

WEBINAR



Network Programmability Jumpstart
with VMware's RIC SDK

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Bringing Developers to the RAN

with VMware RAN Intelligent Controllers
(RICs)

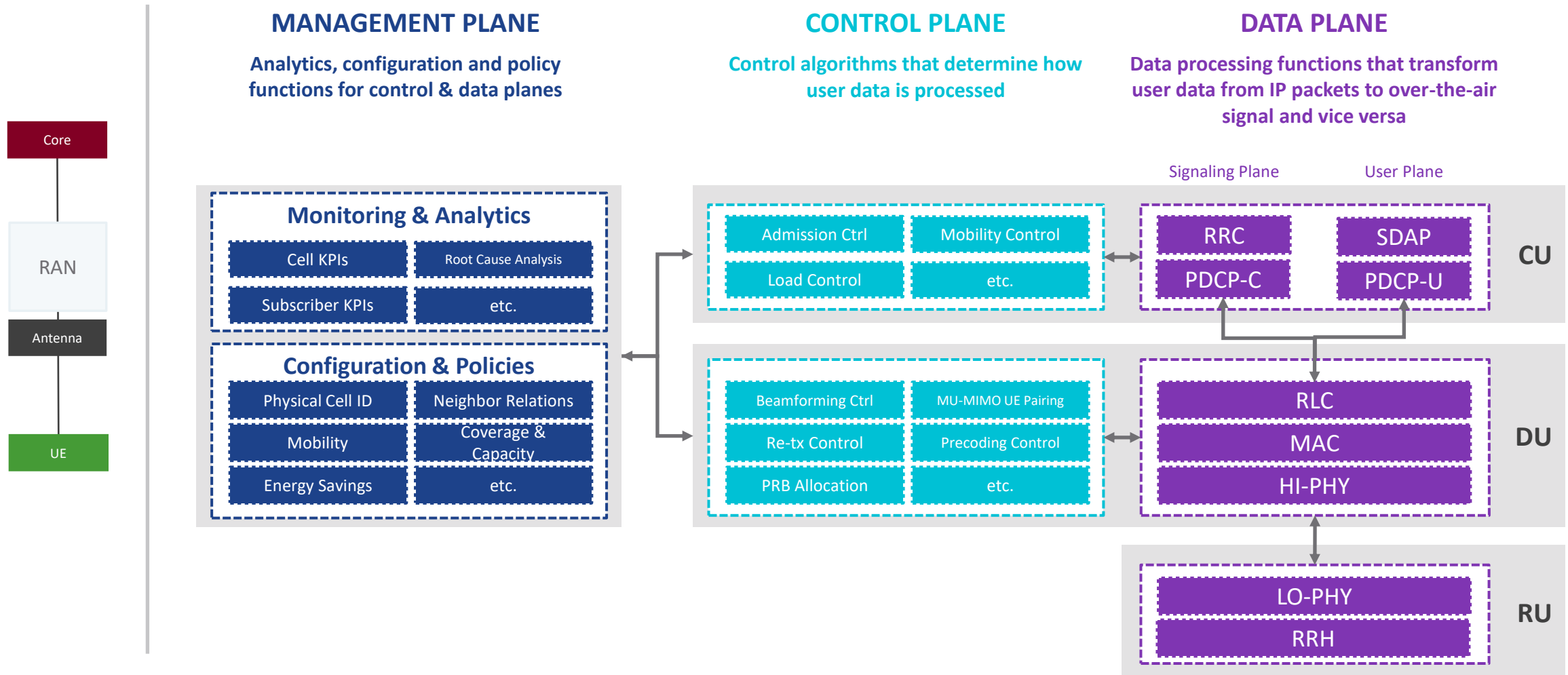
Rakesh Misra

Director, R&D

Service Provider & Edge BU, VMware

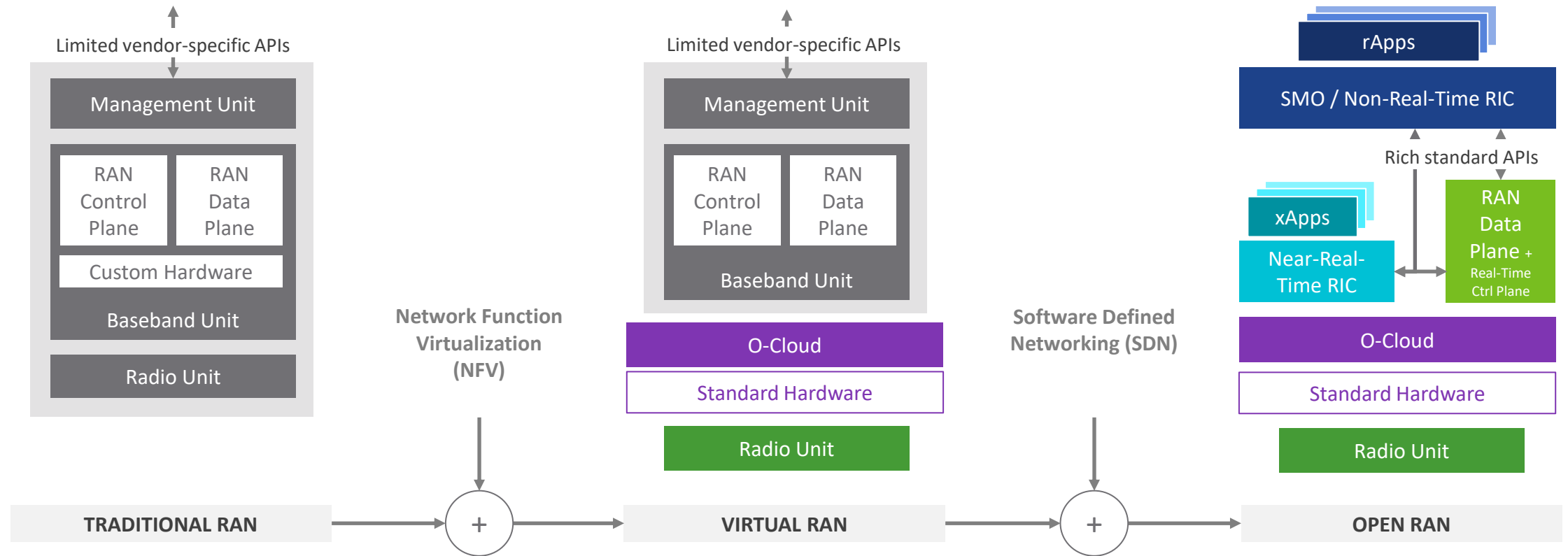
What do we mean by *RAN intelligence*?

