MWC GSMA

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ctia™

LAS VEGAS
SEPTEMBER 26–28
2023

Session 3
Unlocking a world of opportunity
with Open RAN

Agenda

Session 3 keynote speaker(s)

David Nowicki, Ecosystem Development Director, Telecom Infra Project

Lalit Kashyap, Vice President and Head - US Communication, Media and Information Services, Wipro

Ganesh Shenbagaraman, Head of Standards, Regulatory Affairs & Ecosystems, Radisys

Sadayuki Abeta, Global Head of Open RAN Solutions/ OREX Evangelist, NTT DOCOMO

Session 3 panel member(s)

Sameer Vuyyuru, Head of WW Business Development for Communication Service Providers, AWS

Manish Singh, CTO, Telecom Systems Business, Dell Technologies

Geoff Hollingworth, CMO, Rakuten Symphony

Moderator: **Lourdes Charles**, VP, Global Head of 5G & Connectivity, Wipro

Telecom Infra Project (TIP): Overview

650+ Participating Companies

FACILITATOR

TIP is a US-based independent & neutral non-profit industry organization with global reach enabling vendors, operators, system integrators, and policy makers to develop, test and deploy open and disaggregated connectivity solutions across the access-, transport- and core-networks

100+ Service Providers

ACCELERATOR

TIP accelerates adoption by aligning industry roadmaps with operator requirements/deployment scenarios, and supports deployment through test validation and certification. After years of successful trials and plugfests for Open RAN, TIP is now focussed on full system certification

WHO IS TIP?

150 + Trials and deployments in **45 +** Countries

ENABLER

TIP enables supply chain resiliency, drives economies of scale and secures short time-to-market, benefiting the ecosystem

TELECOM INFRA PROJECT

Unlocking a World of Opportunity with Open RAN

Open RAN is the future	• Open RAN Standards Bring flexibility and efficiency
Obstacles Remain	• TCO, power efficiency and performance • integration complexity • lifecycle management with multi-vendor solutions
What can be done?	• Catalyst funding from US NTIA and other governments ○ NTIA Head Alan Davidson @MWC Barcelona TIP Pavillion "*RFC themes for funding catalysts interventions are Interop, Security & Efficiency … particularly test and certification*" • TIP introducing SCOPE Full System Certification • Innovative Approaches from today's keynotes and panelists: Wipro, Radisys, NTT Docomo, AWS, Rakuten and Dell Technologies

System Level Obstacles are Holding Back Open RAN

While Incumbents Vertically Integrate and Deliver a Full Traditional System to Operators ...

| Product Conformance | System Integration | System Validation | Operator Acceptance |

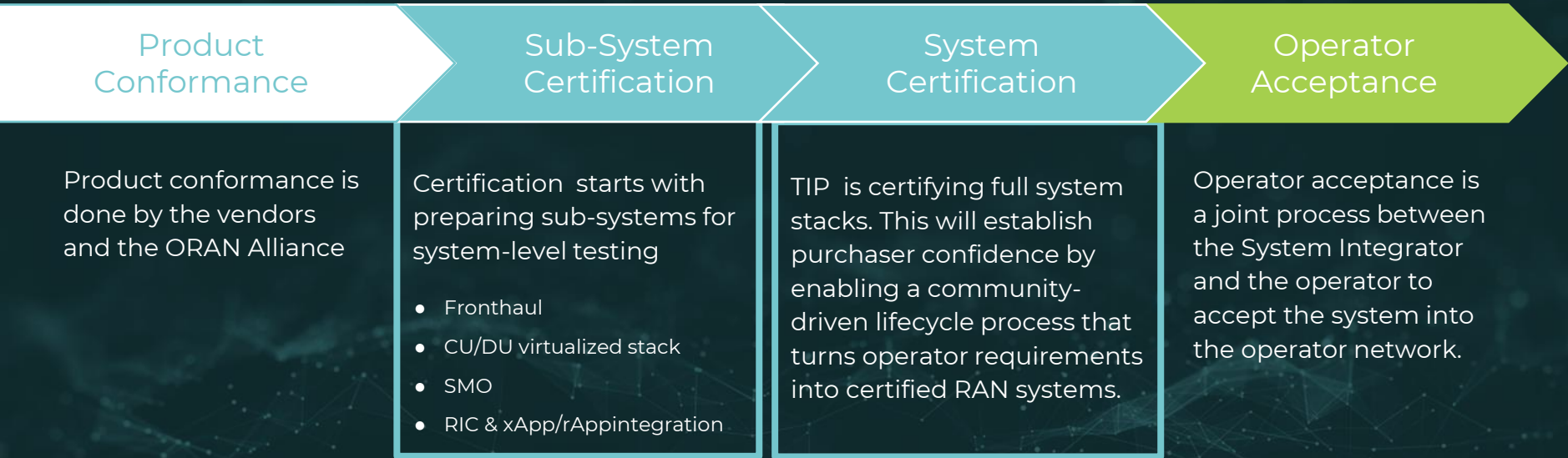... Operators Can't easily Source a Multi-Vendor Open RAN System in a similar manner

