

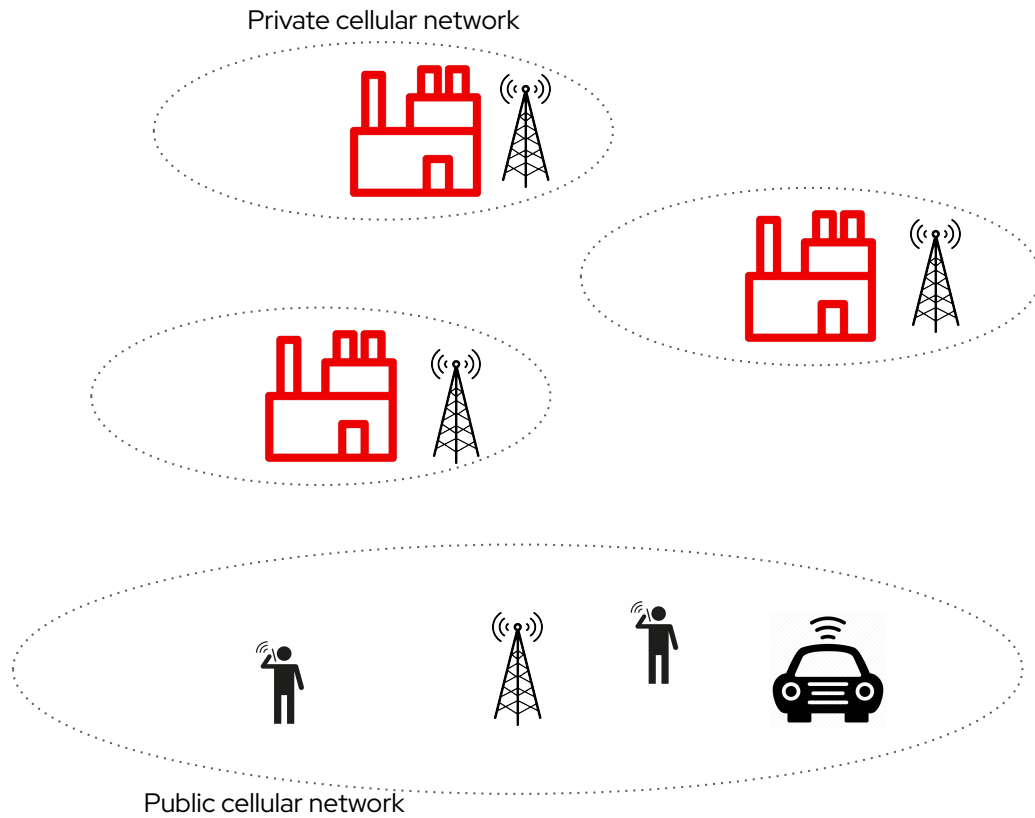
Trends for Private Networking

Intel Network Builders Enterprise Networks
Insights Series, 20 October 2021

Michael Tadault
Chief Technologist Telco
APAC, Red Hat



Private cellular networking



Connectivity

- Connectivity in areas underserved by public networks

Performance

- Suitable for mission critical applications

Customization

- SLAs unique to enterprise requirements

Reliability

- Even more reliable than public networks

Revenue stream

- Possibility for enterprises to act as neutral hosts

Data Security

- Guaranteed data security

Opportunities for Private 5G

Healthcare

Enhanced diagnostic and image analysis,
early pandemic detection



Shipping ports, airports

Manage traffic growth,
optimising transfers, assets monitoring



Financial services

Trading, personal finance planning,
fraud detection, customer operations



Transportation and logistics

Traffic flow management, autonomous
trucking and delivery



Technology, media, & telecommunications

Network maintenance & optimization, self-learning
security, neural nets, personalized content



Mining

Automated production, delivery management,
demand prediction and analysis



Energy

Predictive infrastructure maintenance,
grid operations and storage, smart metering

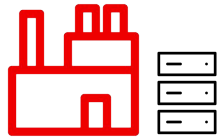


Manufacturing

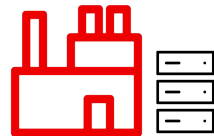
Process correction and optimization,
on-demand production

