Panel Discussion

EDGE

Azita Arvani
General Manager, Rakuten Symphony

Kaustubh Joshi
Director - Inventive Science, AT&T

Don Tirsell
Head of Telco Industry Partnerships, Google

Jim Nelson
OCP Edge Co-Lead, Flex

OPEN COMMUNITY®

OPEN POSSIBILITIES.

OCP GLOBAL SUMMIT
NOVEMBER 9-10, 2021

Agenda

5G Cloud and vRAN architecture with Disaggregation

Challenges facing 5G vRAN Providers

- Panel Discussion

Question and Answers

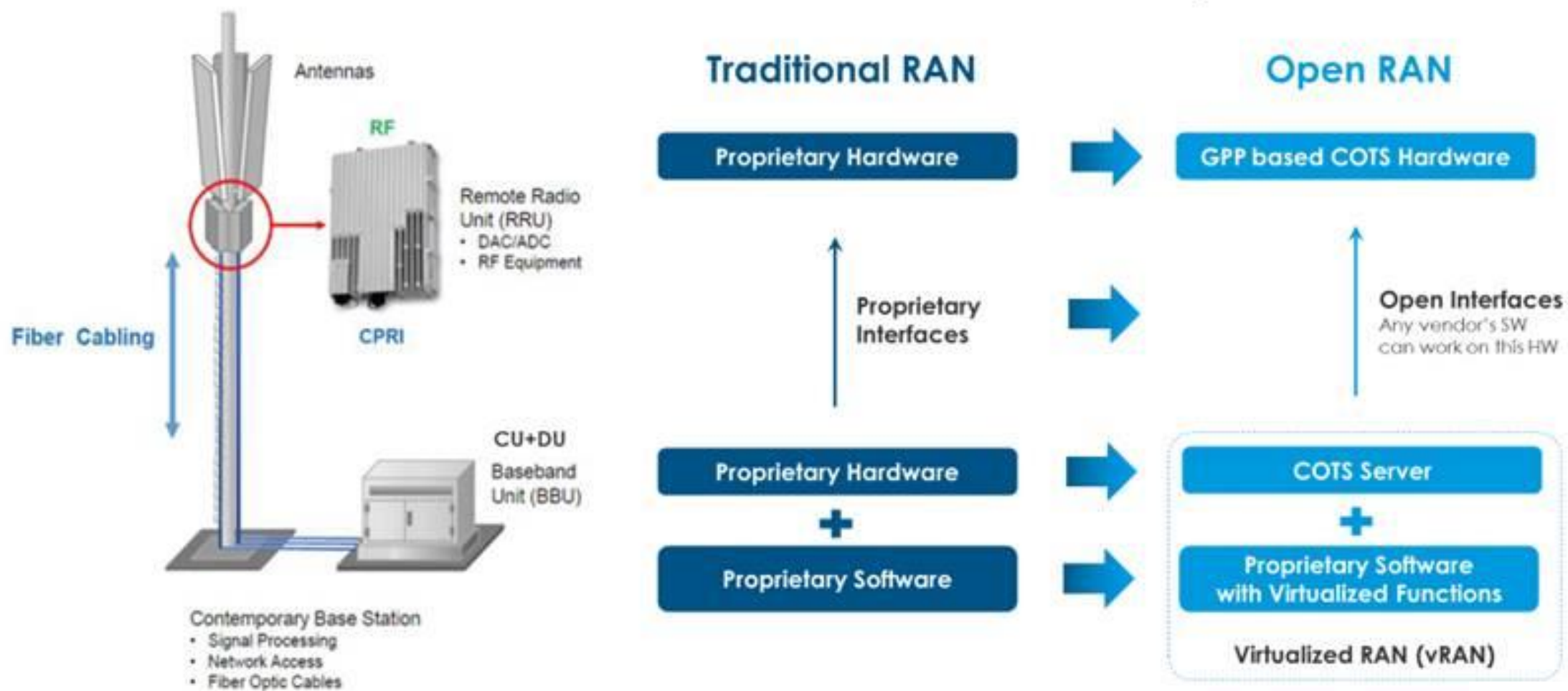# Disaggregation Opportunity for 5G vRAN

Traditional RAN vs Virtualized RAN vs Open RAN

Challenges facing 5G vRAN Providers

vRAN Providers are not alone in dealing with the growing demands on data centers and edge infrastructure, however vRAN Providers challenges are more pronounced, more extreme, due to more users, more services and more servers.

Time to market	**Customized solution**	**Global flexibility**	**Value Delivery**	**Sustainability**
Exceeding TTM expectations to hit the opportunity window and beat competition to service deployment	New workload and software demands require specialized hardware designs to right-size solutions	Data localization laws regulating the storage and transmission of data require a global strategy	Heavier workloads from AI/ML applications are demanding greater processing power balanced by TCO	Advance environmental goals to reduce carbon emissions and improve energy efficiency

OPEN POSSIBILITIES.

Disruption-as-a-Service

Azita Arvani
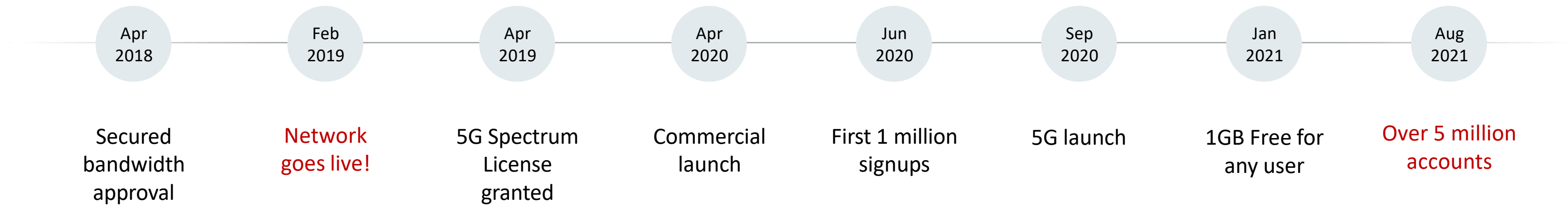GM, Rakuten Symphony

Rakuten Symphony

A young company already transforming the Telco industry

Apr 2018	Feb 2019	Apr 2019	Apr 2020	Jun 2020	Sep 2020	Jan 2021	Aug 2021
Secured bandwidth approval	Network goes live!	5G Spectrum License granted	Commercial launch	First 1 million signups	5G launch	1GB Free for any user	Over 5 million accounts