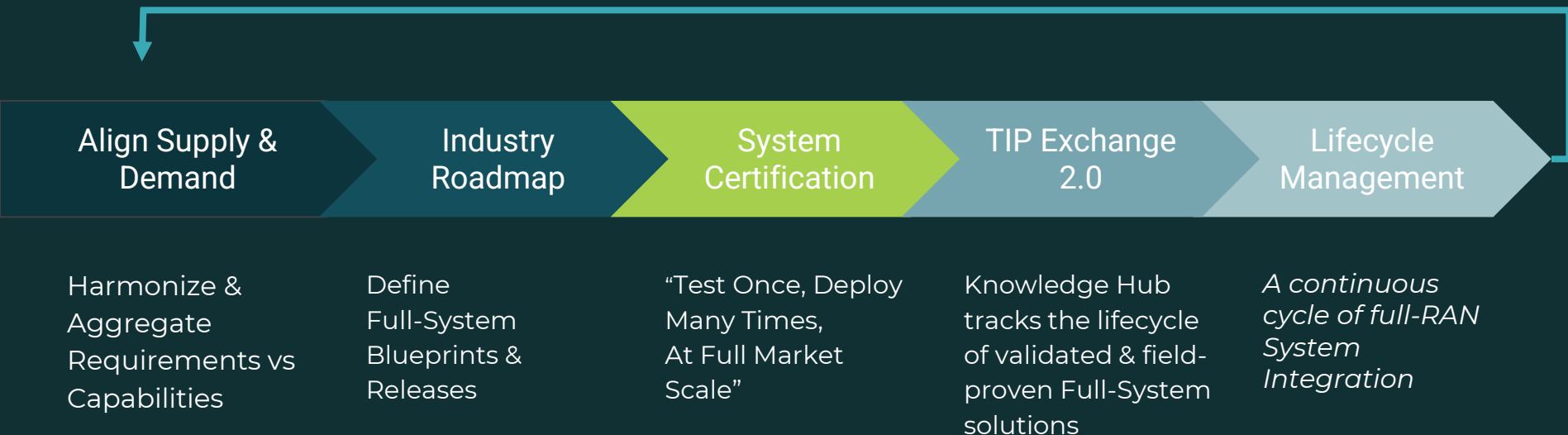| Open RAN Multi-Vendor Conformance | Operators Forced to System Integrate & Validate Multi-Vendor Products | Operator Acceptance |

TIP Community Introducing Full System Certification

Product Conformance	Sub-System Certification	System Certification	Operator Acceptance

Product conformance is done by the vendors and the ORAN Alliance

Certification starts with preparing sub-systems for system-level testing

- Fronthaul
- CU/DU virtualized stack
- SMO
- RIC & xApp/rAppintegration

TIP is certifying full system stacks. This will establish purchaser confidence by enabling a community-driven lifecycle process that turns operator requirements into certified RAN systems.

Operator acceptance is a joint process between the System Integrator and the operator to accept the system into the operator network.

System Certification is a missing link to global acceleration

TELECOM INFRA PROJECT

TIP SCOPE Establishes Open RAN Operator Purchasing Confidence

Align Supply & Demand	Industry Roadmap	System Certification	TIP Exchange 2.0	Lifecycle Management
Harmonize & Aggregate Requirements vs Capabilities	Define Full-System Blueprints & Releases	"Test Once, Deploy Many Times, At Full Market Scale"	Knowledge Hub tracks the lifecycle of validated & field-proven Full-System solutions	*A continuous cycle of full-RAN System Integration*

TELECOM INFRA PROJECT

TIP Open RAN Update
Accelerating Open RAN Globally

SCOPE System Certification will lead to industry-wide streamlined testing & evaluation processes and operator purchaser confidence.

A Téral Research market research report estimated this will greatly accelerate the Open RAN equipment market resulting in a doubling in size globally to $14 Bn by 2028.

System Certification Impact to Open RAN Equipment Market 2028

$B

Legend: ■ Baseline ■ with System Certification

Chart categories: Global, N. America, EMEA, APAC, CALA
Y-axis: 0, 5, 10, 15
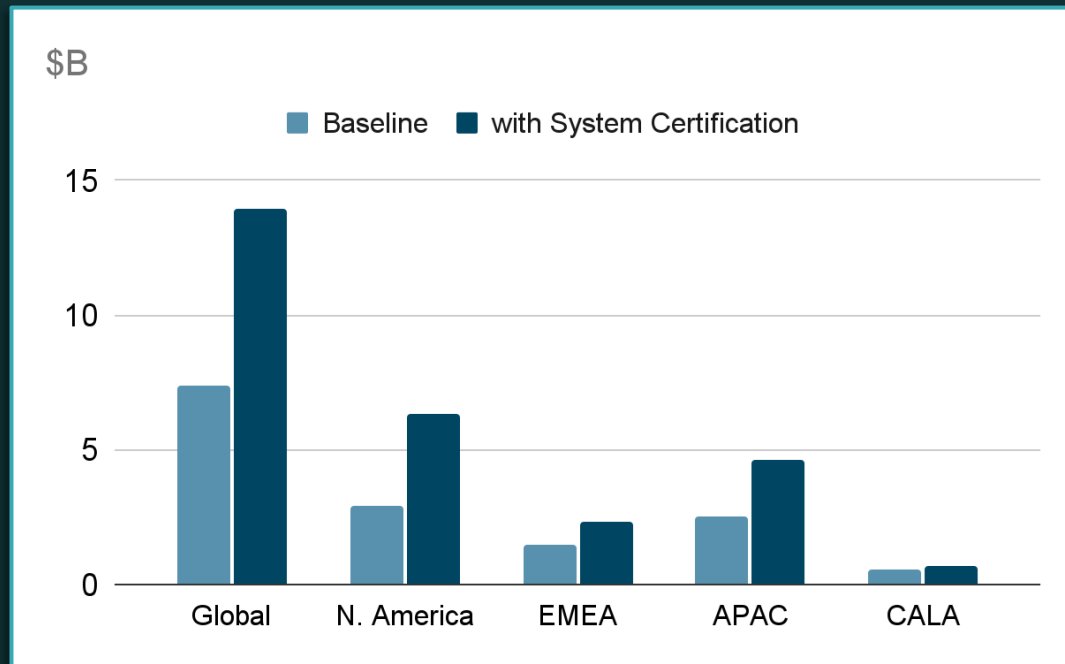
Source: Teral/Lightcounting, May 2023

TELECOM INFRA PROJECT

5G Futures Summit

ORAN Transformation journey: Challenges and Opportunities

Lalit Kashyap
Vice President and Head - US Communication, Media and Information Services
Wipro

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One of the **largest, most trusted, purpose-driven** technology companies in the world.