Edge computing

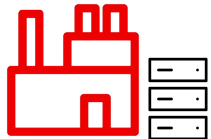
Computing closer to where the data originates and is needed



Edge computing



Edge computing



Edge computing



Centralized data centers / Public clouds

Low latency

- Connectivity in areas underserved by public networks

Reduced backhaul

- Data is processed locally

Data sovereignty, security, and privacy

- SLAs unique to enterprise requirements

Autonomous operations

- No dependency on centralized IT infrastructure

Edge computing is already happening

Industrial use cases with AI/ML

Telecommunications



Manufacturing



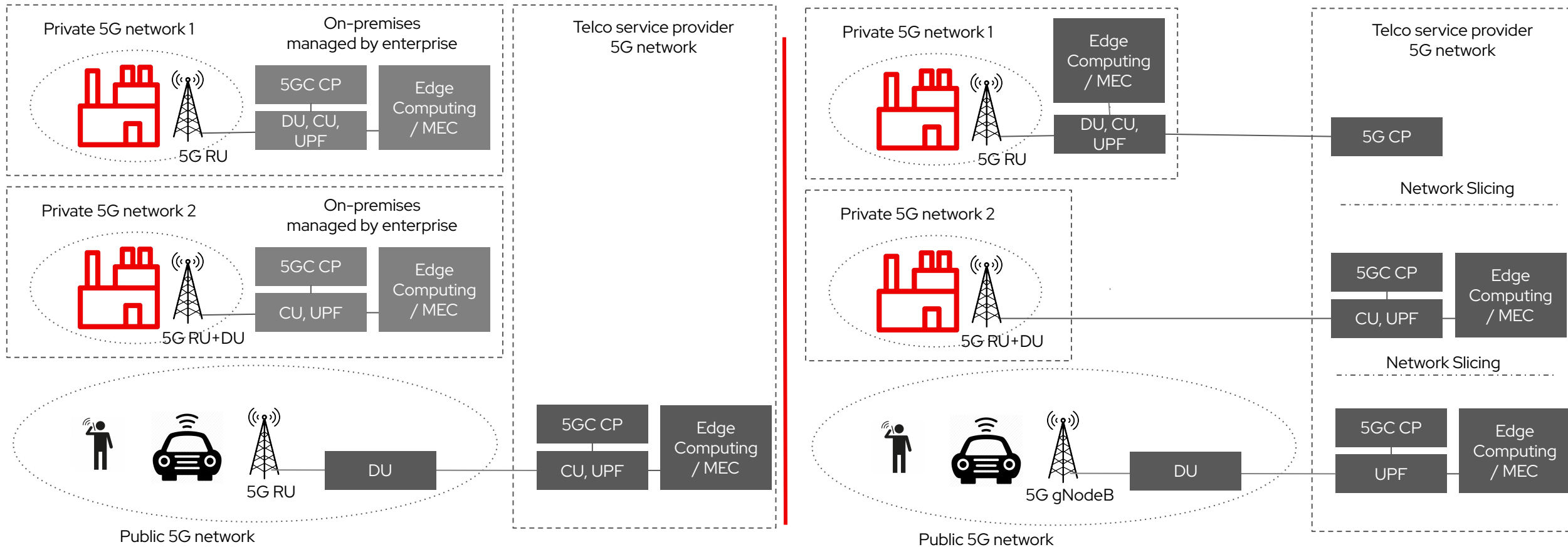
Energy



Use cases	Private networks vRAN Distributed core	Predictive maintenance Factory automation Augmented reality and remote expert	Process control Environment monitoring Autonomous vehicles
Benefits	Better user experience Scale to meet demand Greater network flexibility Improved resilience	Reduced downtime Increased productivity Longer asset lifetime Improved factory safety	Reduced downtime Lower OpEx and CapEx Lower workforce risk Less environmental impact

Private 5G networks

Implementation options



Private 5G and edge computing enable new revenue streams

For telco service providers



Model A - operator as connectivity provider

- Private 5G network as well as connectivity from on-prem edge to private or public cloud
- Edge infrastructure and IaaS
- Could include PaaS if operator has those capabilities
- Likely to happen where operator does not have vertical-specific expertise
- Recurring revenue stream