Four strategic innovations enabling transformation
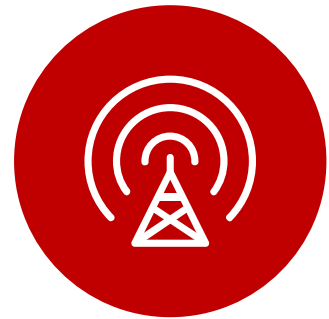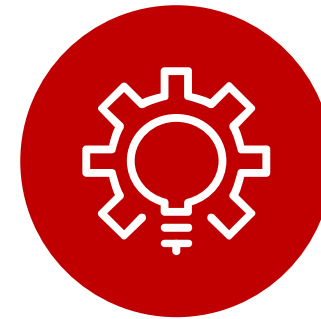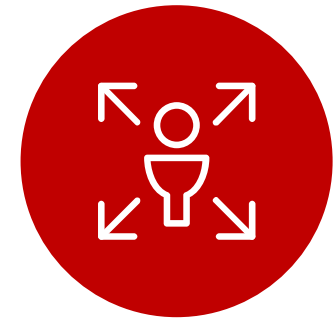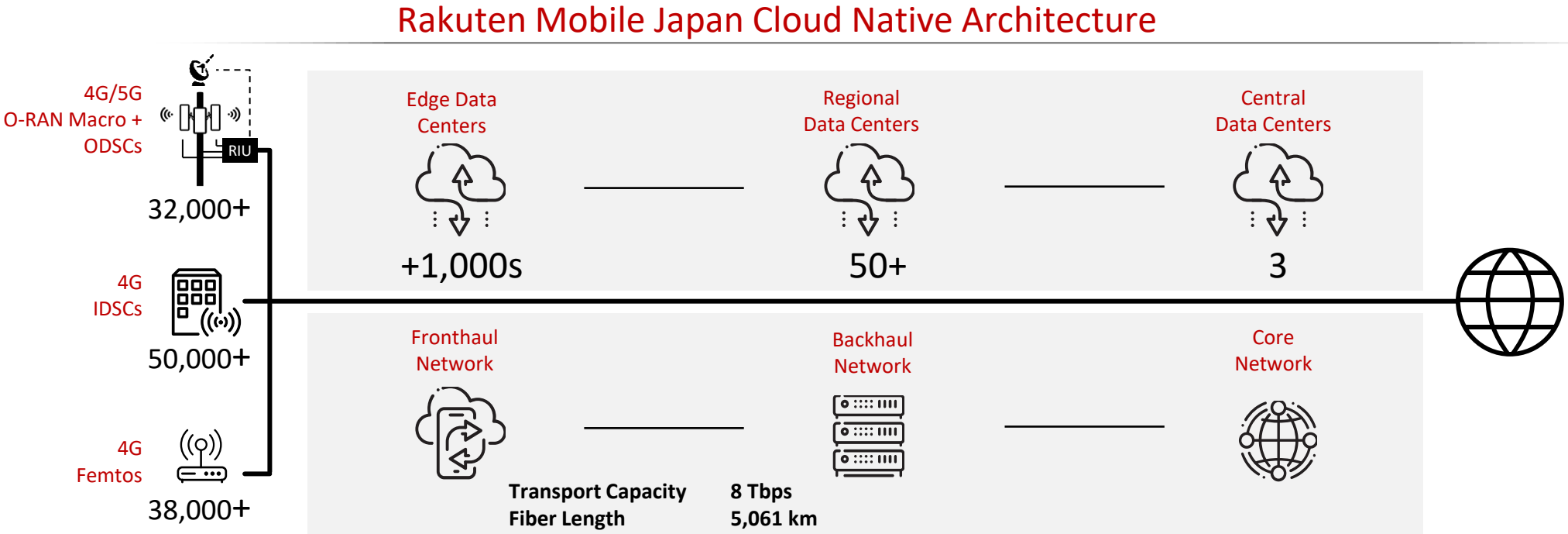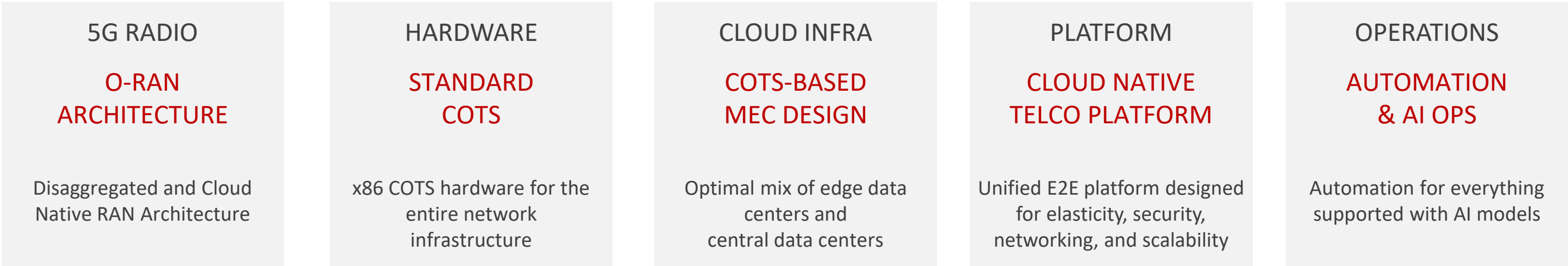
Disaggregated Radio
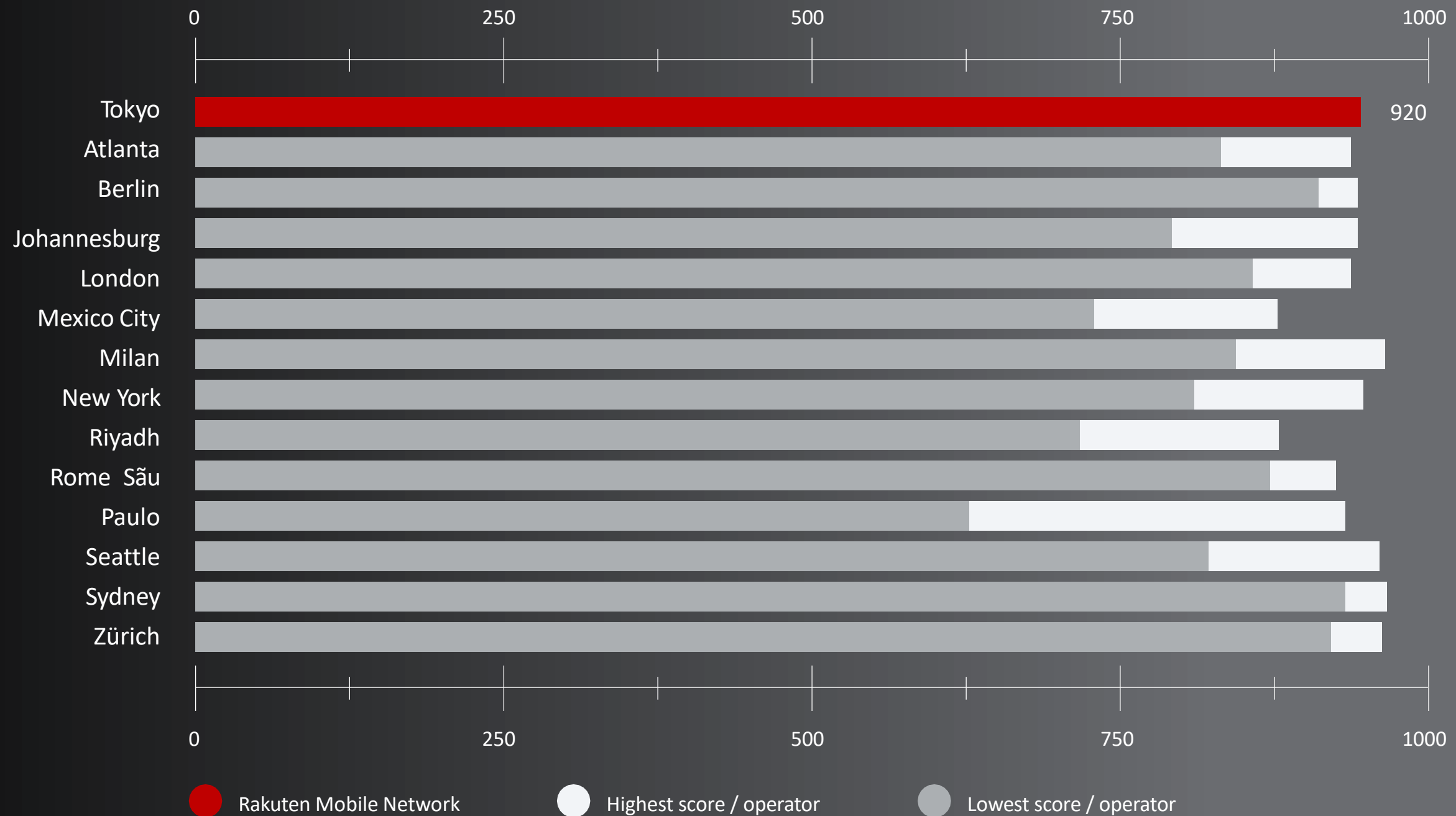
Unified Cloud