Algorithms of value for RAN analytics (open loop) and/or RAN optimization (closed loop)



Open RAN allows *RAN intelligence* to be programmed externally

The RAN Intelligence Controller (RIC) provides the abstraction for multi-vendor apps



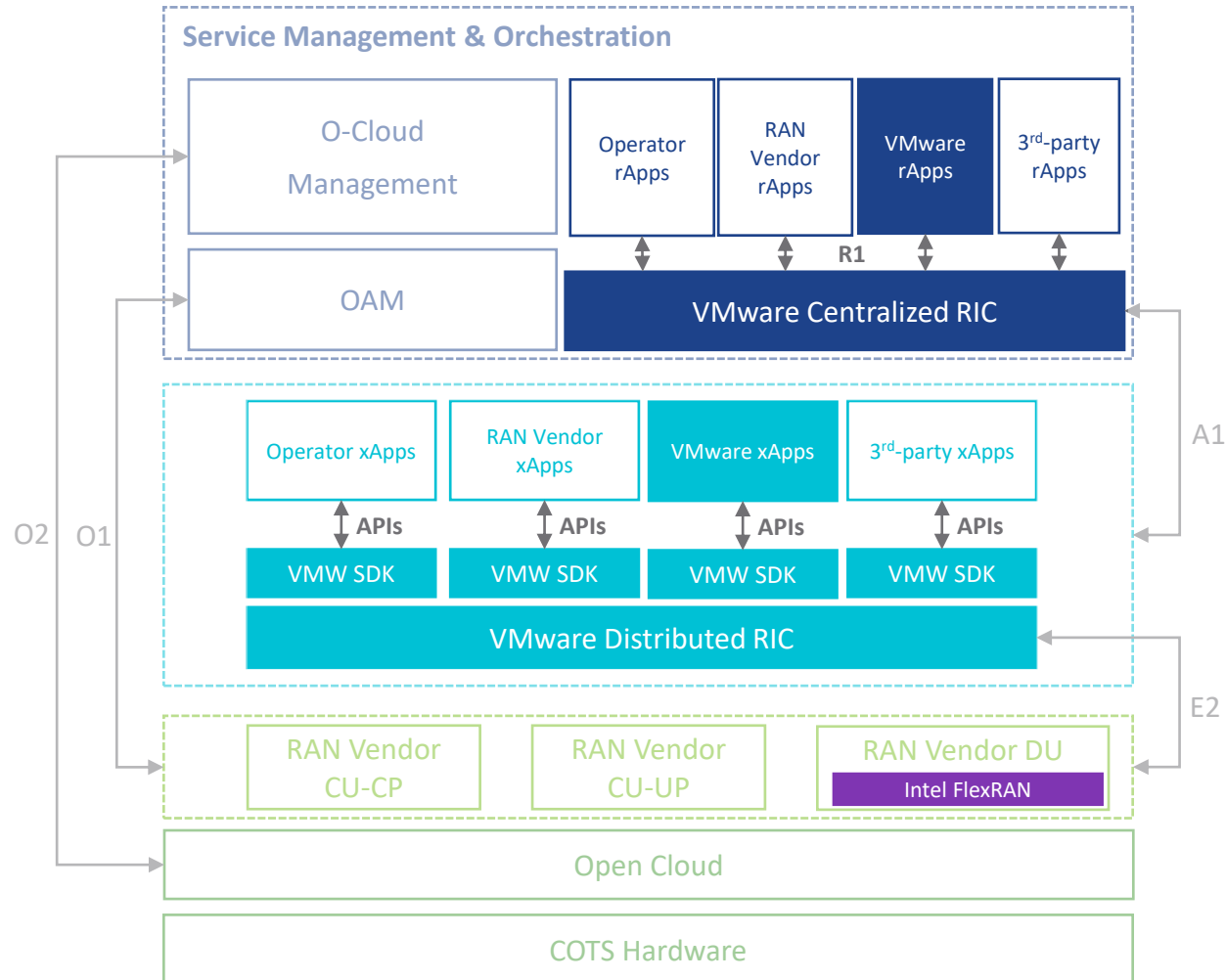
- Single vendor
- Vertically integrated
- Limited programmability

- Few vendors
- Virtual & cloud native
- Limited programmability

- Many vendors
- Virtual & cloud native
- Rich programmability

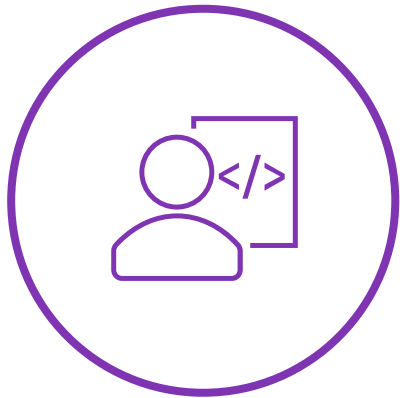
VMware RAN Intelligence Portfolio

Includes Centralized RIC (Non-RT), Distributed RIC (Near-RT), SDKs for developers



VMware RIC: An Open Platform for Innovation in the RAN

Mission: create a vibrant ecosystem of vendors & operators who are innovating in RAN