Model B - operator as systems integrator

- Everything included in Model A and integration of ISV application into existing enterprise systems
- Likely to happen where operator has vertical expertise and/or has established relationship with enterprise for other enterprise services
- One off revenue stream

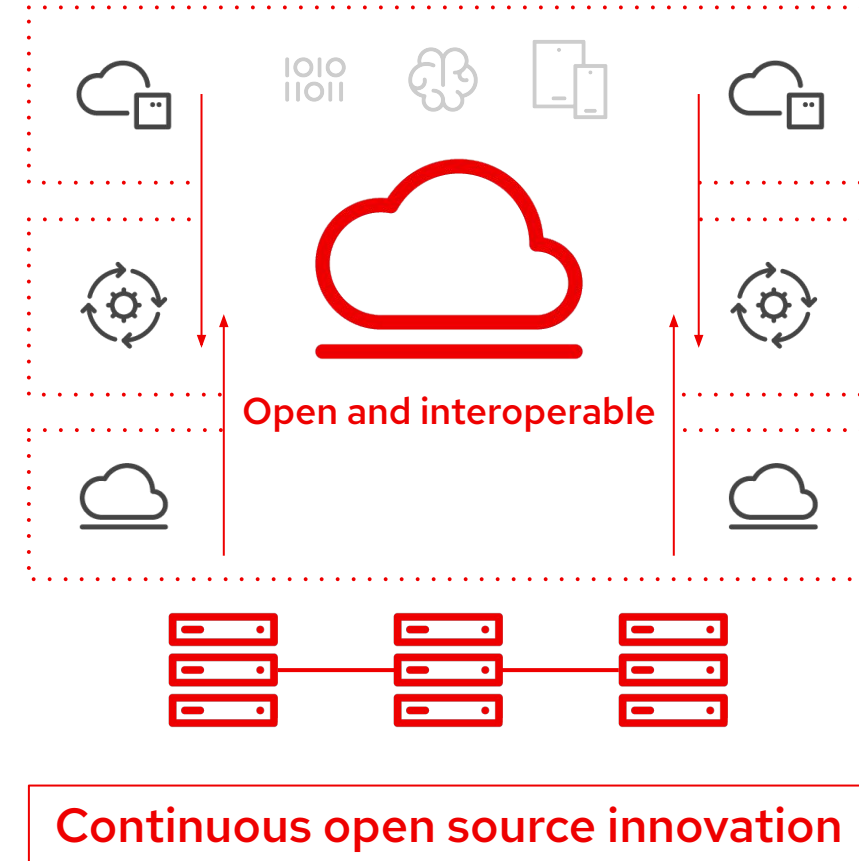
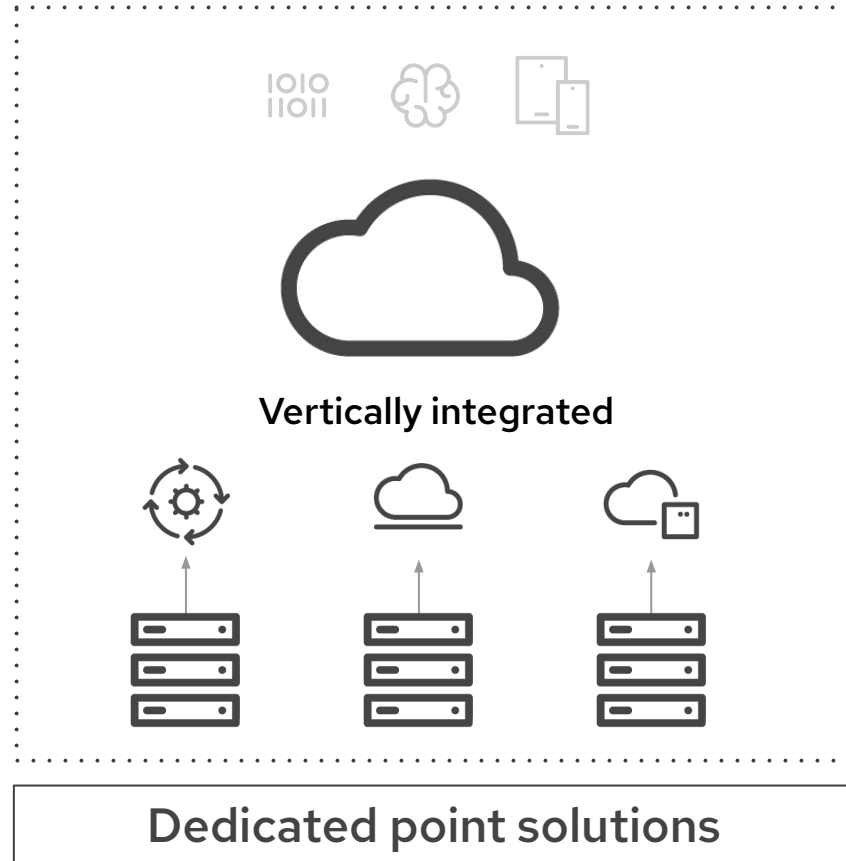