We're realizing ambitions for over

1,400

clients

across

66

countries

250K+

employees

Why do we stand out in a world of business consultants?

We were born in tech.

Impactful innovation grows from hands-on experience and deep technical knowledge.

Welcome to Lab45.

An incubation space where our engineers and scientists fuel your innovation with ambition.

Tap into Topcoder.

The world's largest on-demand digital talent platform with 1.7M+ developers, designers, and data scientists.

Go cutting-edge with Wipro Ventures.

Our strategic investments that bring startup innovation to solve your enterprise challenges.

wipro

4

We design and build pathways to the future.

Empowering enterprises with AI-fueled innovation, platforms, and talent to drive agility, efficiency, and resiliency.

Engineering Edge

Create your engineering edge by leveraging ours

- Align science, technology, and domain expertise
- Digitalize faster with less cost and risk
  using connected platforms
  like IndustryDOT, 5G Def-I, and Cloud Car

FullStride Cloud

Accelerate and innovate as a full-stack, cloud-native enterprise

- Orchestrate ecosystems
- Uncover data insights with AI and ML
- Create the connected future with Wipro Cloud Studio

Consulting

Define and Design Business transformation.

- Access best-in-class business, design and technology minds from Wipro, Capco, and Designit.
- Engage domain experts to help you define, design, and deliver results.

Enterprise Futuring

Drive forward-looking, large-scale transformation

- The leader in next-generation Digital Operations and Platforms (DOP).
- Build foundational cybersecurity
- Gain advanced protection with CyberTransform and CyberShield

Microsoft   servicenow.   powered by SAP   Google   salesforce   aws

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3

Market scape

01.

wipro

The time is right for adoption of ORAN

Increasing consumption of Data | Integration of Cloud computing and AI | Deployment of 5G infrastructure

Market Share

Expanding Global O-RAN Market

Increasing 5G SA technology adoption across the globe is expected to fuel the market growth

Analysis by Rational Stat

Government initiatives for the deployment of 5G infrastructure are expected to fuel the growth

ORAN is Driving innovation and commercialization with interoperable products and systems

5G

Connectivity Technology

5G plays a dominant role

The global O-RAN market stands at $1B and is expected to grow to $15B by 2027*

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*Markets and Markets

Opportunities and Complexities

02.

wipro

Opportunities and Promise

Telco Priorities	O-RAN Promise

Telco Priorities

- Lowering the Total Cost of Ownership
- Reduced lock-in
- Faster Innovation
- Reduce complexity
- Scalable

O-RAN Promise

- Diversify the supplier eco-system
- Resiliency, Interoperability
- Programmability & automation of Network and Services
- Standards adoption and pretested, configurable industrialized solutions
- Disaggregation and Cloud Native operations

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Complexities and Considerations

While there are several potential benefits of Open RAN, multitude of challenges hindering its adoption and scaling.

- Performance of Open RAN Vs Traditional RAN systems

- Complexity and cost of integrating disaggregated system

- Overall maintenance & operational complexity of multi-vendor O-RAN solution

- Open RAN standards evolution and continuous adoption of vendor eco-system involved

- SLA / KPI ownership of integrated Open-RAN system

- RAN Infrastructures made up of multiple vendors' equipment increase threat surface areas.

Industry eco-system evolution, collaboration of industry players, advanced network automation using AI/ML, application of digital-twin technologies etc., would help in overcoming some of the above challenges.

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Our Value Proposition

03.

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We are an Expert at deciphering Customer Need

Your partner for answering Why, What and How

Maximizing uptime

Maintaining security

Eliminating connectivity dead spots

Staying connected even when the Internet is out

Prioritizing certain applications over others for connectivity, speed, or security

| Banking | Healthcare | Utilities | Manufacture |
| Retail | Automotive | Logistics | Government |

Spectrum availability

Hardware and devices

Cloud and edge services

Network model

Data processing

Security

Monitoring

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A mature, forward-looking ecosystem that's built for your success.

O-RAN, Open RAN & Private Network	MAVENIR	A(elleran Your Open RAN Delivered	celona	NERAGON	ASOCS A On-premise mobile clouds	facebook connectivity	TELECOM INFRA PROJECT	NOKIA
5G Packet Core	MAVENIR	CISCO	NERAGON	affirmed	ATHONET			
Radio Units	NEC	Benetel	COMMSCOPE	Comba	KMW	Tecore networks	SANMINA	JRC · BaiCells · SERCOM · FUJITSU
EDGE & Orchestration	DELL	Hewlett Packard Enterprise	NVIDIA.	IBM	alef	ROBIN	ONAP · Open Source MANO · ciena · CISCO · netYCE	
Infrastructure Networks	OPEN Compute Project	NUTANIX	Hewlett Packard Enterprise	JUNIPER NETWORKS	CISCO	Infinera	exaware · Red Hat · DELL EMC · vmware · intel	
Testing	headspin	VIAVI VIAVI Solutions	ROHDE&SCHWARZ	ixia	spirent Promise Assured	KEYSIGHT		
GTM Partners	AT&T	MAVENIR	DELL	Hewlett Packard Enterprise	dish	Deutsche Telekom	Telefónica · Telstra · intel · NOKIA	
Hyperscalers	aws	Azure	Google Cloud					
Sustainability	Microsoft · SimaPro	SAP · treeni	Greenstone Data that talks to you · enablon	enVizi An IBM Company · ProcessMAP	TRIRIGA An IBM Company · cority	GaBi Product Sustainability Performance · sphera	INTELEX · IHS Markit	FIRSTCARBON SOLUTIONS · salesforce