Open APIs & SDKs for Devs

APIs & developer resources to accelerate app development



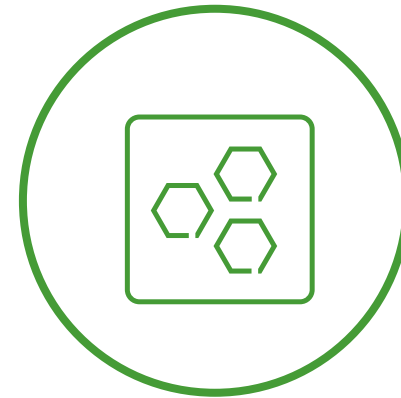
Open Data Access

Real-world RAN data repository for rapid App development & evaluation



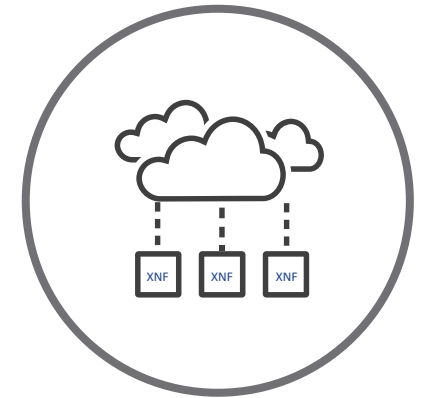
Open APIs for RIC FCAPS

Management interfaces for monitoring, configuration and security policies



Extensible Platform

Service-based architecture extensible with 3rd party services

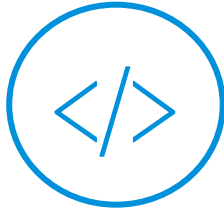


Multi-RAN & Multi-Cloud

RAN neutral and cloud native platform - agnostic to cloud infra

VMware RIC SDK: Designed for Developers

Offers developer resources to accelerate building new xApps and rApps for VMware RIC



APIs for Developers

- REST APIs for rApps
- SDK APIs for xApps (currently available for C/C++)
- Based on O-RAN WG2 and WG3 principles and specifications (standardization in progress)



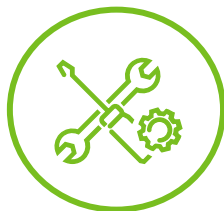
Reference Apps & Starter Code

- Available in multiple languages including C, C++, Python, Go



Transport Libraries for xApps

- Implements the low-latency transport between xApps and the Near-RT RIC services, so xApp developers can focus on their app logic



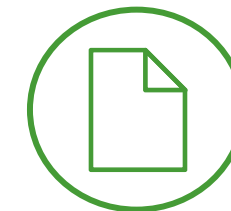
Testing & Debugging Tools

- Programmable RAN simulators
- Metrics & Logging



Custom Resource Definition

- For packaging of xApps and rApps
- Based on O-RAN WG10 principles and specifications (standardization in progress)



Developer Guide

- Instructions and best practices for using the SDK/APIs to build xApps and rApps

VMware RIC SDK Partner Program: Launched in June 2022

An open program to accelerate development, deployment and monetization of your apps

Accelerate RIC App Development



Access to SDK, self-service training videos, developers guides & VMware technical support

Increase Market Reach



Leverage VMware RICs' multi-RAN & multi-cloud support, & 100+ CSPs worldwide who trust VMware technologies

Reduce Time-To-Revenue



With the VMware RIC, rApps & xApps are ready for production faster & simpler to operate

Foster Technical Collaborations



Engage with VMware experts & a growing partner ecosystem to foster new collaborations & accelerate innovation

Visit <https://via.vmw.com/ric-partner-sdk> and/or reach out to your VMware contact



