Leveraging Cloud-Native Operations to Build Edge-as-a-Service

Shain Singh

Cloud/5G Security Architect [APCJ Lead]

ss@f5.com

Jonathan Lee

5G/Service Provider Architect [ANZ]

jonathan.lee@f5.com

Our Speakers

Shain Singh

F5

Cloud/5G Security Architect [APCJ]

Jonathan Lee

F5

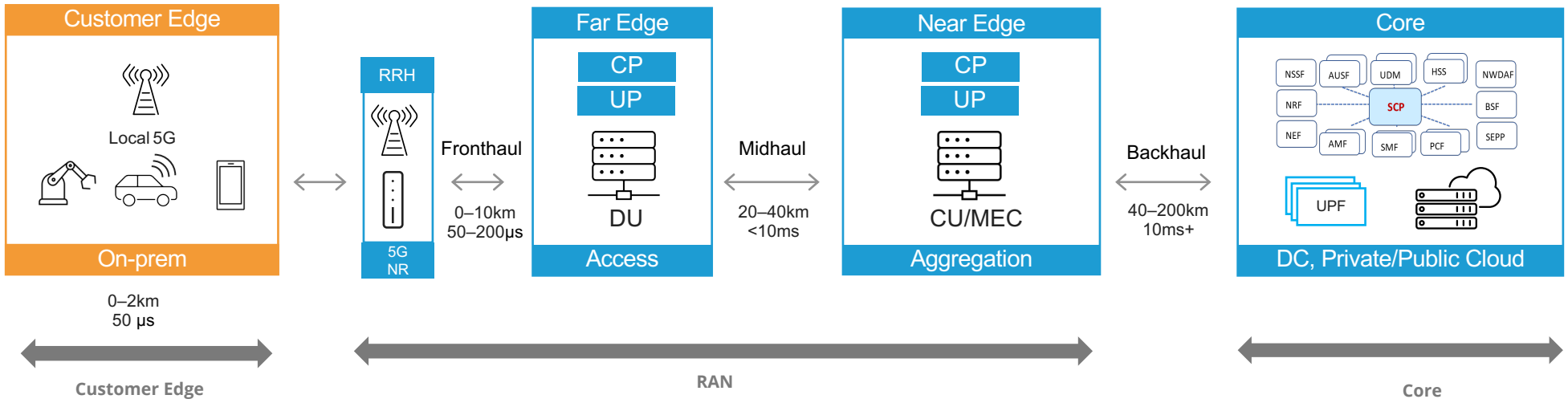
5G/Service Provider Architect [ANZ]

Overview

1. Cloud-Native Edge Architecture
2. Requirements and Challenges
3. Cloud-Native Solutions

Building an Edge Architecture

Cloud Native Operation for both 5G Infrastructure and Enterprise applications



What's Cloud Native?

Cloud Native Software

1. Highly distributed
2. Consistent change
3. Operate in consistent changing environment

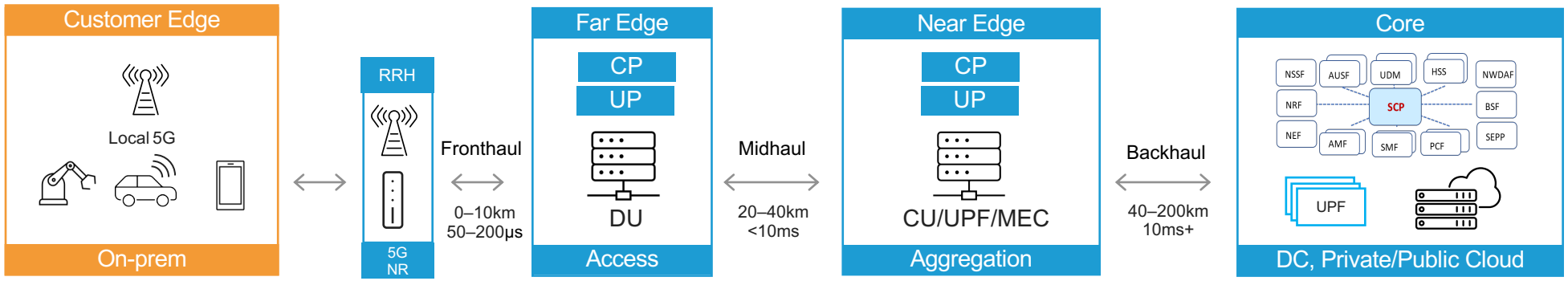
Could Native Operation

1. Composable and connected apps to enable high level service construct
2. API first programmability to build, deploy, operate and secure
3. Abstract and hide the complexity of infrastructure and operations from modern apps

What matters?

Latency	Workload	Network Stack	Fleet Mgmt.	E2E orchestration	Operation Model

Cloud Native Operation for both 5G Infrastructure and Enterprise applications



Workload Type				
	VNF CNF APP Bare metal	VNF CNF Bare metal	VNF CNF APP Bare metal	VNF CNF APP Bare metal

Support all Types of Workloads
- Container, VM, Bare metal
- Stateless and Stateful Apps
- Distributed Data Store for Stateful apps

Workload type

1. Bare metal, VM and Container based workload will co-exist for lifelong by Telco providers—this requires the support to orchestrate Bare metal, VM and Container at large scale in a distributed infrastructure altogether
2. It needs to orchestrate both the infrastructure network functions (VNF/CNF) and the atop applications to move up the value chain
3. While adopting scalable modern web design via stateless REST API, there are a lot of stateful applications in Telco world that need to be supported