Success Stories

04.

wipro

Success Stories in ORAN domain

O-RAN R&D Services delivered to leading O-RAN product vendors:
- O-RU 7.2 compliant Macro Radio product design
- O-Cloud Edge Server Platform design using latest Intel Processor
- Fronthaul GW, O-DU / O-CU Aggregation routers design for D-RAN , C-RAN deployments
- O-RAN O-DU/O-CU SW Features Design & Development
- O-RAN Service Management & Orchestrator Product design

O-RAN System Integration services delivered to leading Telcos
- Multi-Vendor O-RAN integration and validation for an European Telco
- rApps design & development, O-RAN solution integration for a North American Telco

Contributions Open Eco-system
- Gold member in ONAP community, co-lead Network Slicing & SON Features for last 3 years. Complete ownership of RAN Simulators to test ONAP system
- O1 I/F standardization contributions from ONAP community

Wipro Investments in R&D of O-RAN Products
- O-DU/O-CU reference stacks on Intel Flex RAN Platform
- rApps / xApps reference use-cases on NVIDIA GPUs
- 130+ 5G Patents files & 70+ Patent grants

We have played ssignificant role in building E2E integration test labs, architecture blueprints, automation using AI/ML and AI Ops solutions to reduce overall TCO of Open RAN for operators.

wipro

The definition of tech for good.

We're the only tech company majority-owned by a philanthropy—the Azim Premji Foundation, serving some of the most disadvantaged populations in the world.

When you work with us, you're not just transforming your business. You're helping change the world.

Azim Premji Foundation

$29b of founders' personal wealth irrevocably pledged
66 cents for every $ earned by Wipro goes to the foundation

Our 5G Def-i Innovation Center can help you define your strategy and accelerate connectivity.

Our Austin-based collaborative space helps make your products and services more safe, sustainable, and compliant by:

- Certifying 5G smartphones, tablets, modules and IoT endpoints

- Qualifying 5G mobile network infrastructure and performance

- Offering fully integrated solutions such as 24x7 product qualification, compliance, pre-certification, and interoperability testing

Engineering

Wipro's 5G Def-i Innovation Center Opens in Austin, TX

Leaping Forward with Open RAN

Ganesh Shenbagaraman
Head of Standards, Regulatory Affairs & Ecosystems

DNA of Open Telecom Solutions

TELECOM INFRA PROJECT

- LTE eNB RAN system integrator in TIP
- Projects at Menlo Park, SKT, TIM (Italy)
- 5G Open RAN community lab contribution

Small Cell Forum

- Leader of 5G nFAPI standardization
- Award for Open RAN contributions – 2020, 2021, 2022

SCF 2020
Winner
Outstanding Contribution to Open RAN and Core Platforms and Ecosystems

O-RAN ALLIANCE

- Co-chair of O-RAN WG8 since 2019
- Key contributions to WG3: E2SM and E2AP
- Contributions in TIFG, WG5 and WG6
- Project lead of Open source 5G DU

Open Networking Foundation

- Open-source EPC contribution to M-CORD
- Founder member of SD-RAN: Multi-vendor O-RAN trial at DT

Additional Key Organizations

Open RAN POLICY COALITION

THE LINUX FOUNDATION

OnGo alliance

Open Platforms | Open Architectures | Open Source | Open Integration

5G RAN Software Suite on multiple platforms

Radisys

5G Open RAN Software
on multiple platforms

Integrated on Multiple SoCs,
Hardware and Cloud Platforms

Scalable End-to-End

Flexible Architecture

Network in a box
Femtocell
- 16/32 UEs
- >1 Gbps

Enterprise
Small cell Indoor
DU
- 64/128 UEs
- 2 Gbps

Outdoor Micro
CU+DU
- 256 UEs
- 2 Gbps

Tower bottom
CU+DU
Multi-cell CA
- 2000 UEs
- Multi Gbps

vCU and
vDU (CNF)
Multi cell CA
- Scale in/out
- Multi Gbps

Open RAN in 2023: Forces driving the momentum

Network transformation underway

Radisys

Vendors
- Open RAN portfolio and interops
- HW/SW Decoupling
- COTS and vRAN offering
- Consortiums

Telcos/Pvt NW
- Steering industry forums
- Extensive trials/Early deployments
- Collaborations with vendors
- Vision for AI, Green 5G/6G