Universal Spectrum Multiplier

O-RAN Innovation via xApp



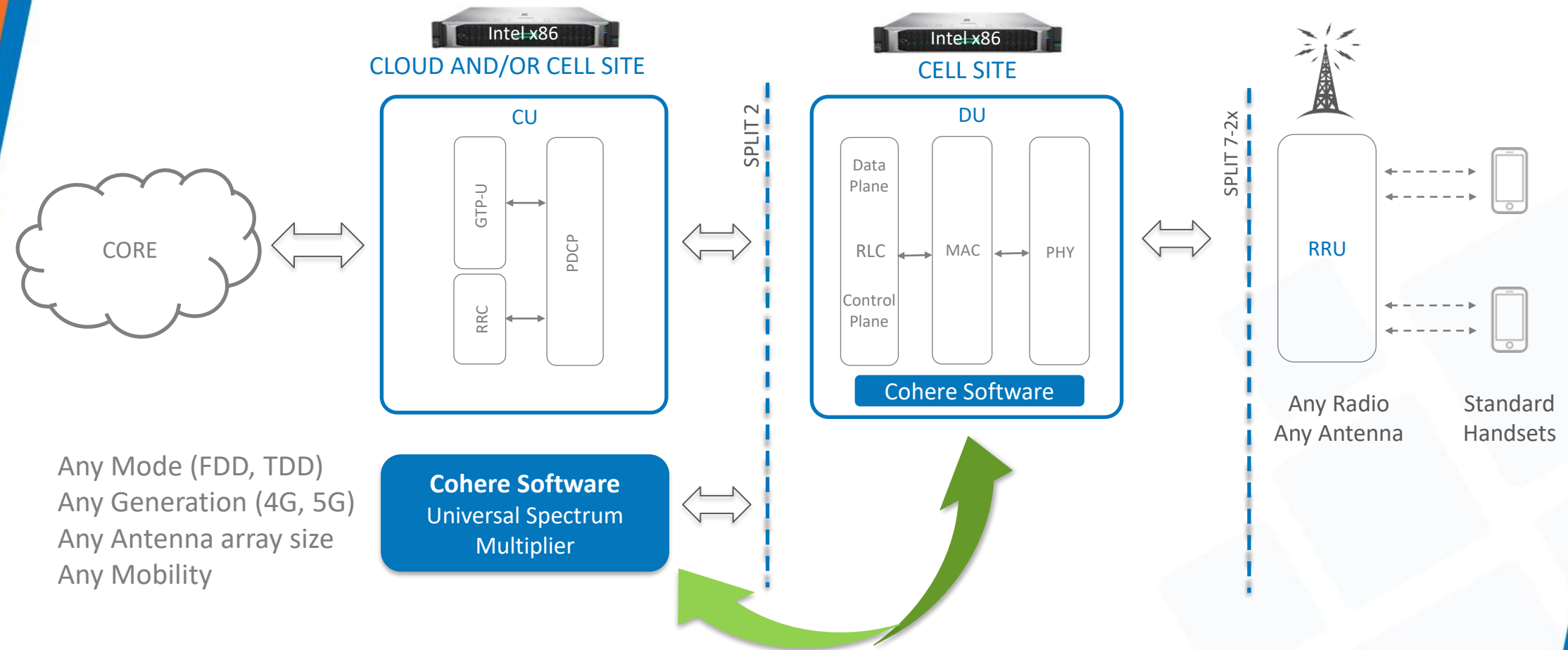
@Cohere_4G_5G



www.cohere-tech.com

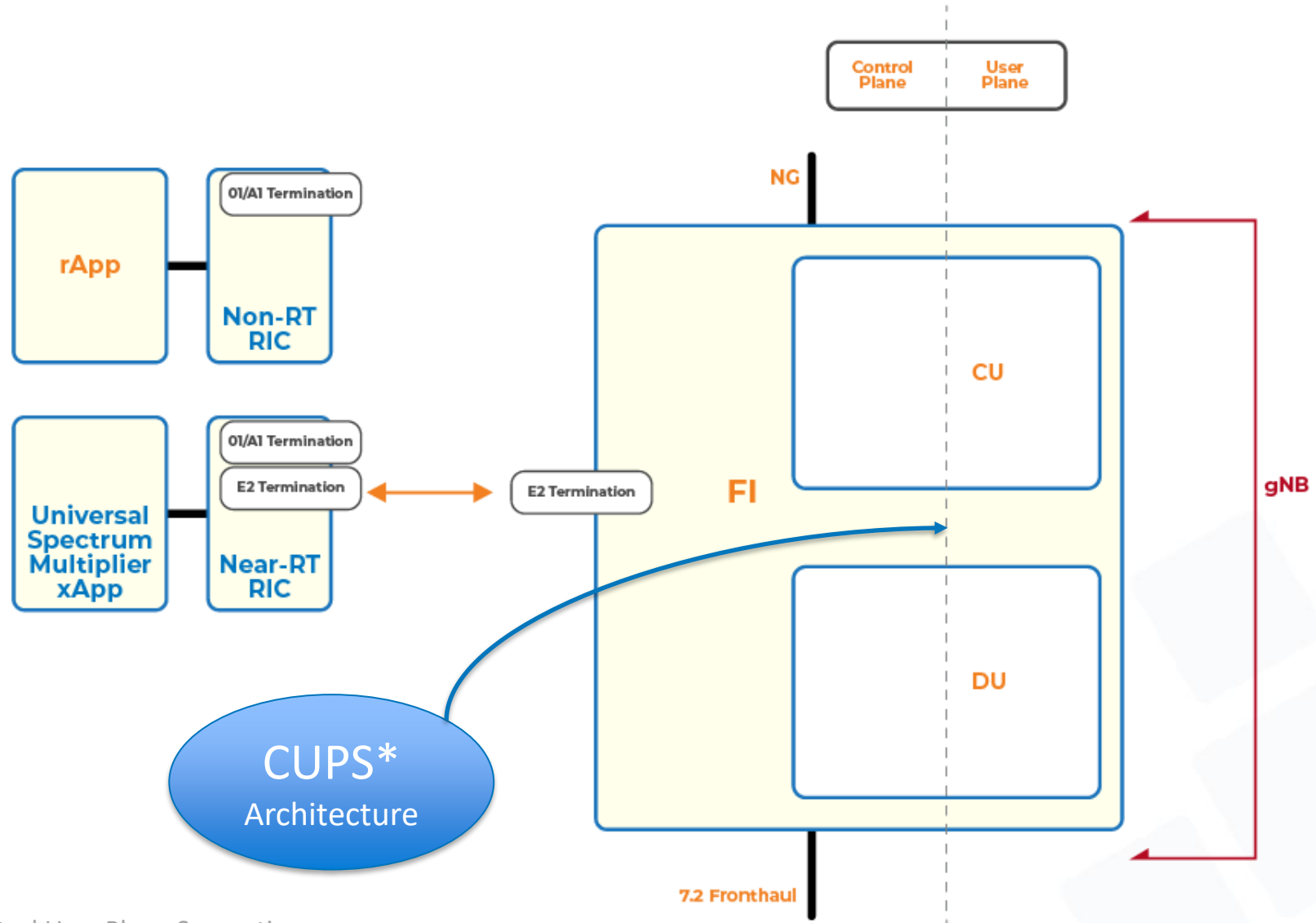
Cohere Software Product & Technology

Cohere software can be integrated within the DU, or can operate in the cloud as an xApp in the near-RT RIC enabling CoMP and ICIC



