with resiliency and redundancy
- Role of SI to ensure **e2e SLA & KPI adherence** hence becomes important.

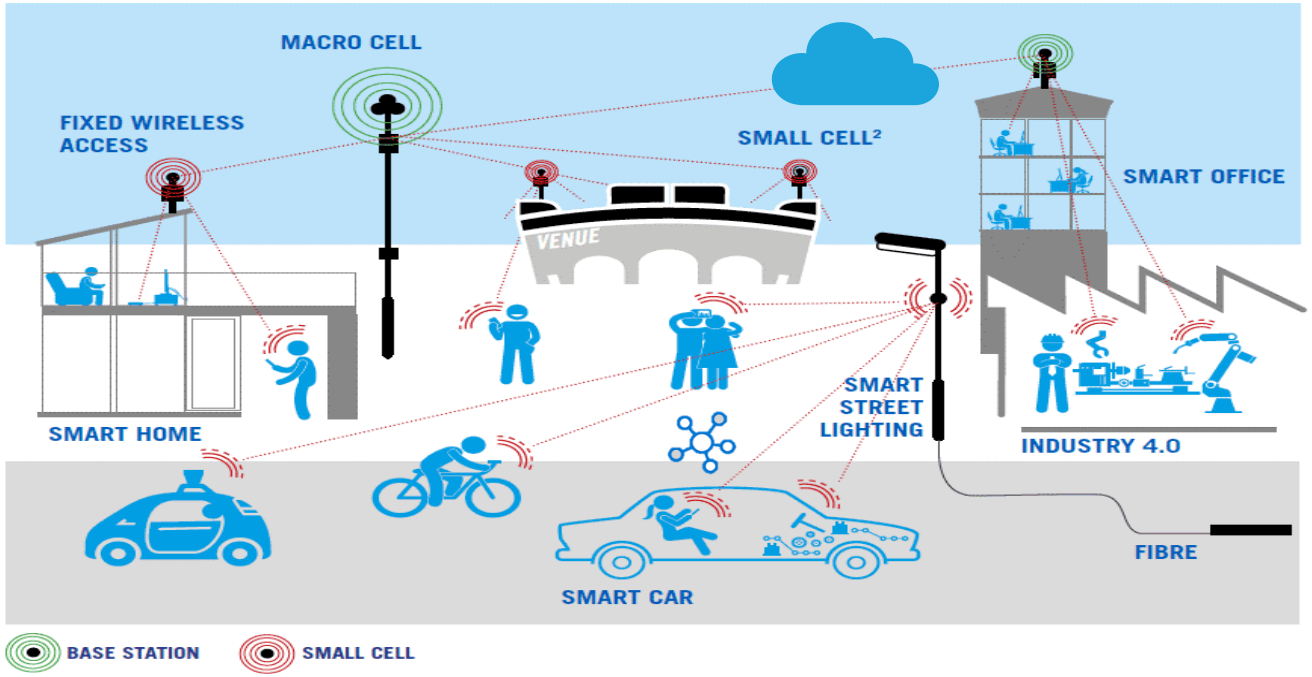
Sources: Sana Commerce

CAPGEMINI ENGINEERING Wireless Field of Play

Experience across all network nodes of network

Solution Consulting | Solution Build | Solution Rollout | Solution Test | Support Service

- Optical & Transport
- Mobility
- Cloud & Datacenter
- IoT
- SDN/NFV
- Networking



5G Network
- gNB (SA, NSA) – RRM, L3, L2
- 5G Core Expertise
- SoC & FPGA Services
- Integration and Verification labs

Solutioning
- Small-Cell / Macro / D-RAN Development
- Virtualized/C-RAN Solutioning
- L2 Schedulers / RRM algorithms
- HW and SW Architecture / Development
- O-RAN based 5G RAN Architecture

LTE Network
- LTE eNB Expertise (L2, L3, SON & OAM)
- LTE HeNBGW Expertise
- LTE Core Network Expertise
- Integration and Verification labs

Other Nodes
- ML Model for RAN
- EDGE Computing Solution
- Transport Solution for RAN
- Fronthaul / FHGW for 5G RAN