Massive Automation

Platform Organization

Our architecture vision and design principles

5G RADIO	HARDWARE	CLOUD INFRA	PLATFORM	OPERATIONS
O-RAN ARCHITECTURE	**STANDARD COTS**	**COTS-BASED MEC DESIGN**	**CLOUD NATIVE TELCO PLATFORM**	**AUTOMATION & AI OPS**
Disaggregated and Cloud Native RAN Architecture	x86 COTS hardware for the entire network infrastructure	Optimal mix of edge data centers and central data centers	Unified E2E platform designed for elasticity, security, networking, and scalability	Automation for everything supported with AI models

Rakuten Mobile Japan Cloud Native Architecture

4G/5G O-RAN Macro + ODSCs — RIU — 32,000+

4G IDSCs — 50,000+

4G Femtos — 38,000+

Edge Data Centers — +1,000s
Regional Data Centers — 50+
Central Data Centers — 3

Fronthaul Network
Backhaul Network
Core Network

Transport Capacity — 8 Tbps
Fiber Length — 5,061 km

Ranked among the best networks of the world

Legend:
- **Rakuten Mobile Network** (red)
- **Highest score / operator** (white)
- **Lowest score / operator** (grey)

Cities: Tokyo (920), Atlanta, Berlin, Johannesburg, London, Mexico City, Milan, New York, Riyadh, Rome, Sãu Paulo, Seattle, Sydney, Zürich