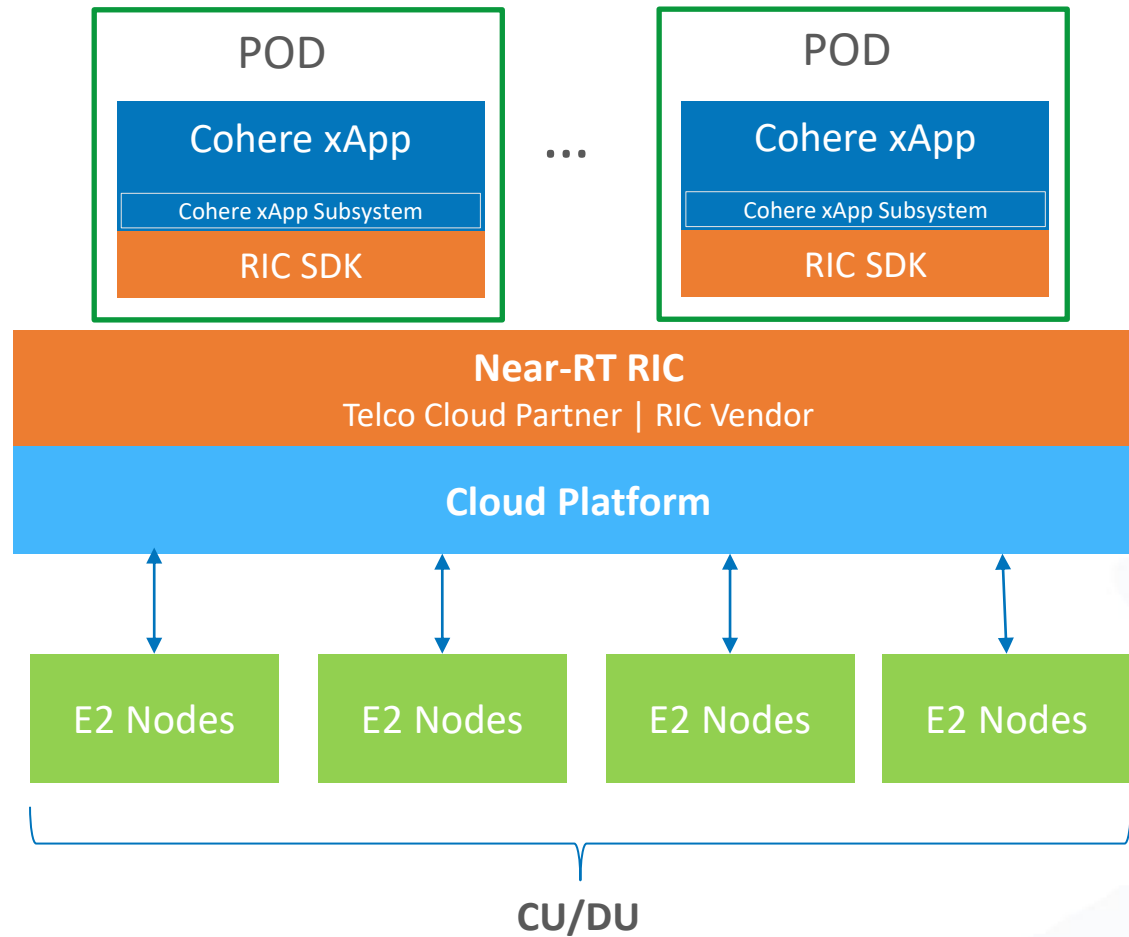
Any Mode (FDD, TDD)
Any Generation (4G, 5G)
Any Antenna array size
Any Mobility

How Cohere Software Fits Within O-RAN



*Control User Plane Separation

Cohere O-RAN Ecosystem





Accelerating Intelligence, Automation and Optimization for 5G Open RAN

Anand Parikh
VP, Strategic Partnerships

AirHop is Leading the Way to Meet the 5G Challenges

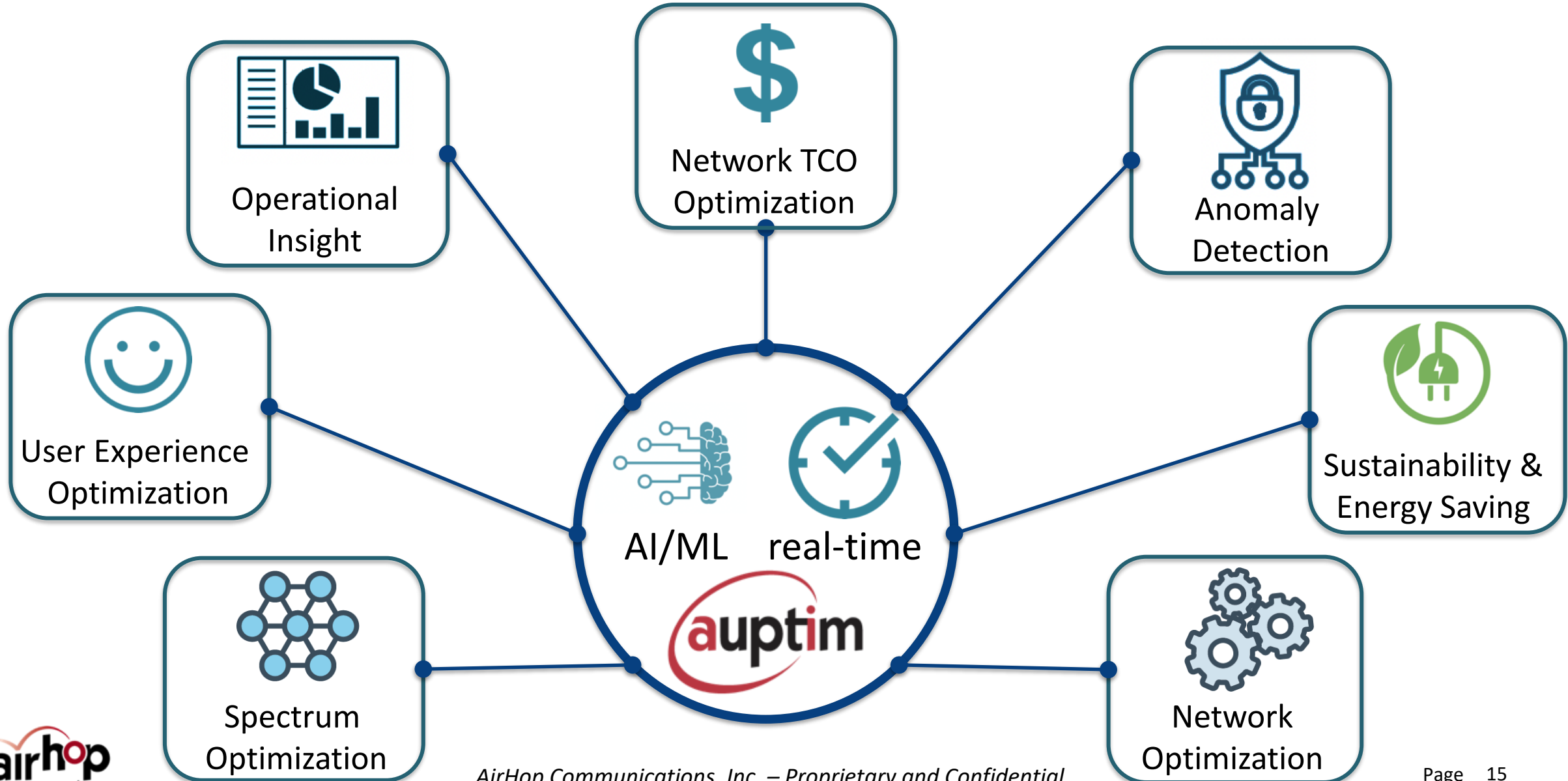
AirHop is the leader in **Advanced 4G & 5G Network Intelligence Solutions for Open RAN**