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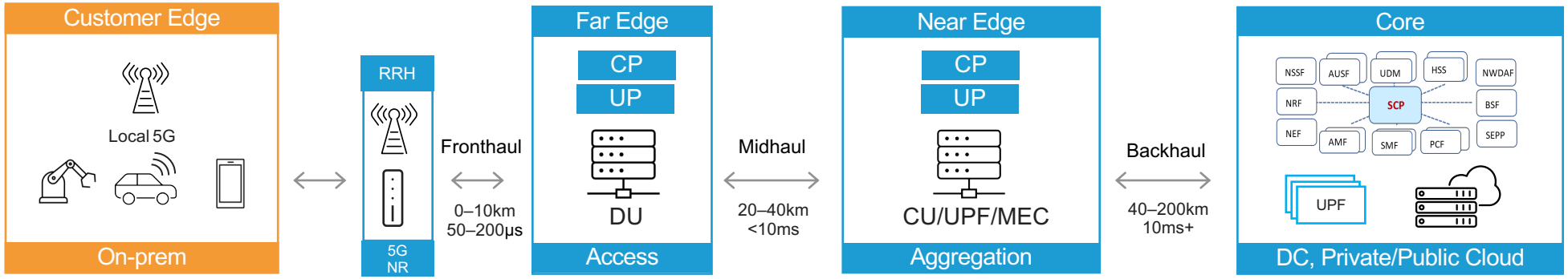

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OS Requirement	RT Near RT Non RT	RT Near RT	Non RT	Non RT	**OS support for different use cases** • RTOS • Near RTOS • GPOS

OS requirements per workload types

1. Various workloads impose different requirements for response time
2. Network functions at Far Edge and Customer Edge would demand more deterministic response time, which requires the support of RTOS/near RTOS

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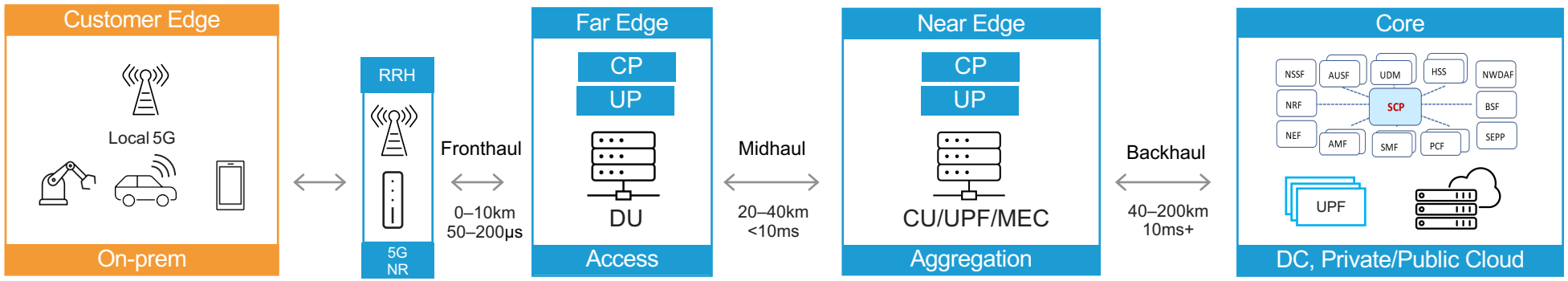

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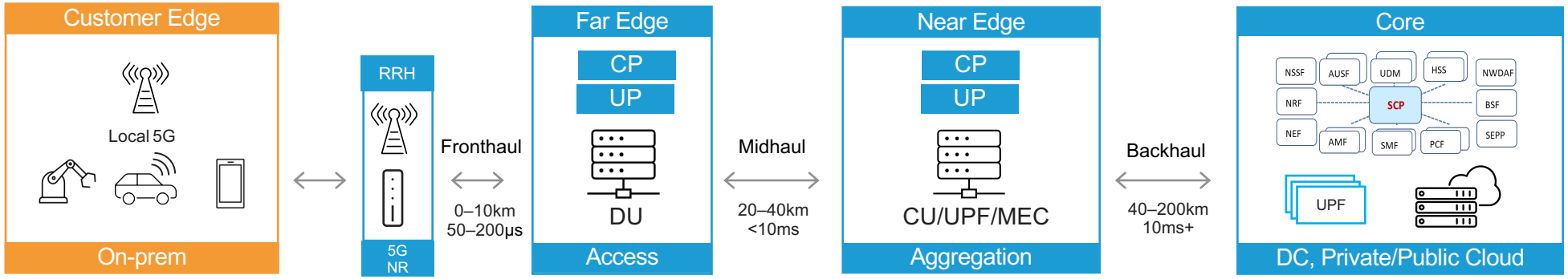
Fleet Management	APP APP OS	APP APP OS	APP APP OS	APP APP OS	**LCM via Fleet management** • Apps • Firmware, OS • ZTP, ZTO

Fleet management for both Infra and Apps LCM

1. It requires Zero-Touch to Low-Touch to deploy, operate and secure thousands of sites and/or apps at large scale in a distributed manner under a single pane of glass for end-to-end management
2. It requires upgrade, downgrade, rollback for OS, Firmware, applications via cloud native operation model like GitOps for A/B testing, Blue/Green deployment, config mgmt., certificate rotation, auto-scale, AuthN/AuthZ, IAM, etc.
3. It requires simplified management to tag/label sites with declarative configuration, which can select the group of sites with affinity in the business context for the same operation. This has to site agnostic, no matter whether the target site sitting in customer edge, network edge, private data center/cloud, or public cloud providers

Cloud Native Operation for both 5G Infrastructure and Enterprise applications



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Cloud Native Operation					**E2E Orchestration** • Scalable centralized management • Location agnostic

Cloud Native Operation with Centralized Management

1. It requires a scalable centralized orchestration and End to End management for both infrastructure network functions and atop applications
2. The centralized management must be able to support thousands or potentially millions of distributed clusters under one single consumable interface for easy operation
3. It must provide one single operation model with an API centric open architecture to simplify Day-2 operation across all network domains (e.g., on-prem vs. access vs. aggregation vs. core)