Axis: 0, 250, 500, 750, 1000

Rakuten Mobile named a 5G Global Leader

OpenSignal 5G Global Mobile Network Experience Awards 2021
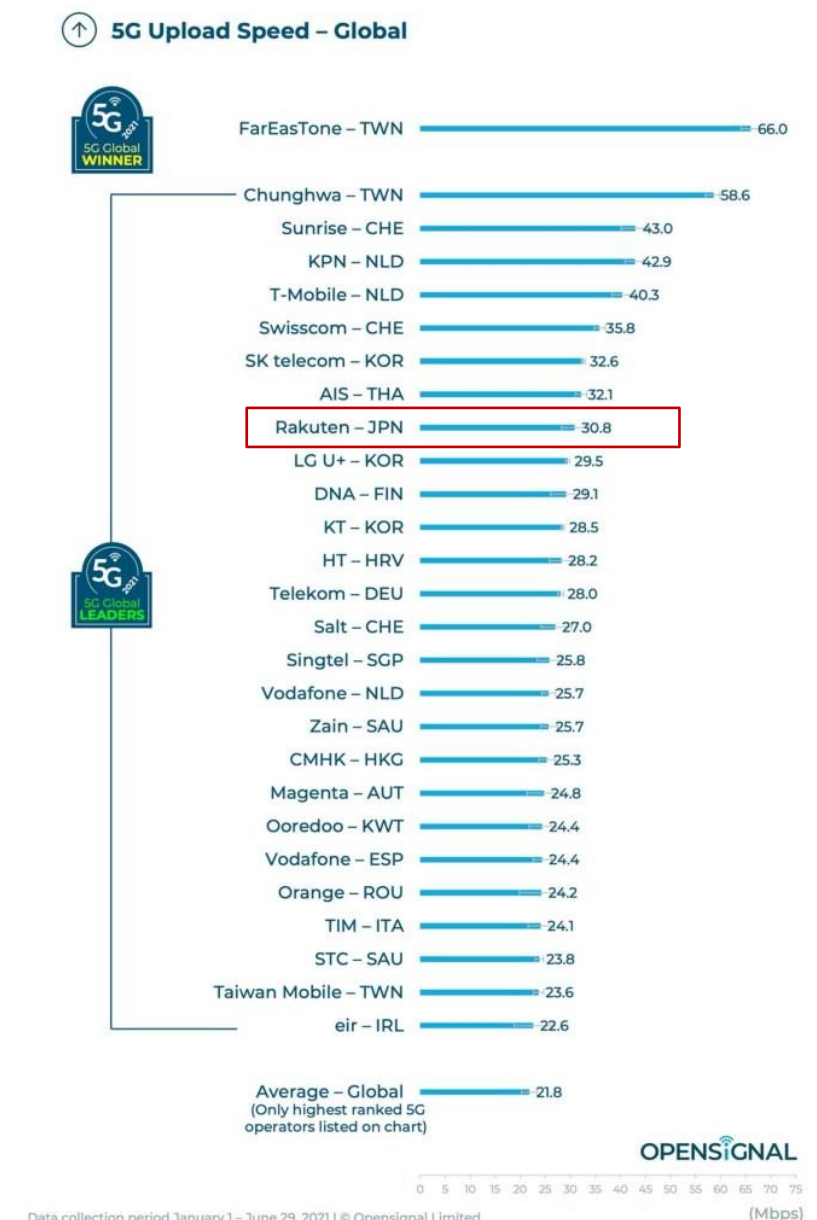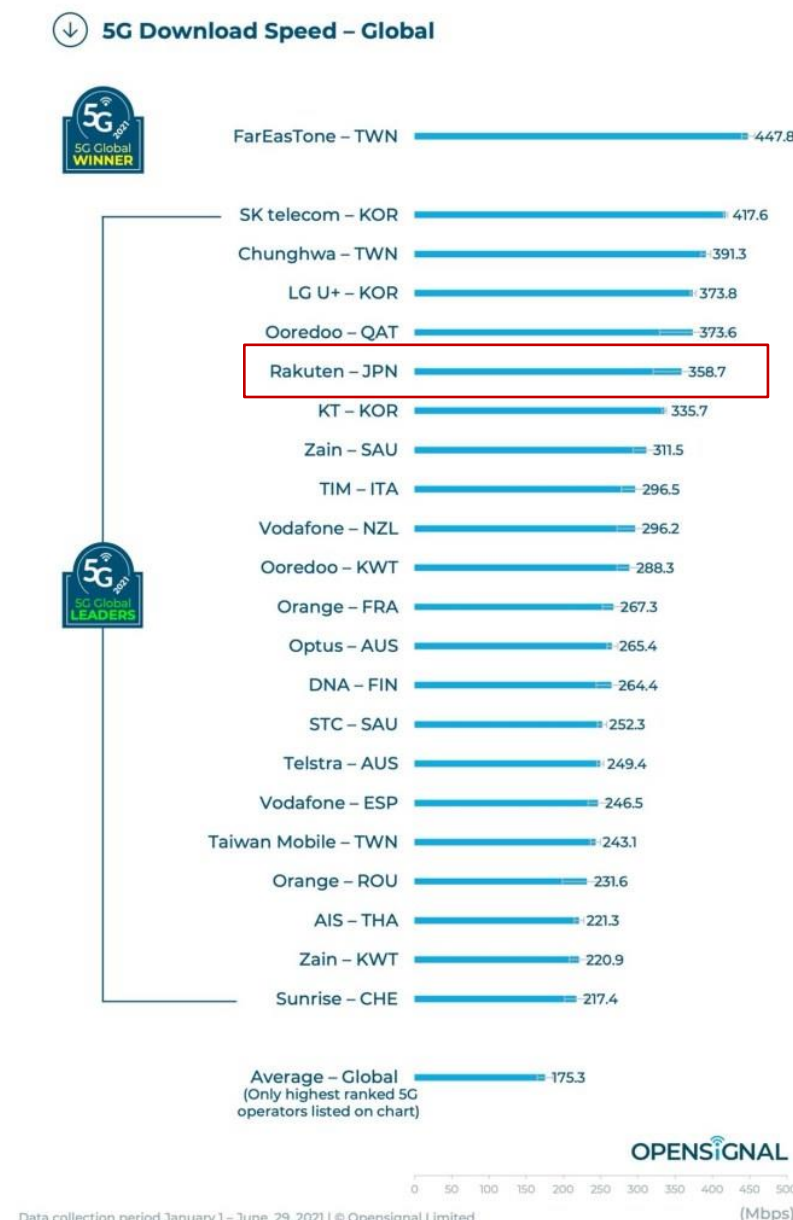
Rakuten Symphony

Vision
Connect everything to fulfill its potential for a sustainable future

Purpose
Empower industries, societies and individuals to transform themselves through cloud, edge and automation technologies

Rakuten Symphony

Organized around five unique business opportunities

Internet & Ecosystem Services	Membership & Loyalty Platforms	Media & Gaming Platforms	Payment & Finance Platforms
Digital Experience	Business Support System	Marketplace	
Intelligent Operations	Operation Support Systems	Network & Service Orchestration	Automation & Artificial Intelligence
Network Functions	RAN	CORE	EDGE
Unified Cloud	Cloud Infrastructure	Cloud Orchestration	

Collaboration in Technology and Policy Groups

Rakuten Symphony is designed and built upfront as a platform to enable co-innovation and openness

Leveraging open-source technology across the board as a critical enabler to drive innovation and openness:

Actively driving and **co-innovating on key industry** cloud native open source initiatives such as:

TELECOM INFRA PROJECT

O-RAN ALLIANCE

Open RAN POLICY COALITION

CLOUD NATIVE COMPUTING FOUNDATION

Creating a **global network of co-innovation labs** with Rakuten Symphony customers:

Tokyo

San Mateo

Rome

Bangalore

Singapore

Leading OpenRAN greenfield competition

Driving brownfield telco transformation

OpenRAN Greenfield Innovators

Early Brownfield Adopters

Majority Operators

Rakuten Mobile

1&1

dish

Telefónica

etisalat

stc

2019

2021

2023

2025

15

Road to vRAN

Kaustubh 'KJ' Joshi, Director – AT&T Labs

Nov 10, 2021

AT&T's road to vRAN
State of the Union
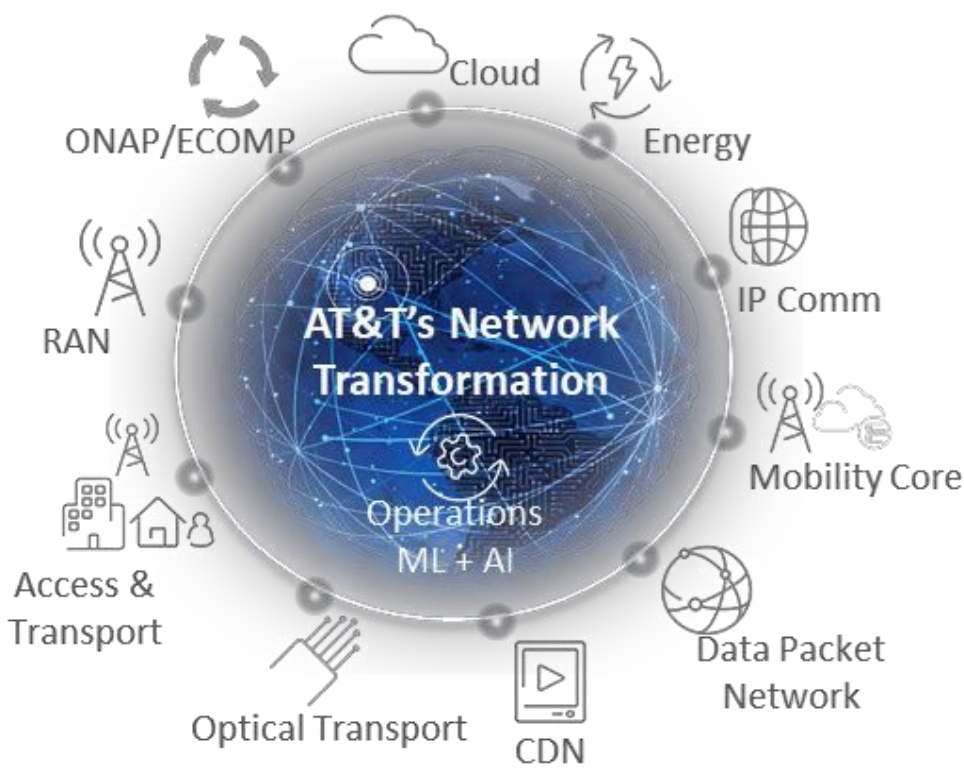
75% core network virtualized by 2020 [1]

=> RAN is next

Nation's best 5G network [2]
100M+ devices, 250M covered by 5G

Aggressive C-band rollout
70-75M covered by 2022, 200M by 2023 [3]

Early days for VRAN
FDD stable, TDD maturing

Brownfield is critical
Seamless customer experience, integrity

Previous announcements
Early pilots and partners

More will follow

Cloud RAN goes prime time as Nokia and AT&T prove fully virtualized capabilities

by Mark Atkinson
5 Mar 2021

AT&T Moves 5G Mobile Network to Microsoft Cloud

Intel announces new projects with AT&T, Google Cloud, FedEx

Intel said its hardware is involved in a slate of new projects ranging from university research to autonomous FedEx delivery robots.

By Jonathan Greig | October 27, 2021 | Topic: Intel

Intel announced a new pact with AT&T that will see the company provide silicon to deploy the telecom's virtualized radio access network (vRAN).

HARDWARE
What does this black dot on the iPhone do?
Raspberry Pi Zero 2 W

COHESITY
We Have Your Cloud Covered

AT&T's Road to vRAN
The deployment perspective

Life's great …

H/w supply chain - more choices, different power/perf tradeoffs

Rapid h/w improvement

More deployment flexibility

Automation

Open interfaces

Could be better …

VRAN s/w feature parity

Brownfield interop - complex classic/VRAN interactions - DSS, CA, CU-DU vs integrated

Manage 3 lifecycles instead of 2 – ZTP critical

RAN/cloud cross-layer observability

Integration/certification

H/w diversity – avoid stranding

Large silicon diversity
CPU ISA, FEC or PHY accel, NICs (LLS-C1 vs C3)

RAN is highly distributed
400,000+ cell sites across all US carriers [1]
25,000+ COs (potential CRAN hubs) across all US carriers [1]

RAN more s/w defined
RAN, management, automation

Significant YoY h/w improvements in cap/power

Multi-year spectrum rollouts

S/w investments must be preserved despite h/w diversity

The ideal VRAN server:

Stable interchangeable exterior

Diverse & innovative interior

Opportunity for open source & standards

(1) https://api.ctia.org/wp-content/uploads/2021/07/CTIA-2021-Annual-Survey-Highlights_0727Update.pdf

AT&T

Opportunities for open source & standards – h/w interoperability points
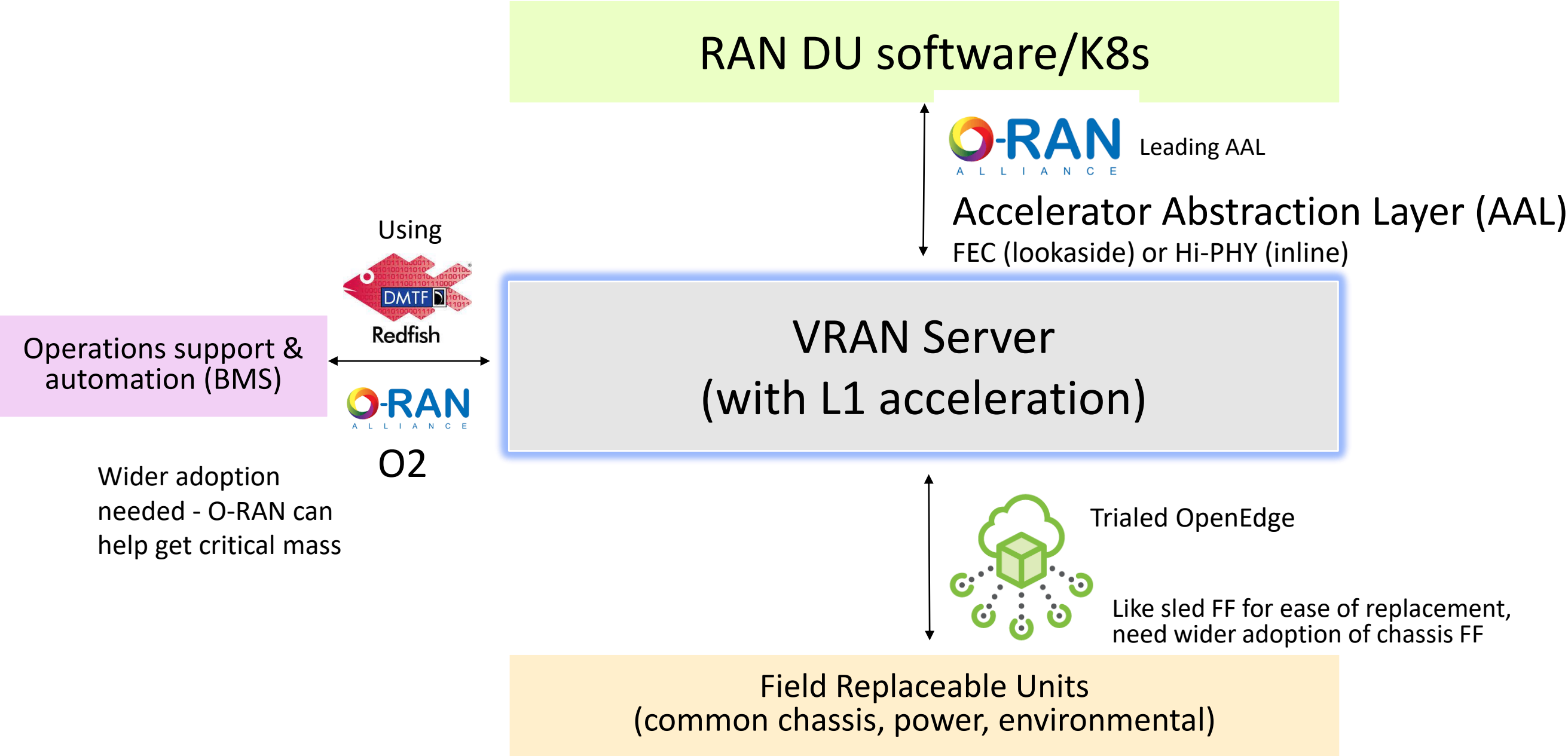
RAN DU software/K8s