Cloud native, real-time network automation and optimization

Commercially managing more than a million cells at the network edge

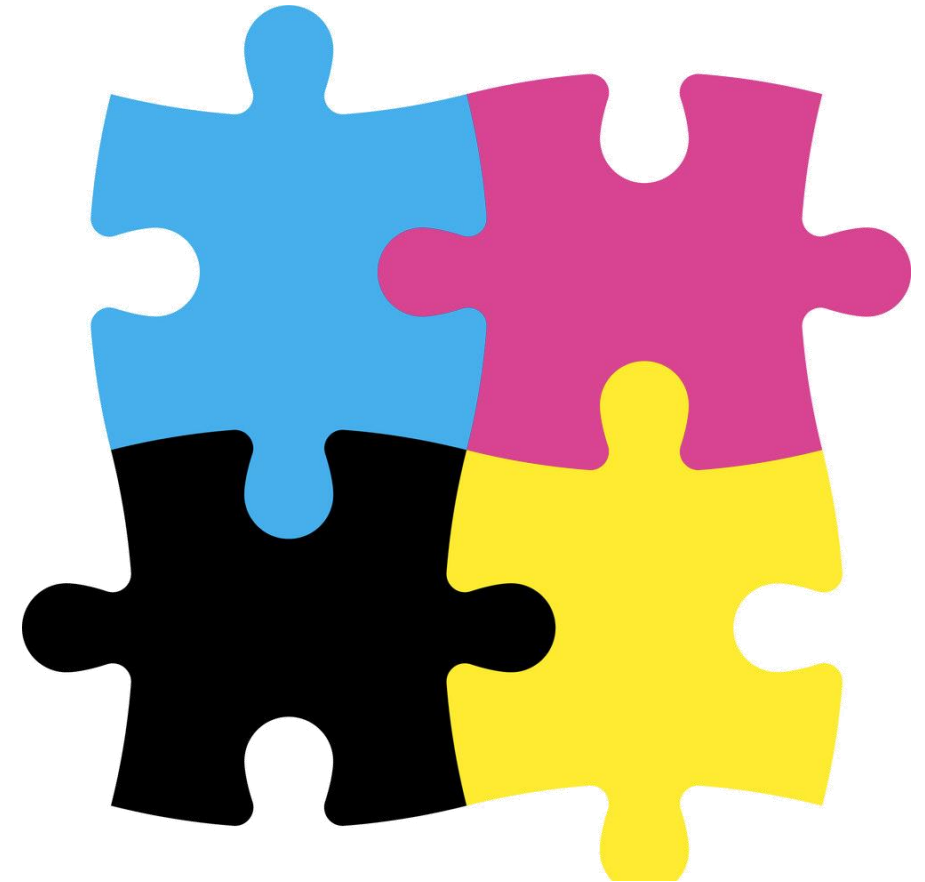
Industry's First Comprehensive Portfolio of Open RAN rApps/xApps

Auptim – Industry’s Broadest Portfolio of Open RAN rApps and xApps



RIC's Role for AirHop Open RAN Solutions

- Open RAN movement cannot succeed without a rich vendor ecosystem
- RIC + xApps/rApps = central nervous system of Open RAN, critical for its operation
- Symbiotic relationship = Collaboration is essential to enable CSPs with RAN automation and optimization



Auptim Integration on VMware RIC SDK

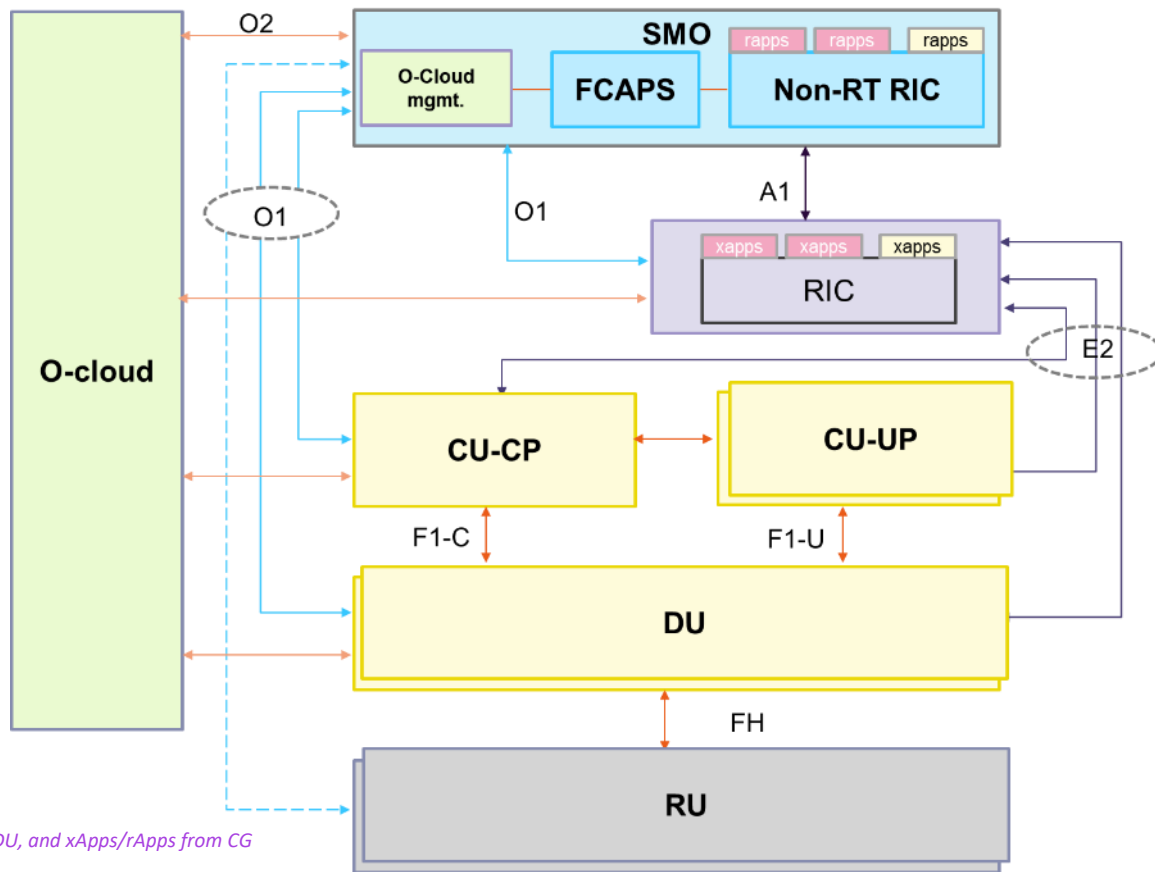
- ✓ VMware SDK was very well prepared and everything worked as advertised
- ✓ Integration of Auptim rApps with VMware Centralized RIC was performed quickly with minimal support needed from the team.
- ✓ VMware's use of OpenAPI specification
 - It made the process fairly simple and easy
 - Easy to understand and interact with remote services with a minimal amount of implementation logic, removing guesswork in calling a service
- ✓ VMware's development and integration platform
 - AirHop has significant experience deploying solutions on multiple Kubernetes environments. Some are easier than others.
 - VMware's Centralized RIC deployment and Auptim rApp integration were done on a AWS EKS Kubernetes environment, making integration simple