5G FWA Enabled Broadband – Licensed (FR1/FR2) and CBRS Bands
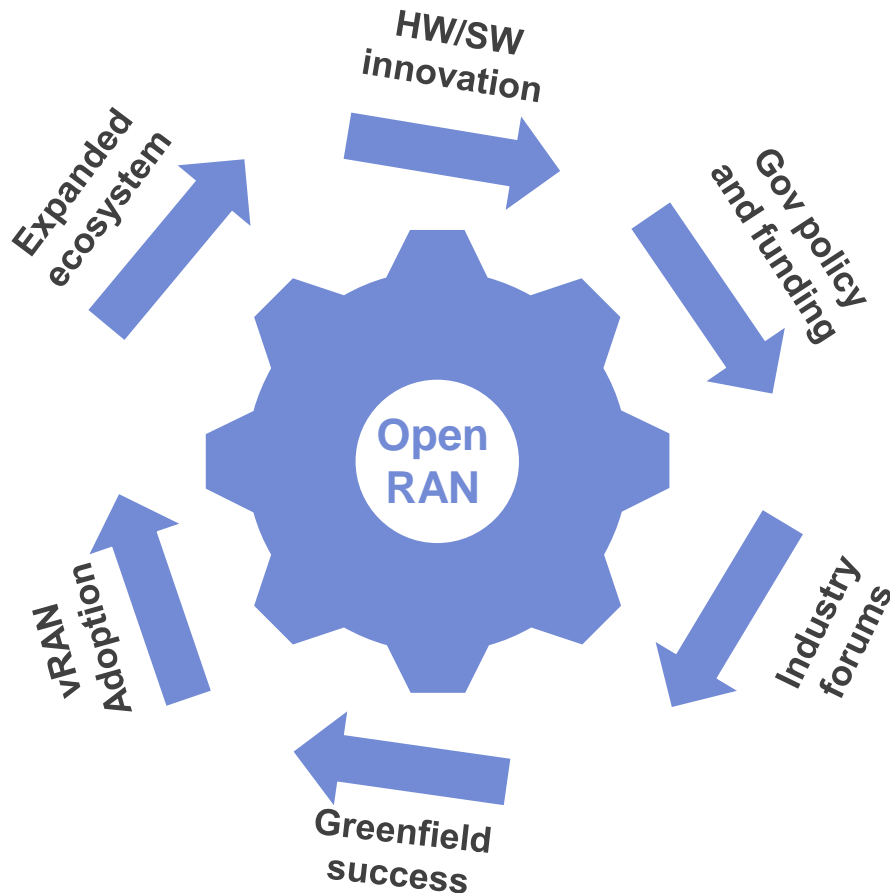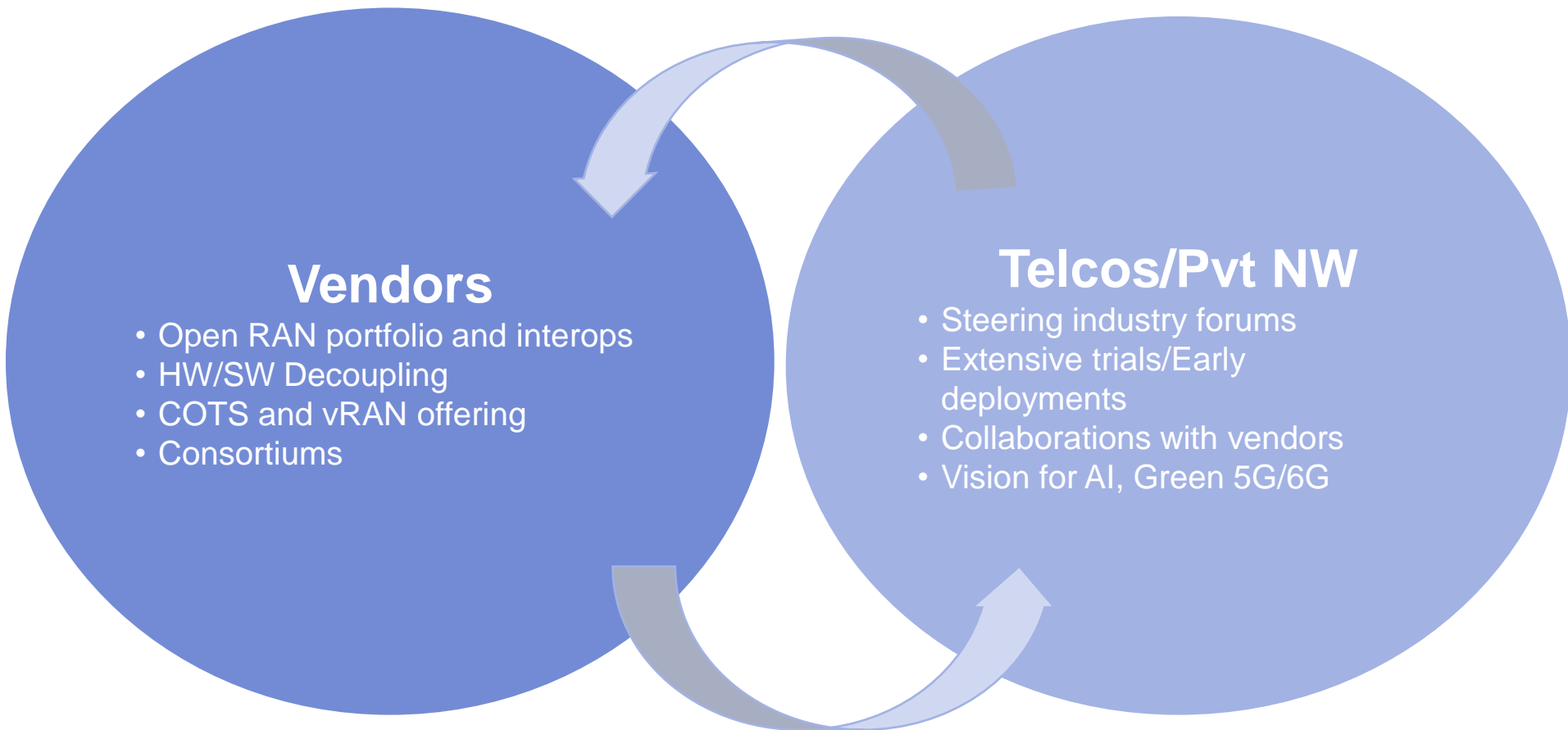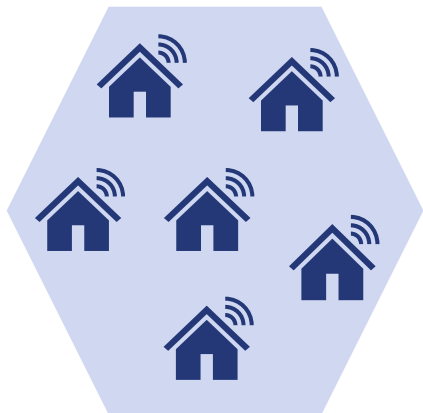
- FR1 and CBRS Deployments
- O-RUs in multiple bands
- CU+DU at tower bottom
- CPE devices connecting homes
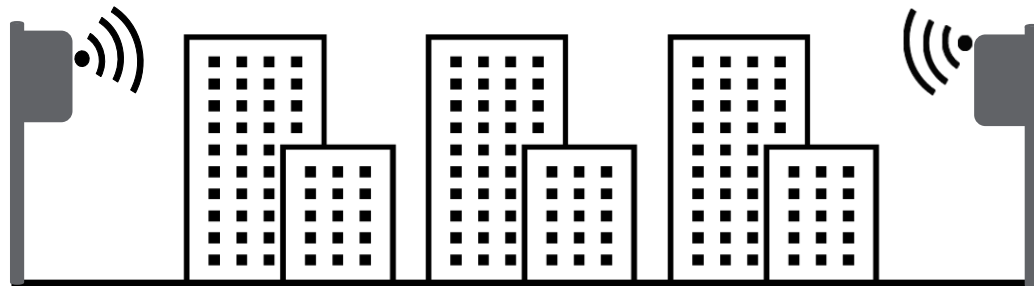
- FR2 based ultra high bandwidth deployments
- Small Cells/Micro O-RUs in FR2 bands