O-RAN ALLIANCE — Leading AAL

Accelerator Abstraction Layer (AAL)

FEC (lookaside) or Hi-PHY (inline)

Using

DMTF Redfish

Operations support & automation (BMS)

O-RAN ALLIANCE

O2

Wider adoption needed - O-RAN can help get critical mass

VRAN Server
(with L1 acceleration)

Trialed OpenEdge

Like sled FF for ease of replacement, need wider adoption of chassis FF

Field Replaceable Units
(common chassis, power, environmental)

Google Cloud - Network News
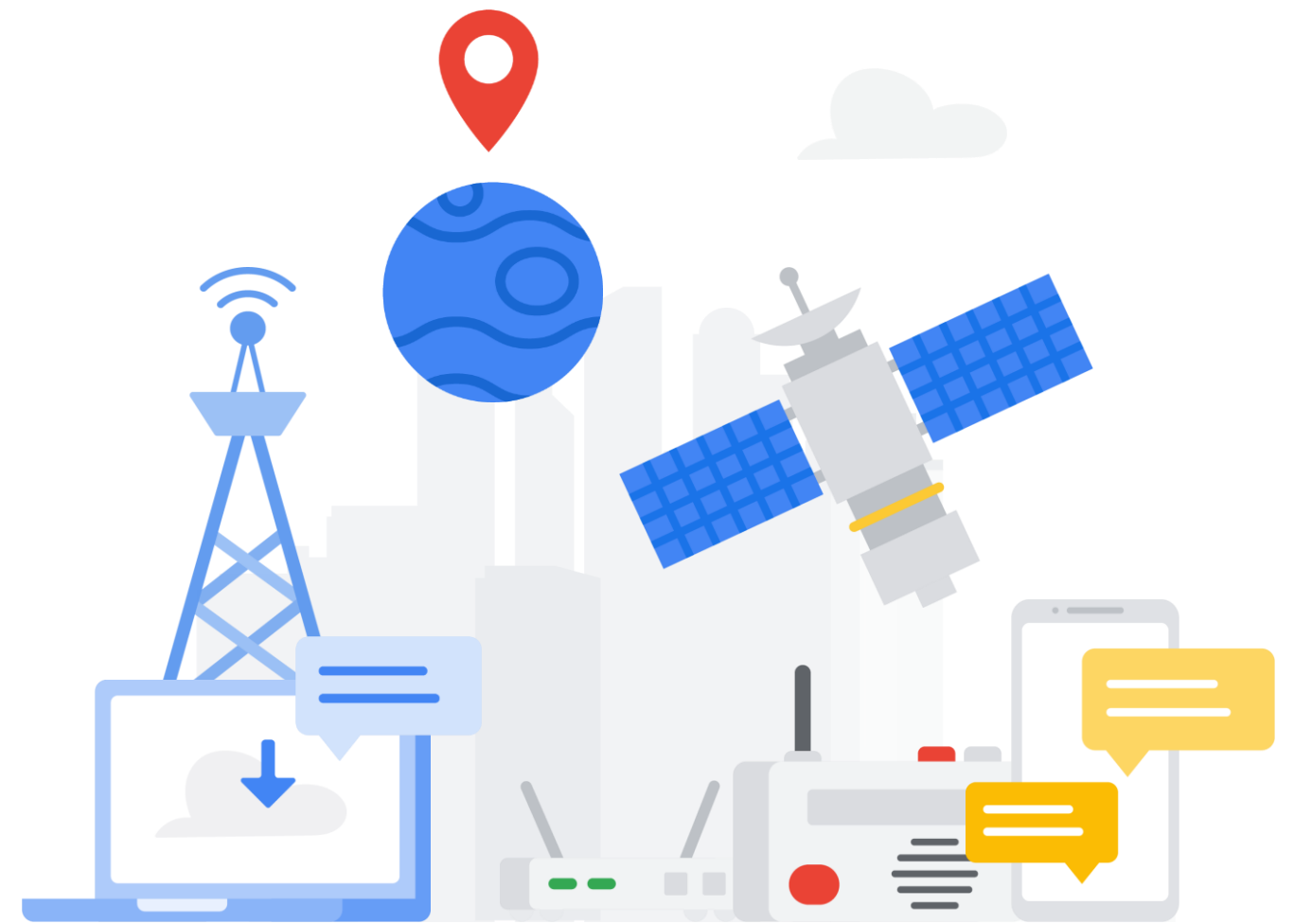
INSIDE GOOGLE CLOUD

Google Cloud unveils strategy for telecommunications industry

Thomas Kurian
CEO, Google Cloud

March 5, 2020

We know that telecommunications companies continue to face pressures to digitally transform. Not only are rapid technology advancements disrupting the industry—the rise of 5G and network-centric business models, for example—but also new connected devices and applications have dramatically raised consumer expectations. Many of these disruptors also offer significant possibilities for business transformation, so I'd like to share how Google Cloud is partnering with telecommunications companies to tap into these opportunities.