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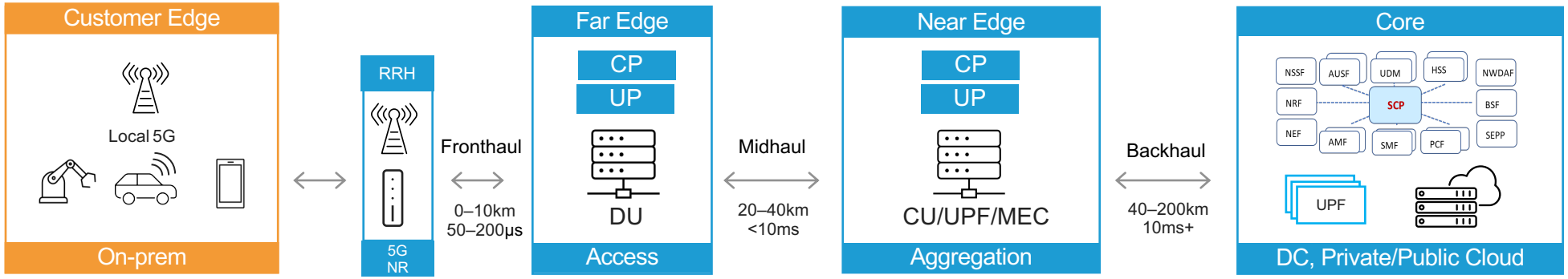


High Performance Network Stack

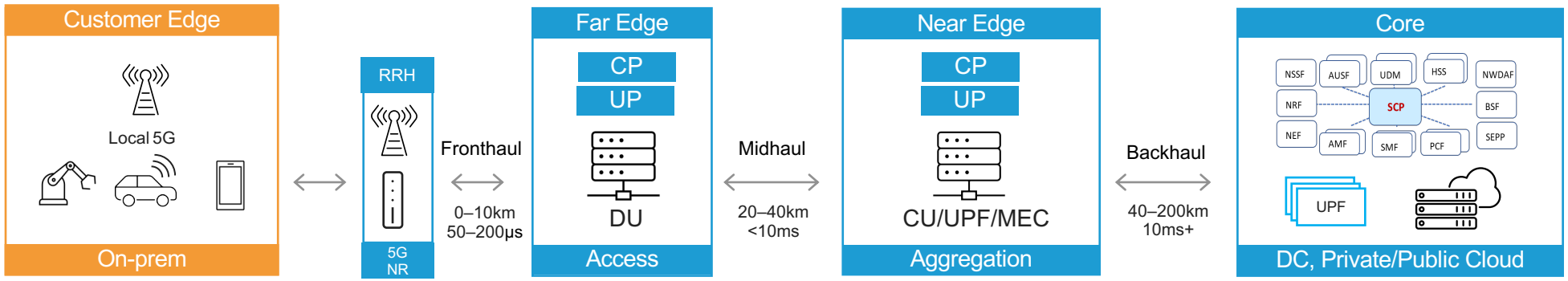
1. It requires a high-performance network stack for various workloads at different locations between infrastructure workload across Customer Edge, DU, CU, MEC, Core, **AND** Enterprise application workload respectively
2. This requires the network stack to support RTOS/near RTOS for latency sensitivity workload at DU for example, along with GPOS in general everywhere else

Network Stack

Requirements	Requirements	Requirements	Requirements
• Nomadic Edge & Fixed Edge • Large variety of form factors, I/O, CPU/GPU/FPGA, Wi-Fi/LTE/5G • Cost/Perf sensitive, COTS HW • IPv4 & IPv6	• High performance network stack with Low Latency & High throughput • CPU pinning, NUMA aware scheduling, PCI passthrough, Guest TSC • SR-IOV, Multus, DPDK • GPU/FPGA Acceleration • RT/near-RT OS • IPv4 & IPv6	• Distributed resource allocation • Reliability and mobility • Hybrid cloud applications portability • Security and Data sovereignty • IPv4 & IPv6 • GPU/FPGA acceleration on MEC	• Gi/N6 NF – CGNAT, Gi-FW, DDoS, Secure DNS cache, TCP & Video Optimization, WAF • CDN, Anti-fraud, Anti-bot • Service Mesh, K8s Ingress/Egress, API mgmt • LI, Analytics, Logging • IPv4 & IPv6

High Performance Network Stack

It requires one operational model



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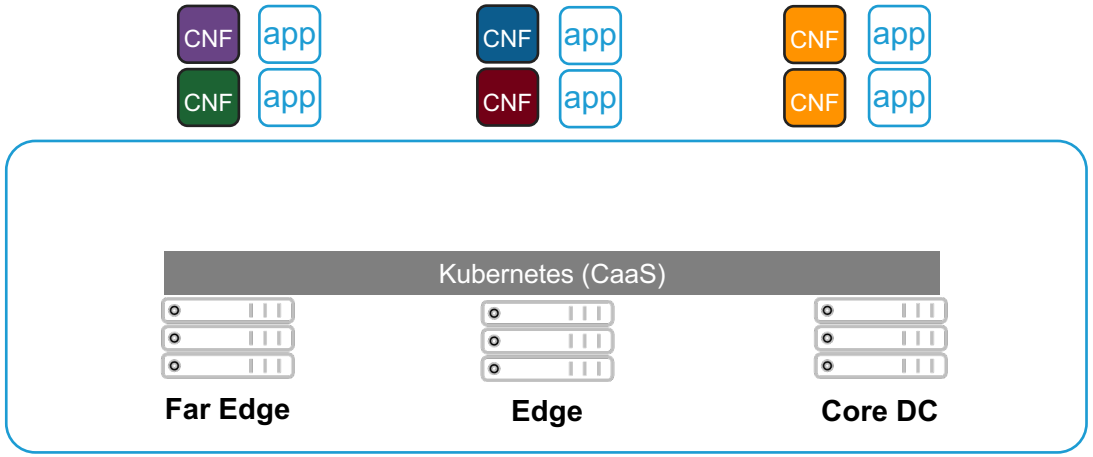
Deployment Challenges

Who owns the cloud-native infrastructure?