BUILDING REFERENCE SOLUTION TO ENABLE O-RAN SOLUTION

Developing xApps using VMWare RIC and validating with Capgemini CU/DU



5G vCU/vDU FRAMEWORK BASED ON O-RAN ARCHITECTURE

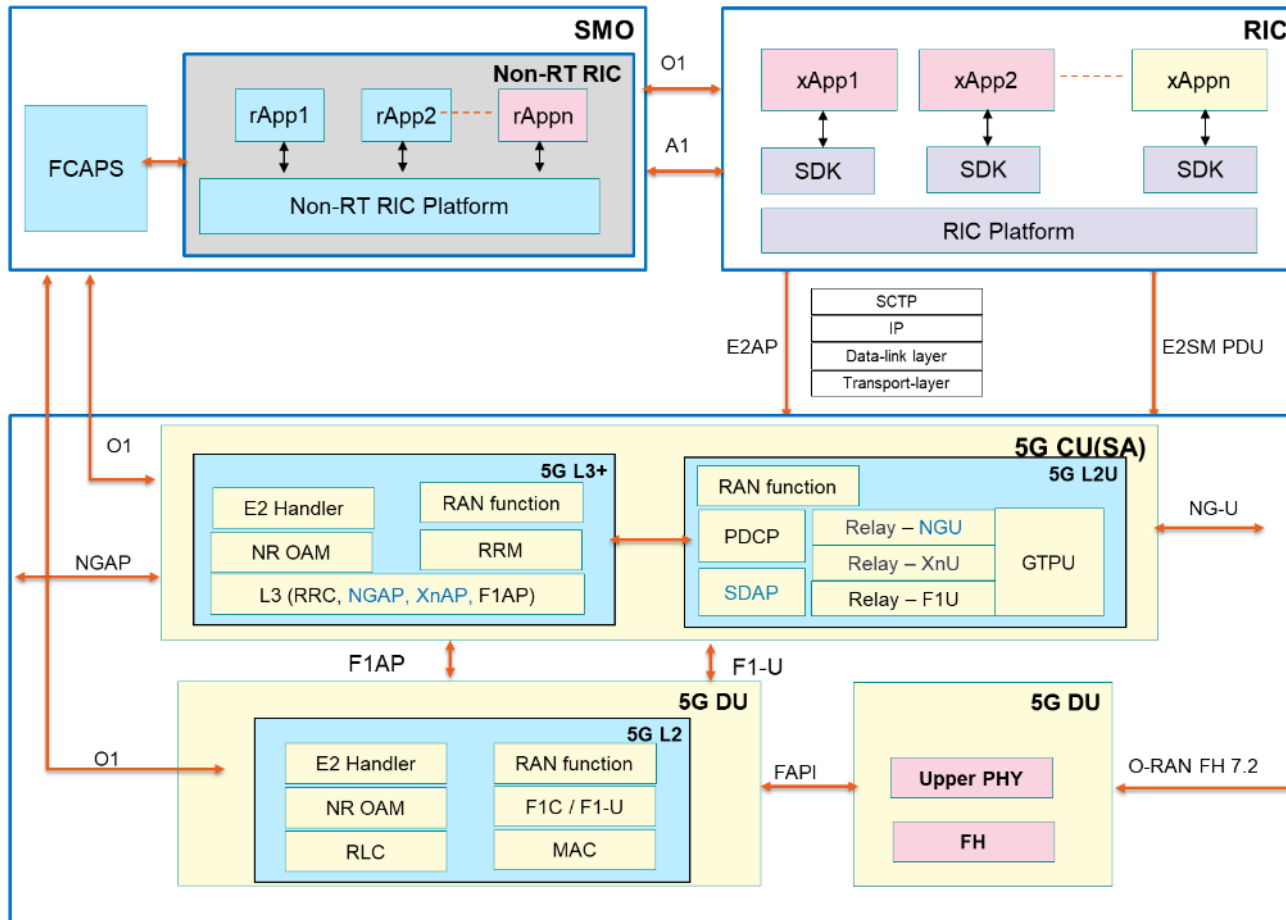


- CU/DU supporting **3GPP Rel-15 with Rel-16 roadmap**, and based on **O-RAN based architecture and interfaces**
- Support for **3GPP defined interfaces**, distributed CU/DU or integrated CU/DU Options , and RAN split-options - 2,6,7.x,8
- Support for **O-RAN defined E2SM and proprietary E2SM**, and onboarding of **xApps integrated with RIC and CU/DU**;
- **Programmable and scalable CU/DU** with HW/SW decoupling (based on Intel based servers and accelerators) and efficient usage of cores;
- Support for HW accelerators (FPGA) and **data-path acceleration** (using DPDK);
 - Real-time kernel patch for real-time processing, CPU/memory usage, core-isolation / core-pinning, bind cores with same NUMA awareness, network interfaces (**SR-IOV, MACVLAN**), PTP support;
- Deployment using CSAR files, helm charts and integration with Cloud Infra.