Contact Sales

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casa systems

NEWS RELEASE

Casa Systems Extends 5G Standalone Core Availability to Google Cloud's Anthos

- First demonstrable integration of Casa Systems' cloud-native 5G standalone core platform with a hyperscale public cloud
- Showcases 5G Core control and user plane separation performance across hundreds of miles for improved user experience and application performance
- Delivers ultra-low latency with reduced end-to-end delivery costs and creates a path to 5G network deployment with centralized control and edge-based delivery intelligence

ANDOVER, Mass. – June 9, 2021 – Casa Systems, Inc. (Nasdaq: CASA), a leading provider of cloud-native infrastructure technology solutions for mobile, cable and fixed networks, today announced a new partnership with Google Cloud and the delivery of its cloud-native 5G Standalone (SA) Core on Google Cloud's Anthos for single pane-of-glass management. Working closely with engineers in Google Cloud's ISV/SaaS Centre of Excellence, the field-tested solution successfully demonstrated the power of control and user plane separation of Casa Systems' cloud-based 5G SA Core across hundreds of miles, driving down application latency to 10 milliseconds and reducing the end-to-end delivery cost up to 25% using local application hosting.

TELECOMMUNICATIONS

Google joins the O-RAN ALLIANCE to advance telecommunication networks

Amol Phadke
Managing Director, Telecom Industry Solutions at Google Cloud

Ankur Jain
Distinguished Engineer, Google Cloud

June 28, 2021

At Google, we believe that co-innovation with customers, partners, and technology vendors as part of a broader ecosystem is critical to accelerating industry digital transformation. From our contribution to open standards, to our commitment to open source and our continued focus and expansion of Google's vibrant partner network, we are committed to drive transformative change in telecommunications.

Since announcing our comprehensive strategy for the telecommunications industry in 2020, we've been working closely with customers, partners, and industry bodies globally to help transform the industry together. Today, we're excited to take another step forward and are proud to announce that we are joining the O-RAN ALLIANCE, which is a world-

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HYBRID & MULTICLOUD

Introducing Google Distributed Cloud—in your data center, at the edge, and in the cloud

Google Cloud
Next '21
Solving for what's next
October 12-14

Sachin Gupta
GM and VP of Product for IaaS

October 12, 2021

Now more than ever, organizations are looking to accelerate their cloud adoption. They want easier development, faster innovation, and efficient scale, all while simultaneously reducing their technology risk. However, some of their workloads cannot move to the public cloud entirely or right away, due to factors such as industry or region-specific

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Nokia and Google Cloud partner to develop new, cloud-based 5G radio solutions

Press Release

Nokia and Google Cloud partner to develop new, cloud-based 5G radio solutions

- The two companies will develop 5G solutions combining Nokia's Radio Access Network Cloud RAN, with Google's edge computing platform
- Building on recent partnership announced in February, new collaboration between deliver additional 5G monetization opportunities for CSPs

15 March 2021

Google Cloud and Ericsson Partner to Deliver 5G and Edge Cloud Solutions for Telecommunications Companies and Enterprises

Available in English 日本語 繁體中文

- Google Cloud and Ericsson come together to help communications service providers deliver capabilities to the edge, unlocking new possibilities for enterprises and consumers
- Partnership brings together Google Cloud's compute platform with Ericsson's market-leading 5G portfolio
- Ericsson, Google Cloud and TIM are currently piloting 5G cloud solutions in Italy for telco edge enterprise use cases in automotive, transportation and other sectors

PRESS RELEASE | JUN 29, 2021 13:00 (GMT +00:00)

AT&T and Google Cloud Expand 5G and Edge Collaboration

Sunnyvale, Calif. and Dallas, July 06, 2021

share

AT&T and Google Cloud Expand 5G and Edge Collaboration to Deliver Next-Generation Business Outcomes

Codeveloped innovative, end-to-end solutions will enable new customer experiences and business services across industries with on-premise or network-based deployment

Today, AT&T and Google Cloud are announcing new solutions across AT&T's 5G and Google Cloud's edge computing portfolio, including AT&T's on-premises Multi-access Edge Compute (MEC) solution, as well as AT&T Network Edge capabilities through LTE, 5G, and wireline.
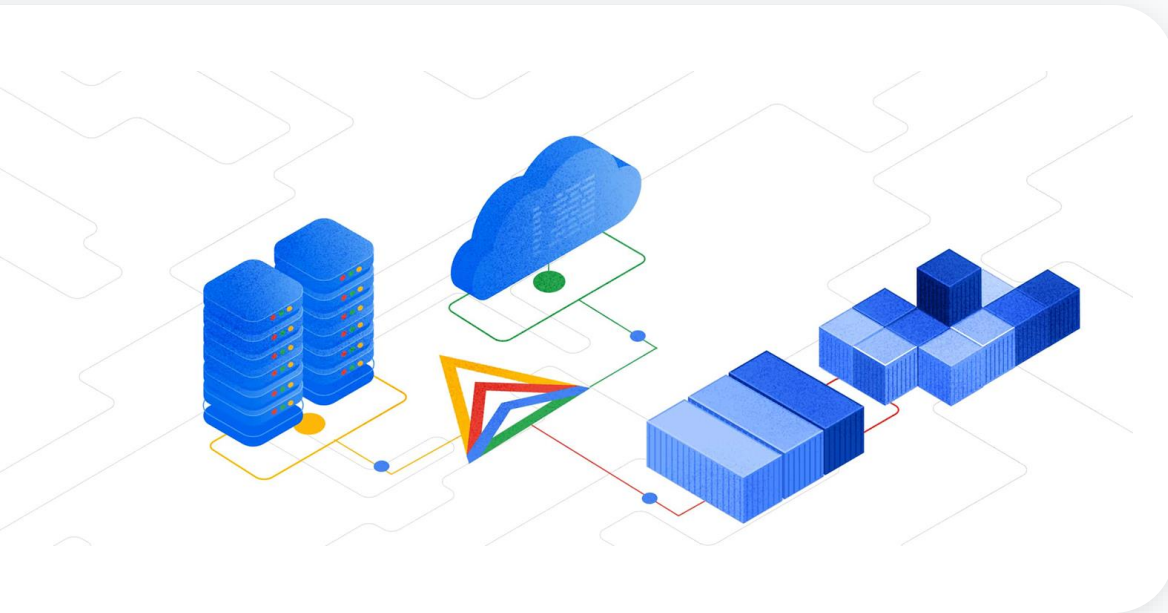

Google Cloud

Google Cloud - Network Modernization

Modernize your network, reduce total cost of ownership (TCO) and improve network performance

Accelerate the journey to cloud-native networks

Anthos provides an open, multi-vendor platform for hosting cloud-native network functions - increasing velocity and flexibility. Transform your network by leveraging Google's leadership and best-practices in Kubernetes, orchestration, security, service mesh and CI/CD.