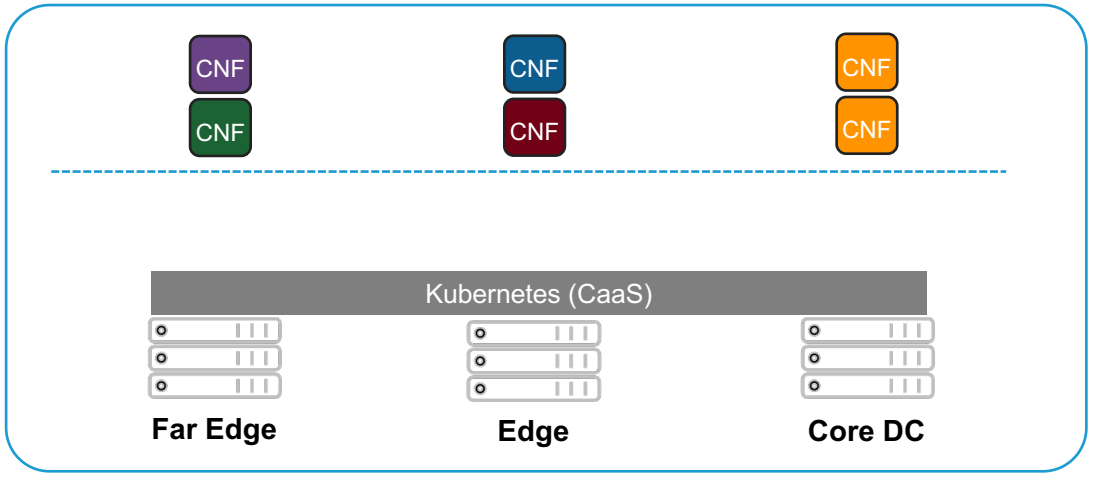
HURDLES SEEN IN SERVICE PROVIDER ORGANISATIONS

Infrastructure / Platform Group



Goals: Consistent architecture across IT and 5G environments supporting multiple use cases

Mobility Group

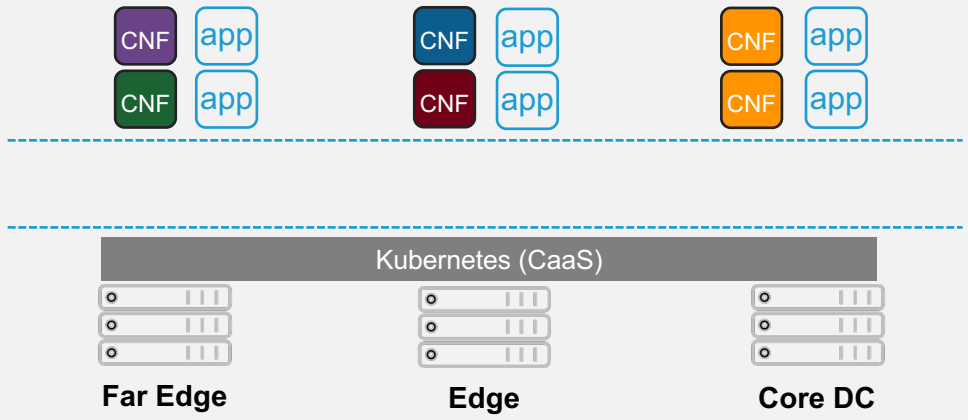


Goals: Deployment of 5G components without too much focus on IT and enterprise applications

Common infrastructure deployment strategies

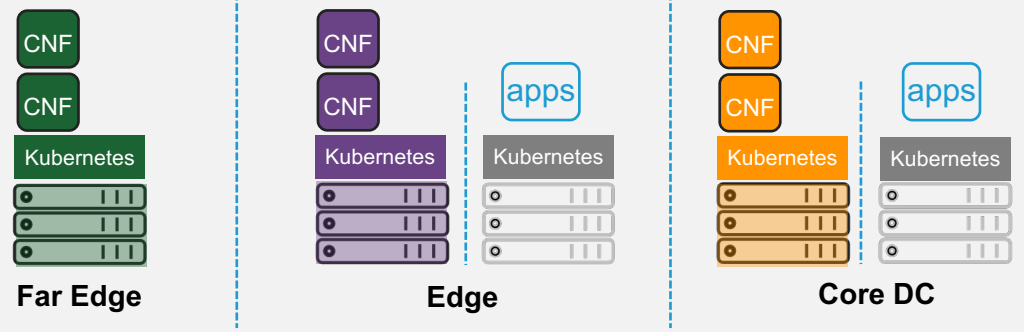
TURN-KEY VERSUS BUILD-YOUR-OWN APPROACHES

Horizontal Stack Approach



Decouple infrastructure from container-native functions
"Web Scale Approach"

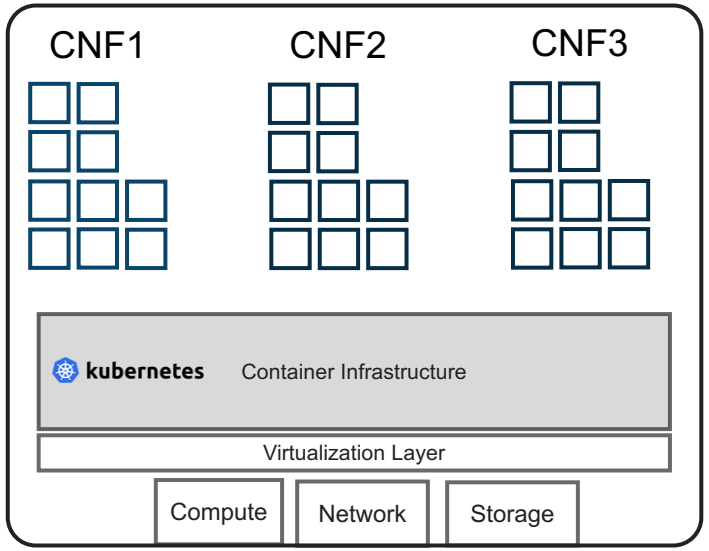
Vertical Stack Approach



5G vendor provides full stack
"Traditional Telco Approach"