Macro and Edge Deployments – Leveraging Disaggregation

DU CU at Tower bottom	CU @ Edge	DU and CU @ Edge	IBS

RU2 RU1 RU3

DU, CU

RU2 RU1 RU3

DU

CU @ Edge as Cloud Native

RU2 RU1 RU3

DU and CU @ Edge as Cloud Native

Low Power RUs

DU

CU @ Edge as Cloud Native
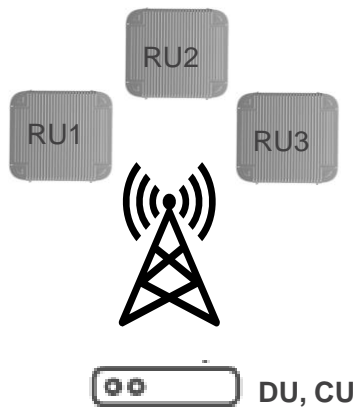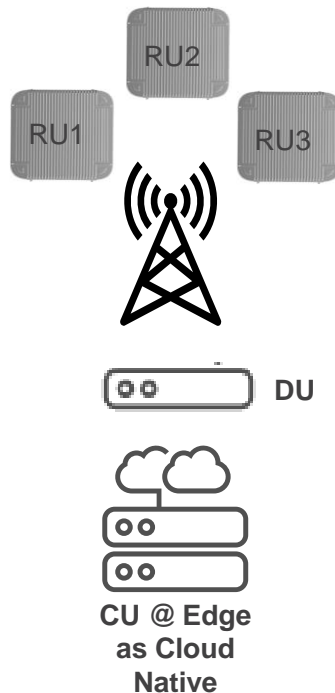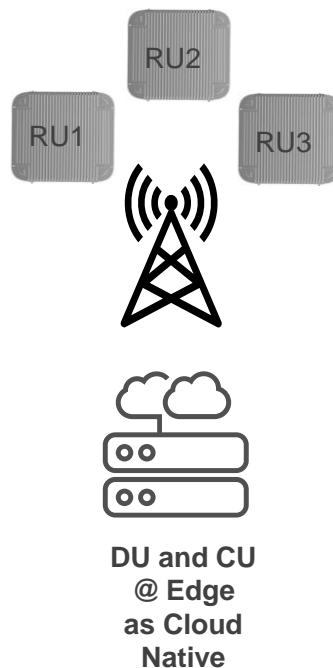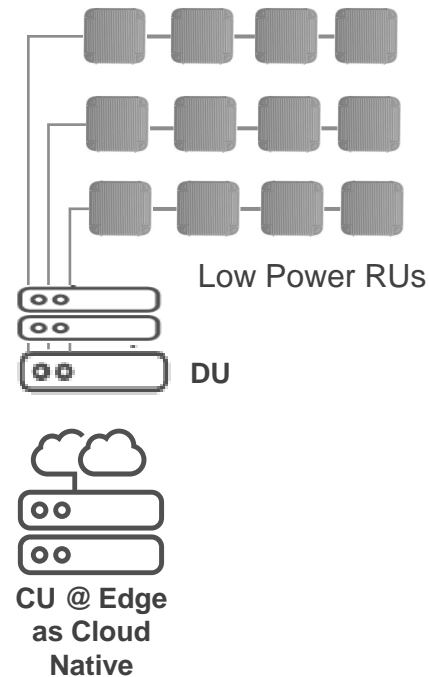
Deployment Scenarios: Urban/Rural Coverage Solution, In-building and Neutral Host