Reduce TCO of software-based networks

Anthos helps simplify network functions hosting, onboarding and orchestration - reducing infrastructure and engineering spend. Seamlessly leverage public cloud capacity for bursting, unexpected growth or to rapidly trial new capabilities.
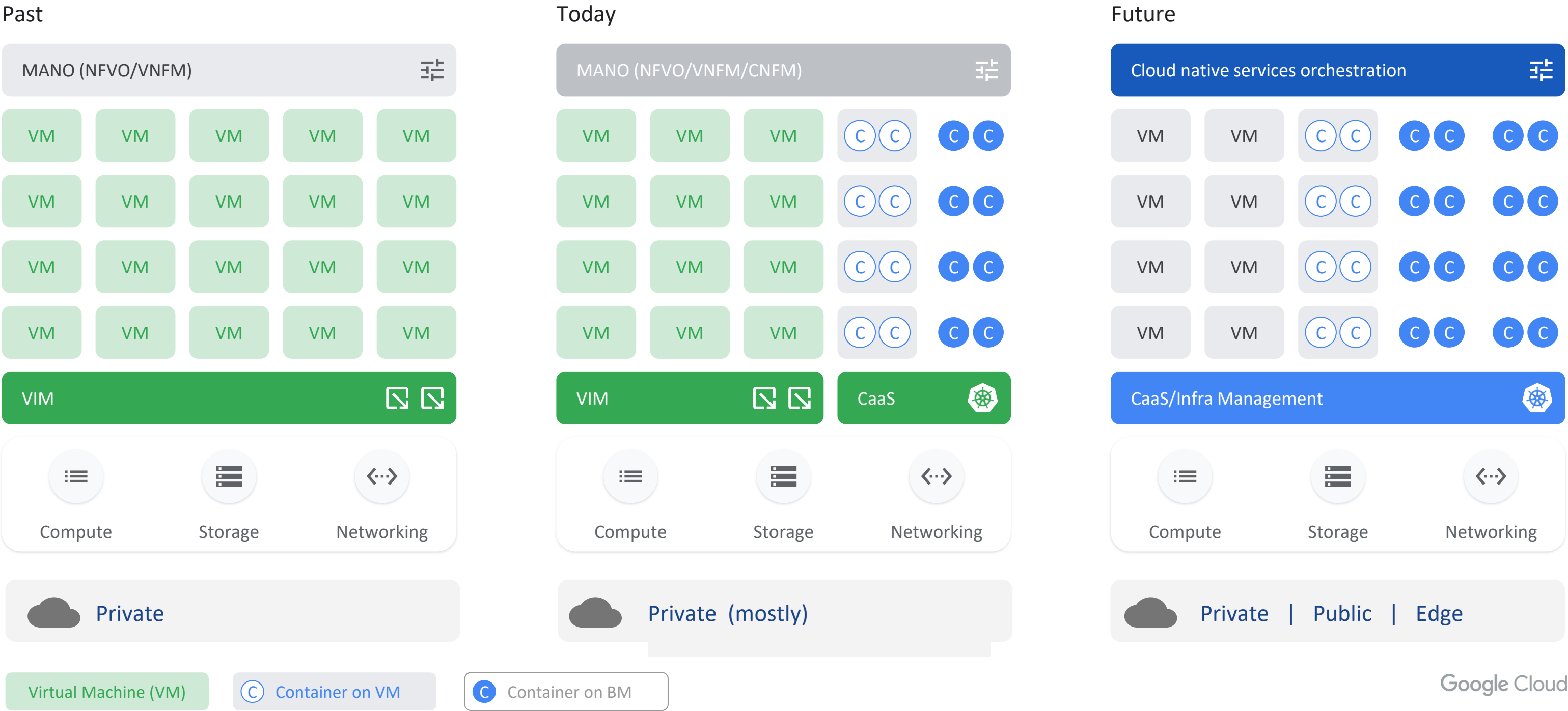
Unlock speed, low latency and scalability with Network Functions on the Edge

Increase your performance of network functions with Anthos. Distribute your network to the Far Edge with low-footprint, efficient hosting - enabling reduced latency and unlocking new architectures (e.g. RAN disaggregation).

Google Cloud

The journey from VNF to CNF

There is a significant change in how CSP Network Functions are designed, deployed and operated as we evolve from legacy Virtualized Network Functions (VNFs) to modern Cloud-Native Functions (CNFs).

Past

MANO (NFVO/VNFM)	

VM	VM	VM	VM	VM
VM	VM	VM	VM	VM
VM	VM	VM	VM	VM
VM	VM	VM	VM	VM

VIM	

Compute · Storage · Networking

☁ Private

Today

MANO (NFVO/VNFM/CNFM)	

VM	VM	VM	C C	C C
VM	VM	VM	C C	C C
VM	VM	VM	C C	C C
VM	VM	VM	C C	C C

VIM		CaaS	

Compute · Storage · Networking

☁ Private (mostly)

Future

Cloud native services orchestration	

VM	VM	C C	C C	C C
VM	VM	C C	C C	C C
VM	VM	C C	C C	C C
VM	VM	C C	C C	C C

CaaS/Infra Management	

Compute · Storage · Networking

☁ Private | Public | Edge

Virtual Machine (VM)	C Container on VM	C Container on BM

Google Cloud

Open RAN Challenges & Opportunities

Everyone wants to "Monetize", few know how, need guidance

Legacy RAN replacement is taking considerable CSP bandwidth

5G 'Cloud Native" buildout is just starting but accelerating

Cloud RAN/VRAN Pilots are now feasible on Cloud Native

Google is active in ORAN, Kubernetes, Service Mesh, KRM standards

2022 Goal - Launch several Cloud RAN market trials

Google Cloud

Q&A

- Can you talk about your experience deploying 5G Cloud RAN and vRAN, what were the key benefits and where is there room for improvement?

- What does the industry need to do to accelerate adoption?

- What comments do you have regarding scalability nationwide and globally?

OPEN POSSiBiLiTiES.

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NOVEMBER 9-10, 2021

Call to Action

How to get involved in the Project/Sub-Project Community

- Telco Edge team meets at 10 am Pacific, 1 pm Eastern time on the 2nd Tuesday of each month
- Call Calendar – www.opencompute.org/projects/telco

Where to find additional information (URL links)

- Project Wiki with latest specification – www.opencompute.org/projects/openedge-sub-project
- Mailing list – ocp-all.groups.io/g/OCP-Open-Edge

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