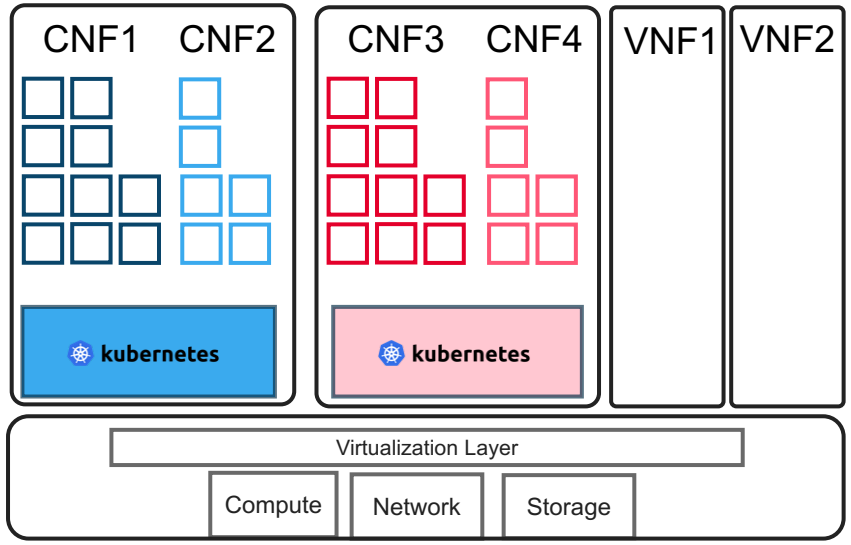
Common CNF deployment strategies

THREE POSSIBLE OPTIONS IN DEPLOYMENT MODELS



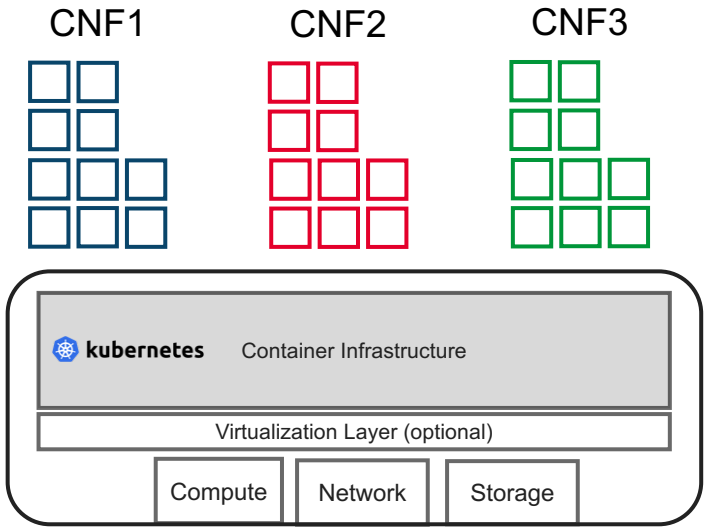
Mode 1

Everything provided by one vendor



Mode 2

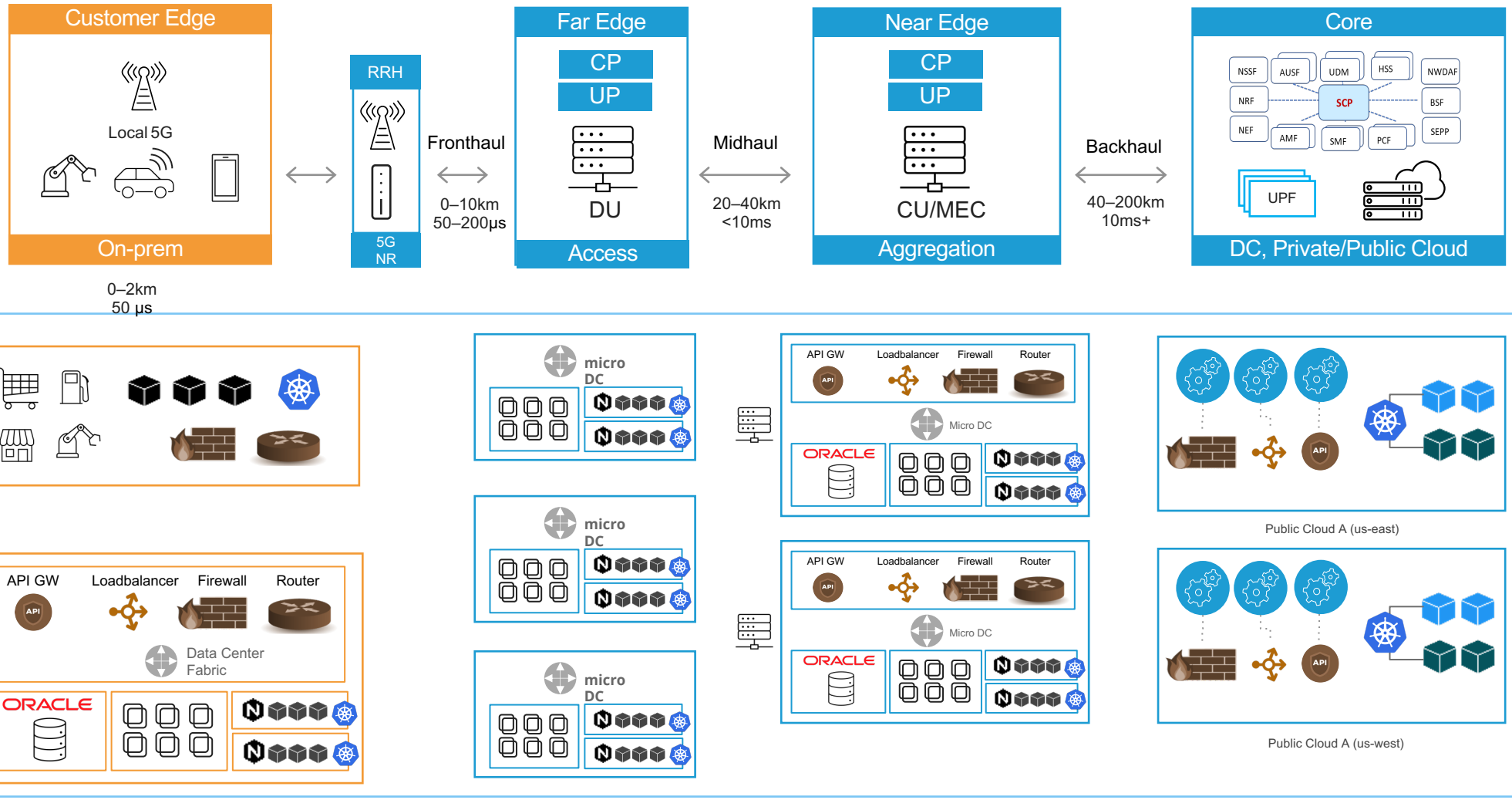
Different vendors bringing their container runtime layer