Unleashing the power of 5G SA: Industrial deployments

Radisys

Industrial Apps

5G SA Core

gNB (5G)
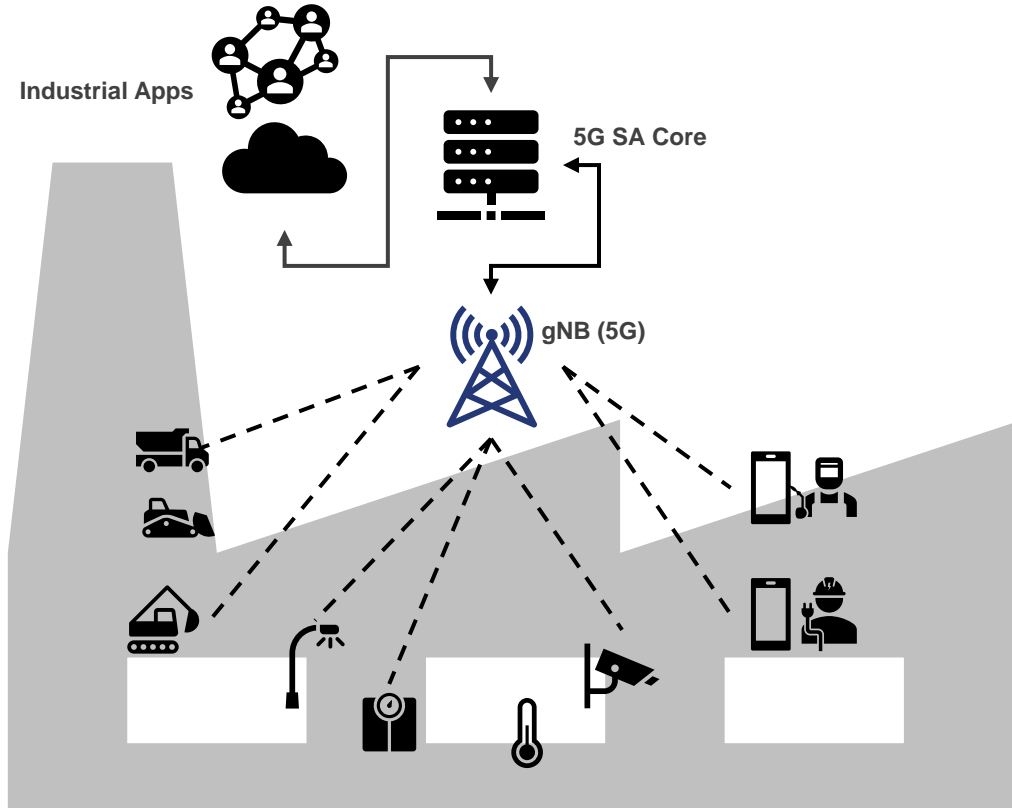
- URLLC and TSN
- IoT Devices
- Precision location
- Slices for differentiated services
- Local processing of data

Future Forward: Revving up with 5G SA

Radisys

3GPP/O-RAN Features

Red Cap Devices   NW Slicing   COMP   NR-U

5G Satcom   IAB   URLLC   Enhanced MIMO

TSN   AI/ML   xApps/rApps   NW Energy Savings

RAN Infra Components

Cloud Infra   vRAN   Edge processing   Security

O-RUs   RICs   RAN Automation   SMO

COTS HW   Accelerators   SmartNICs   Real Time OS

Thank You

Empowering Mobile Operators: NTT DOCOMO's new Open RAN service

Sadayuki Abeta
NTT DOCOMO

DOCOMO, as a service provider,
offers true Open RAN solutions to overseas operators.

Global Strategy

B2B2X Business

Smart Life

Open RAN

Open RAN solutions
OREX Packages

Overseas operators

DOCOMO's OREX Packages, a new network experience to the world.

OREX Packages
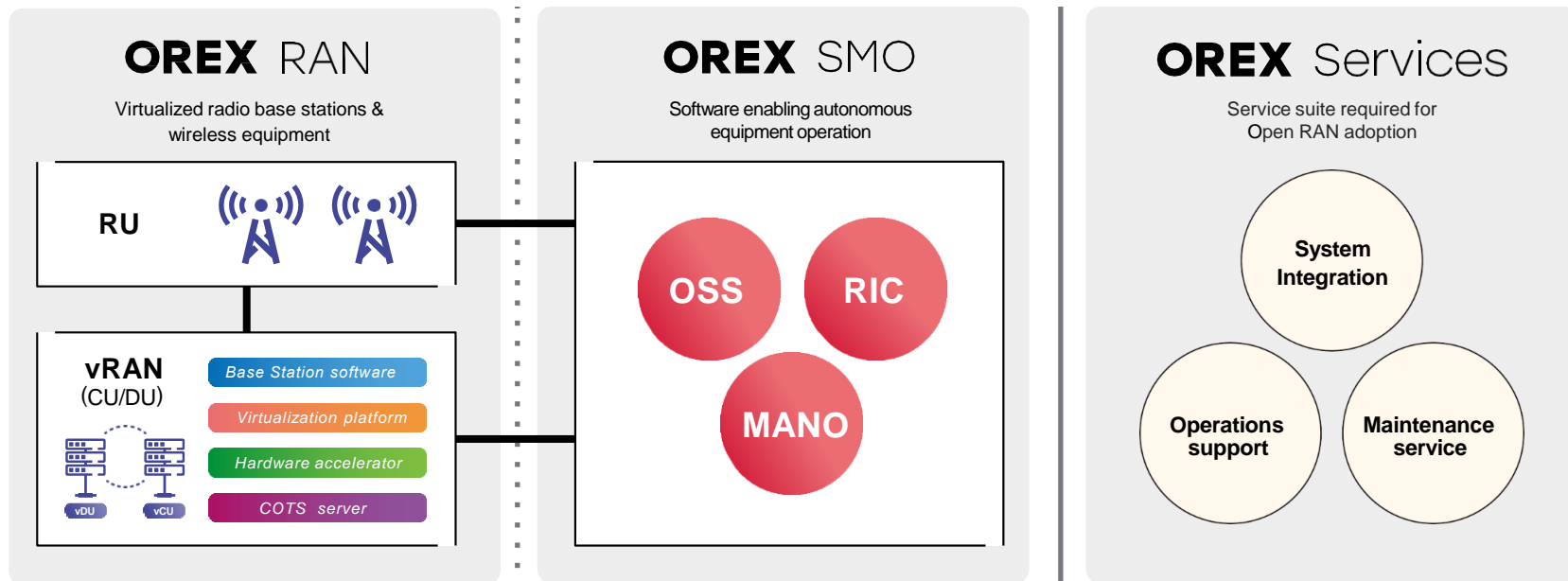
Together with OREX PARTNERS to fulfill our clients' needs
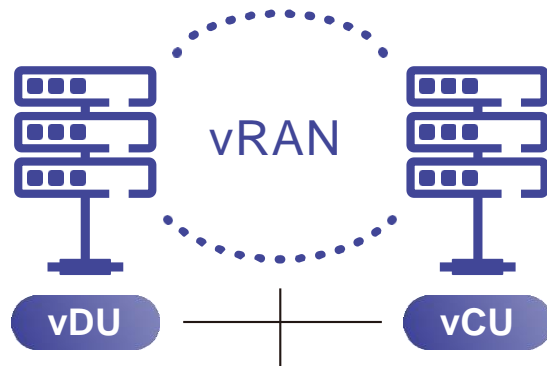
Highlighting OREX's Benefits