Capgemini Engineering 5G gNB Software Framework enables support for 3GPP / O-RAN Architecture & Interfaces.



5G gNB CU/DU FRAMEWORK – HIGH-LEVEL ARCHITECTURE



- Support for **3GPP defined interfaces** and roadmap support for **O-RAN defined “open” interfaces** (O1, E2)
- CU/DU solution **optimized and pre-integrated for multiple SOC platforms** (like Intel, ARM, NXP, Qualcomm, Nvidia)
- Dynamic dimensioning and allocation** of cores based on capacity and feature / functionality configured in DU:
 - Can be adapted to run for **multiple form-factors** (like collapsed CU/DU, integrated CU/DU and distributed CU/DU, integrated small-cell);
 - Support of light-weight scheduler & pooling framework for load-balancing.
- Support for **xApps/rApps** and use of **AI/ML models** for improving network performance and user experience
 - E2 support for O-RAN based and proprietary E2SM to realize use-cases
- OAM and Management support of gNB SW**
 - Support for **O1 interface and xml file** for FCAPS of CU/DU
 - Management & Orchestration** of CU/DU CNFs done by Partner’s solution
- Test framework for standalone validation** of CU/DU – features, functional and performance validation

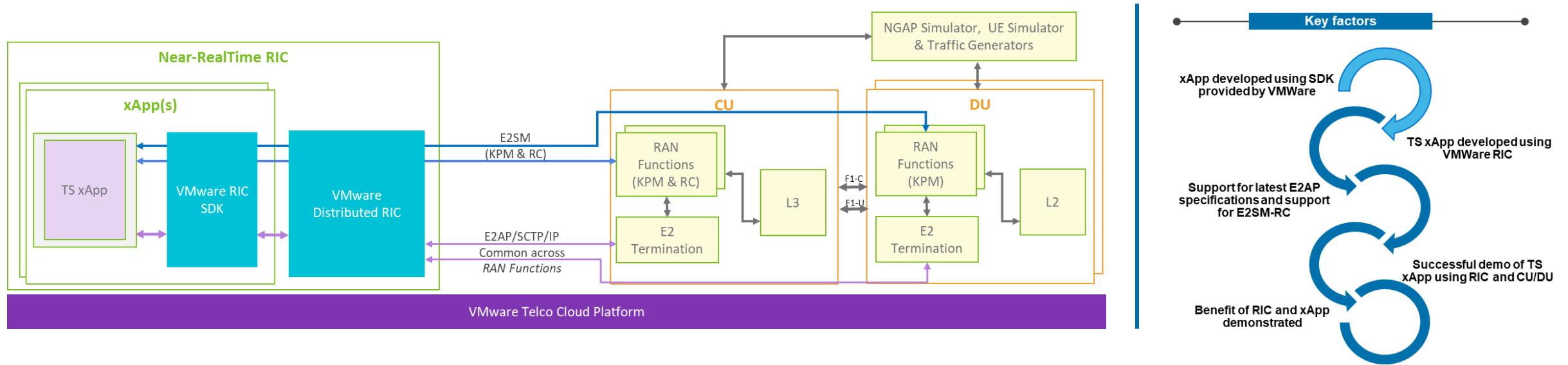
5G CU/DU solution has support for E2, O1 interfaces as per O-RAN specification.

Capgemini Engineering 5G gNB Software Framework is scalable & supports multiple deployment options.



CAPGEMINI xAPP DEPLOYMENT USING VMWare RIC/SDK

- High-level architecture of xApp developed using VMWare RIC/SDK and verified with Capgemini CU/DU



- VMWare and Capgemini demonstrated how to accelerate innovation in the RAN by
 - a) Making the 5G RAN (CU/DU) stack programmable via the O-RAN E2 interface including developing RAN functions to support xApp
 - b) Enabling easy insertion of 3rd-party xApps via the O-RAN Near-RT RIC
 - c) **Ease of developing xApp using SDK provided by VMWare.**
- As part of the Traffic Steering xApp, it was demonstrated how by using intelligent trigger conditions and application logic, xApp is able to improve UE throughput and improve QoS without requiring any changes in the intelligence embedded in the CU/DU



KEY FACTORS TO ACCELERATE O-RAN DEPLOYMENT CAPGEMINI'S ROLE



- Identify the **use-cases, develop Apps and demonstrate** the benefits with O-RAN deployment



- Provide tools to develop Apps that can be onboarded to the network (ie **support for SDKs** for developing Apps that can run on RIC Platform)



- Support for **programmability of RAN** and providing operators flexibility to onboard Apps for network performance improvement and monitoring.



- Build an **ecosystem of partners** (application developers, RIC platform, CU/DU) to accelerate the journey



- Reference **CU/DU solution** that is based on 3GPP specifications and O-RAN architecture/specifications
- Roadmap to **support “RAN functions”** to provide programmability in RAN and to help in realization of use-cases
- Developing set of **reference xApps / rApps** (traffic steering, QoS/QoE, energy saving, slicing etc)
- Working with VMWare in **enabling eco-system** where Apps can be onboarded on VMWare RIC Platform and be verified in e2e set-up with CU/DU
- Feedback/learnings from trials to **help in evolving the O-RAN solution aspects** (across all nodes/components – SDK, RIC Platform, CU/DU)



Thank You