Mode 3

Separated Container infrastructure

Current Approaches were not built for this reality



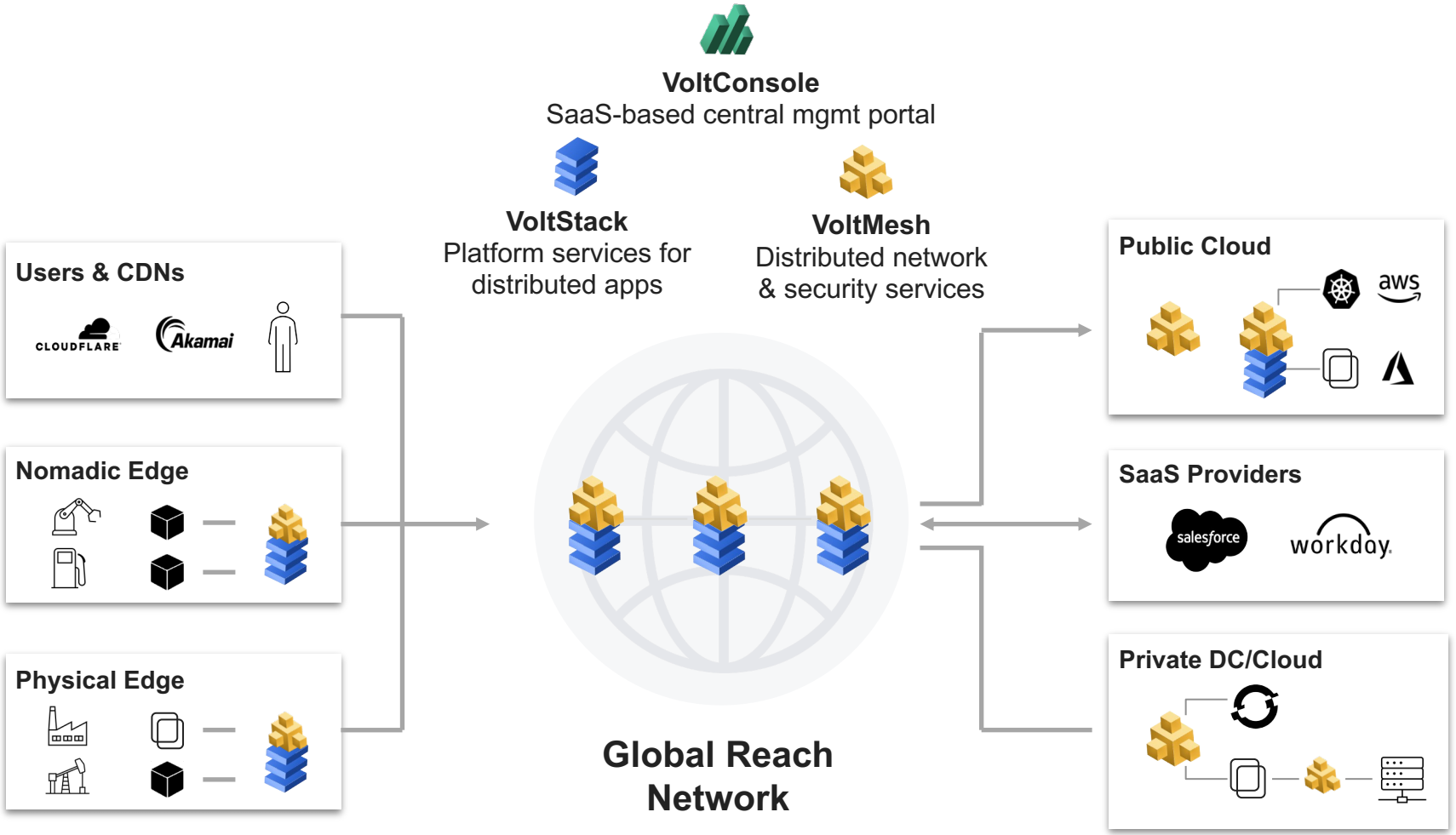
7–15+ Vendor Components

Silo'ed Config Mgmt

Policy + Observability

Distributed Cloud Platform

Leveraging a Distributed Cloud Platform



Consolidated Service	SaaS-based Operations	Edge → Cloud	Policy & Observability
Lower TCO and Complexity	Lower Opex and Faster	Common Tooling	Unified & Centralized