TCO
(total cost of ownership)

Up to

-30%

Power consumption

Up to

-50%

Network design operation

Up to

-50%

Overseas operators will now have a richer lineup with the OREX offering.

This September, DOCOMO began operating on its own network.
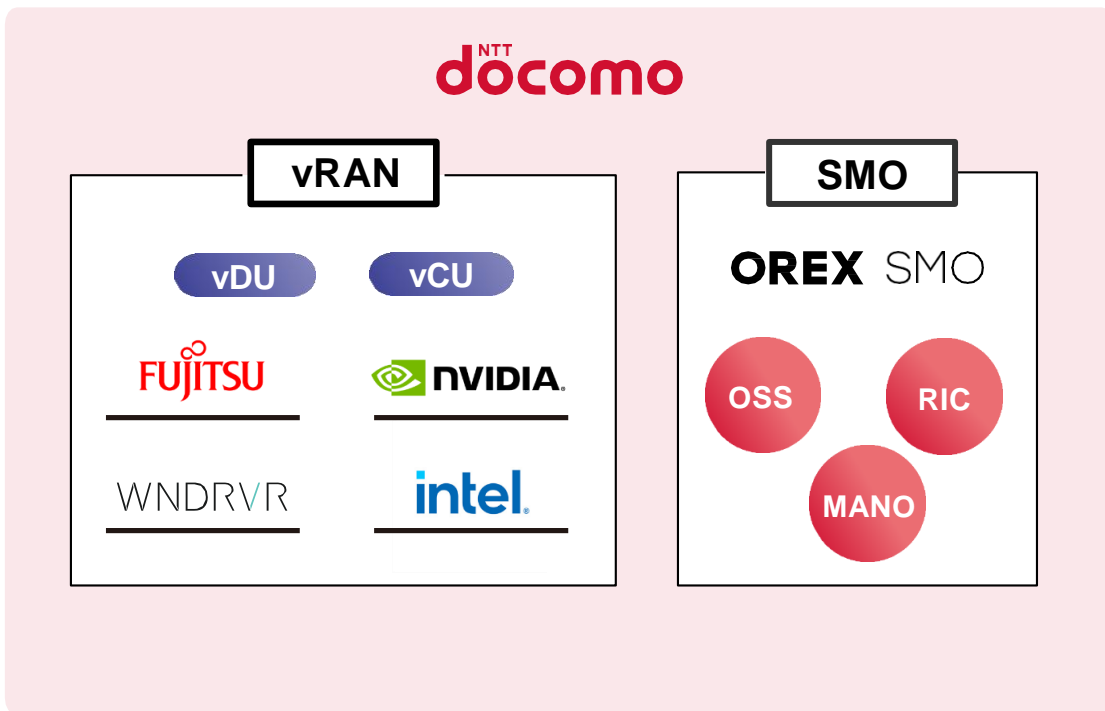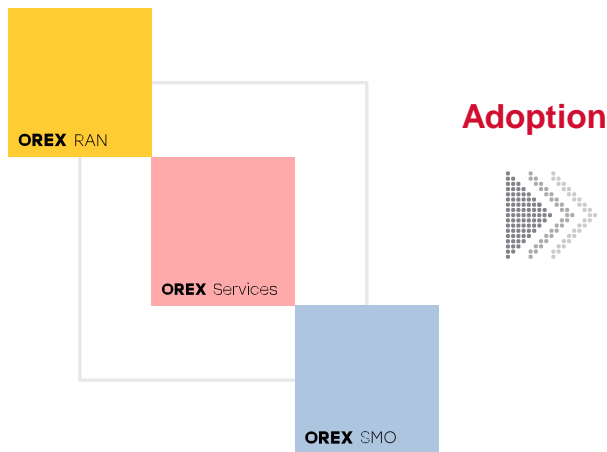
Continuous improvement through operational experiences.

OREX Packages

OREX RAN

OREX Services
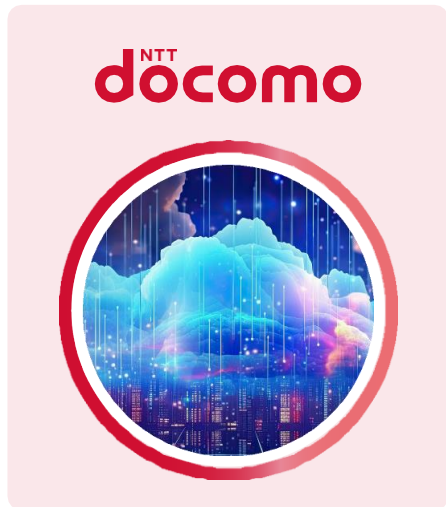
OREX SMO

Incorporation of Tuning Results
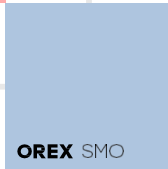
Upgrade and provide

Overseas operators

Panel members

Panel moderator

Lourdes Charles
Wipro

Manish Singh
Dell Technologies

Geoff Hollingworth
Rakuten Symphony

Sameer Vuyyuru
AWS