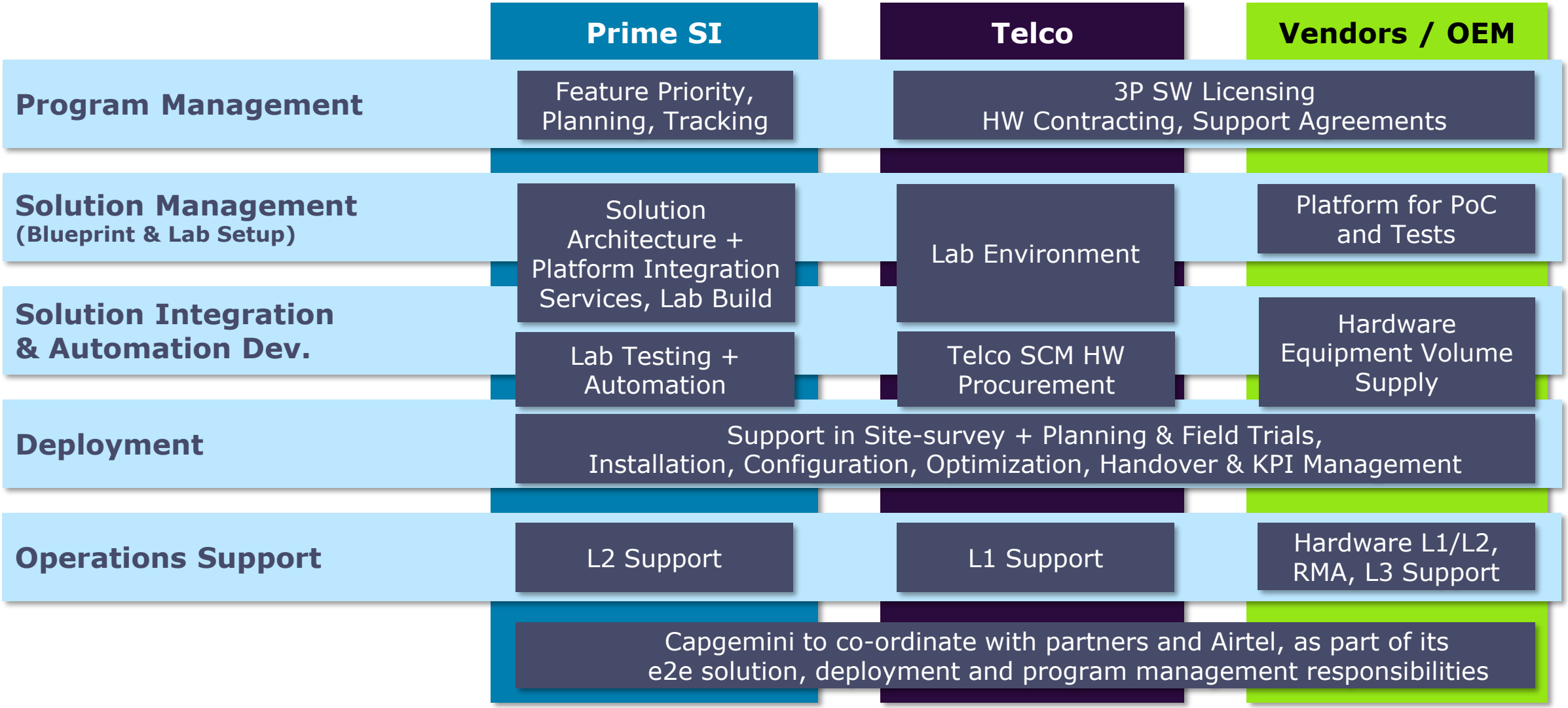
RIC and xAPP
- RIC nRT and NonRT
- xAPP and SMO
- Algorithm (ANR, MRO, ..)
- Orchestration NSMF interface

OSS Interfaces
- Multi-vendor Interface Adapters (CM/PM)
- Network Performance Optimizers
- Call Data Processor

Trusted End to End Service Life Cycle Partner

In Summary

O-RAN changes the network paradigm and therefore, planning, design, integration and deployment of networks will undergo transformation.



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