Cloud Native Distributed Edge-as-a-Service for Telco and Enterprises

Multi-Cloud Networking

Multi-cloud secure connectivity from Edge, Private Cloud to Public Cloud

Distributed WAAP

Distributed WAF, API, Bots, DDoS mitigation

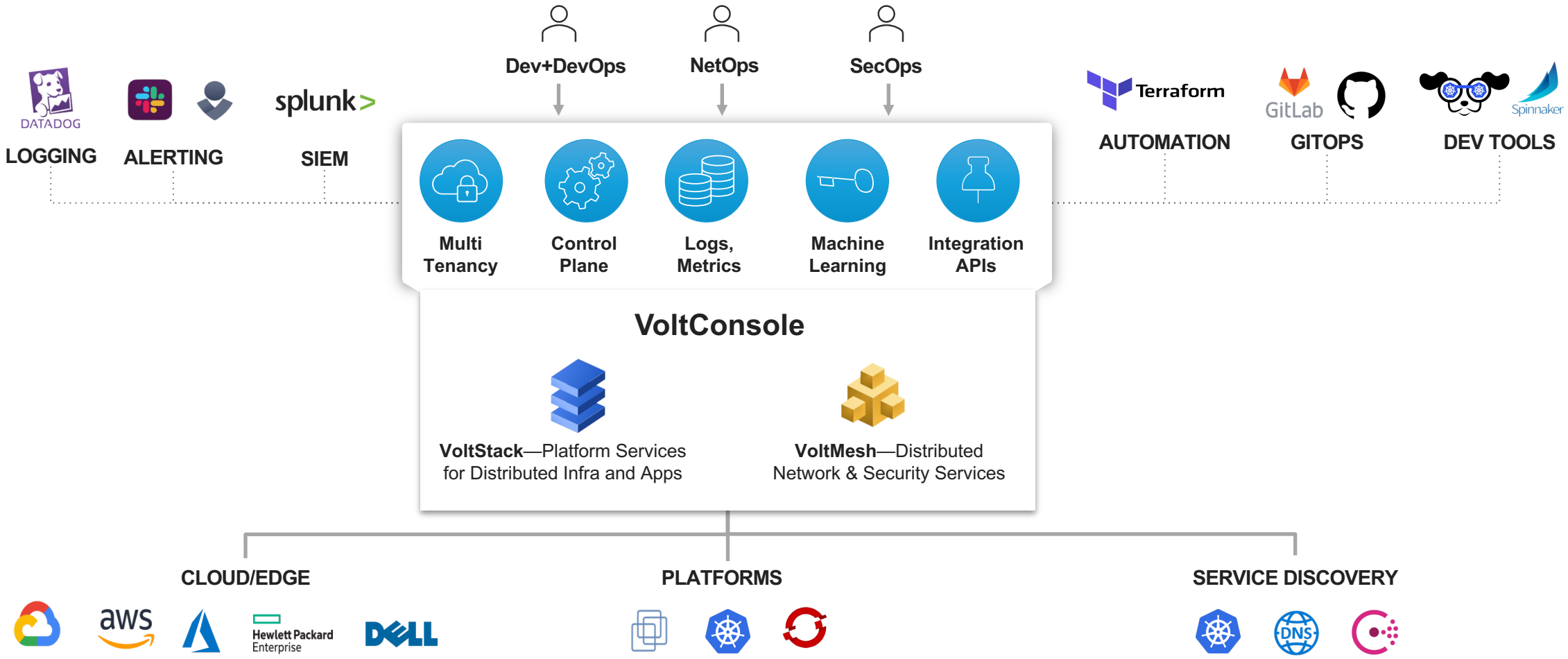
Edge Computing

Telco/Enterprise IT, Industrial IoT, Hyperconvergence

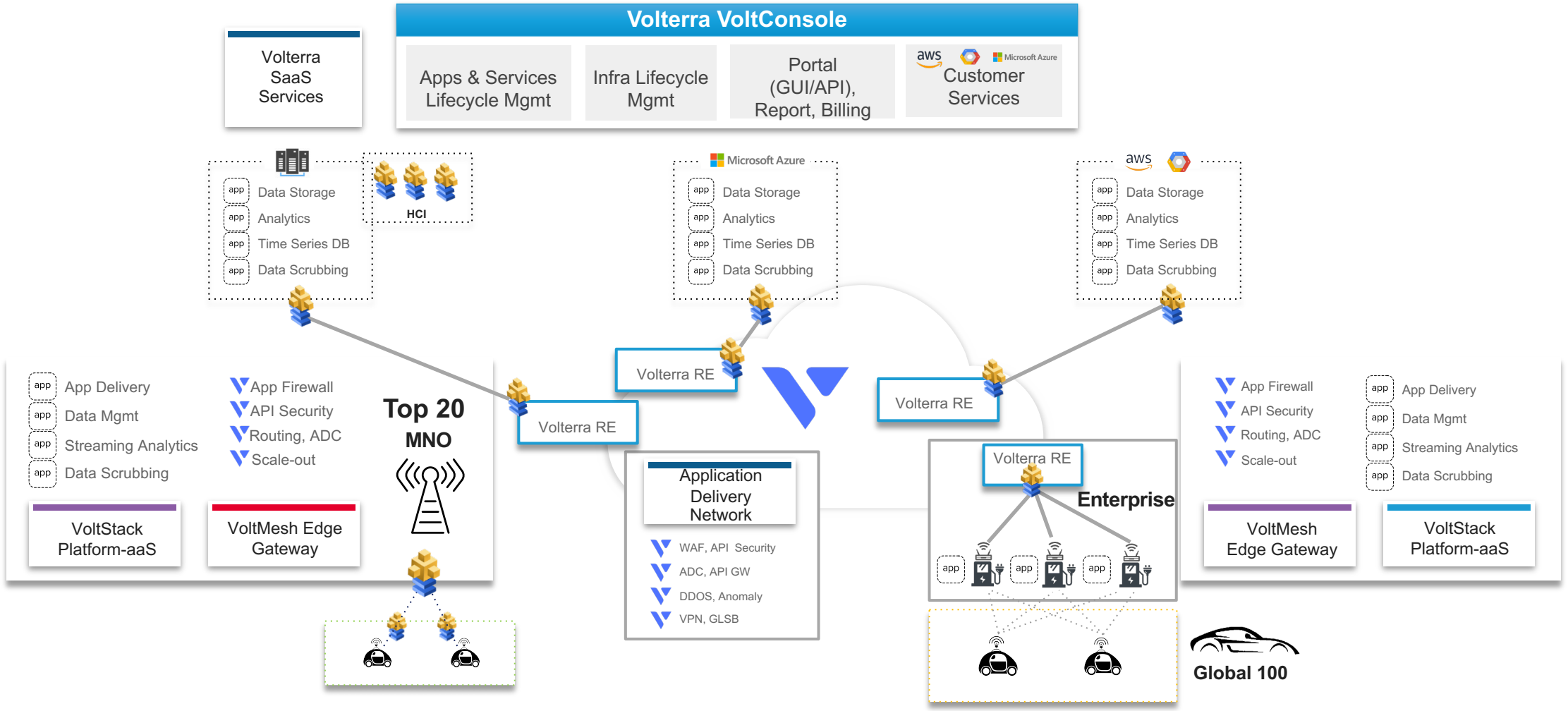
Telco Cloud

Far Edge/Near Edge/MEC/Core/Private LTE/Local 5G

An API first cloud native ecosystem

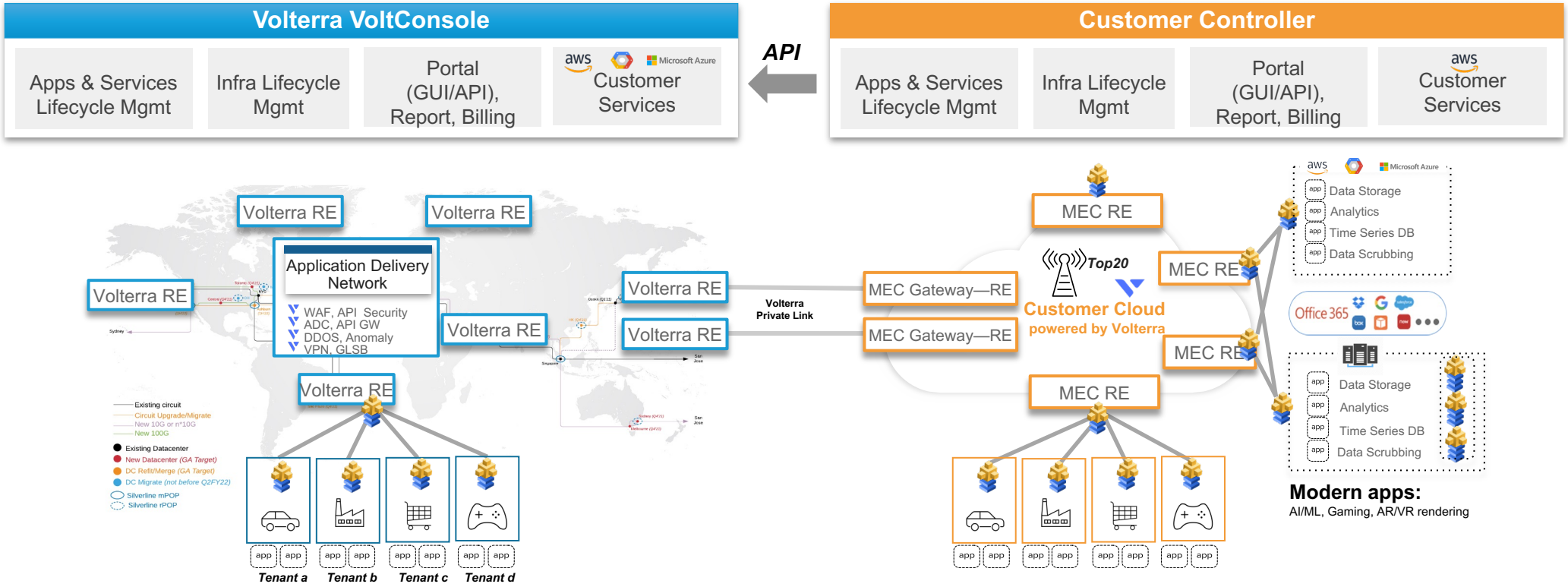


Cloud Native Edge Service for both Telco Infra and B2B Enterprise



Common Tools	Scale Out Fleet Management	Policy & Observability	Cloud Native Operation
Converged Stack (Network & Apps)	Declarative, large Scale, LCM, Location Agnostic	Unified & Centralized RBAC, WAF, API, BOT, DDOS	GitOps, PaaS, Infra-as-Code, Cloud Native (SRE-aaS)

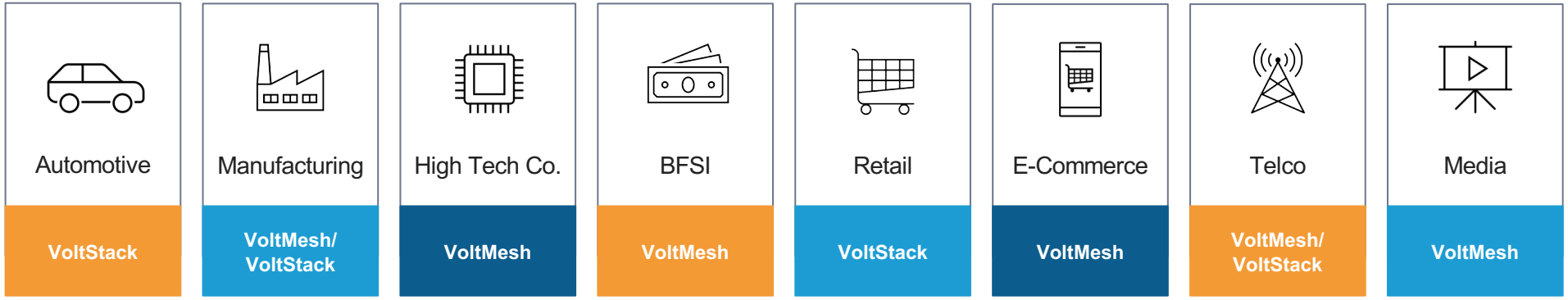
Managed Cloud Native Edge Service to Deploy, Secure and Operate Fleet of Apps Globally



SaaS-based Cloud Platform	Global Reach	Flexible Cloud Ecosystem
API First	Deploy, Secure and Operate Global Apps	Enable International companies, global partnership, roaming, etc.

Volterra Private Cloud Instance	Volterra Private Cloud Instance	Country Wide MEC Coverage
Customer owned Cloud Infrastructure	Cloud Operation Plus Volterra SRE-as-a-Service	Deploy, Secure and Operate Modern Apps for B2B Enterprise

Key takeaways



Common Tools

SaaS-Based Common Stacks

Integration

Integrated Networking, Security & App Infra.

Policy & Observability

Unified & Centralized

TCO

Cloud-Native Operational Model