Model C - operator as a solutions provider

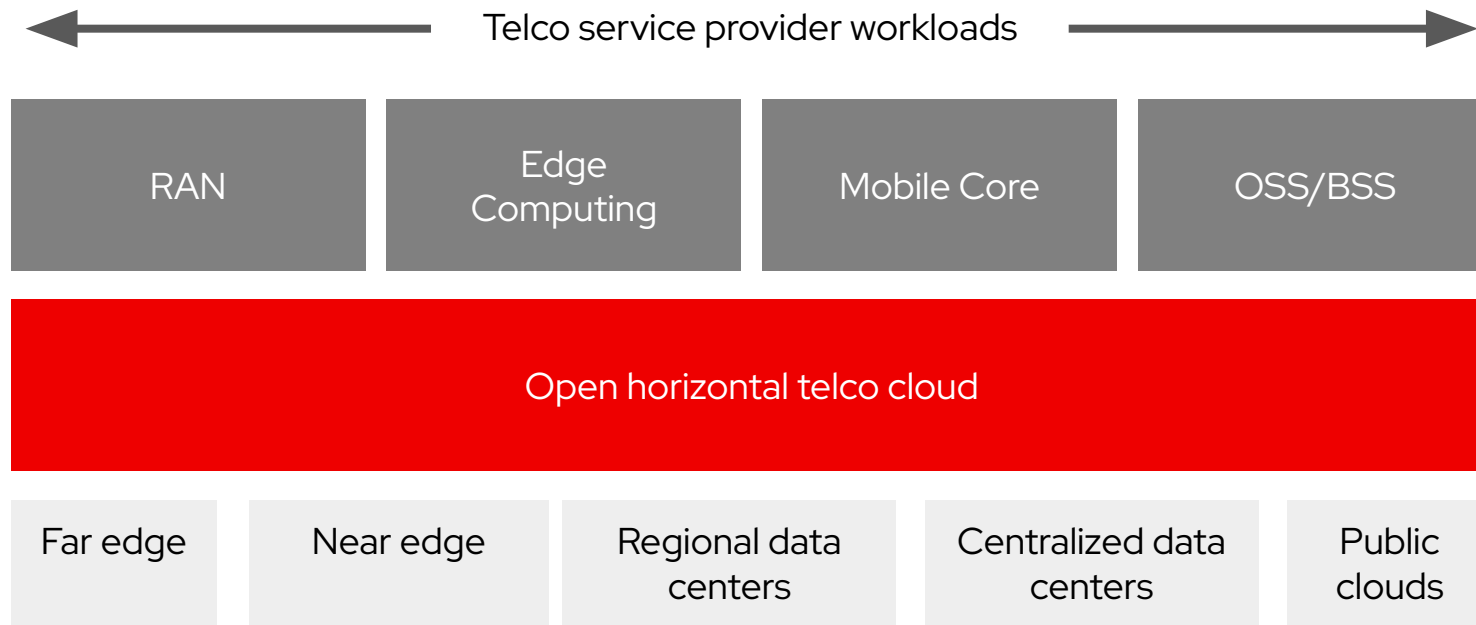
- One off systems integration as well as ongoing customer support
- Operator provides local face for the solution and white-label resale of application and end devices
- Recurring revenue stream from managed services and application licenses

Source: STL Partners

Every organization faces a decision about how to approach these challenges



Open horizontal telco cloud



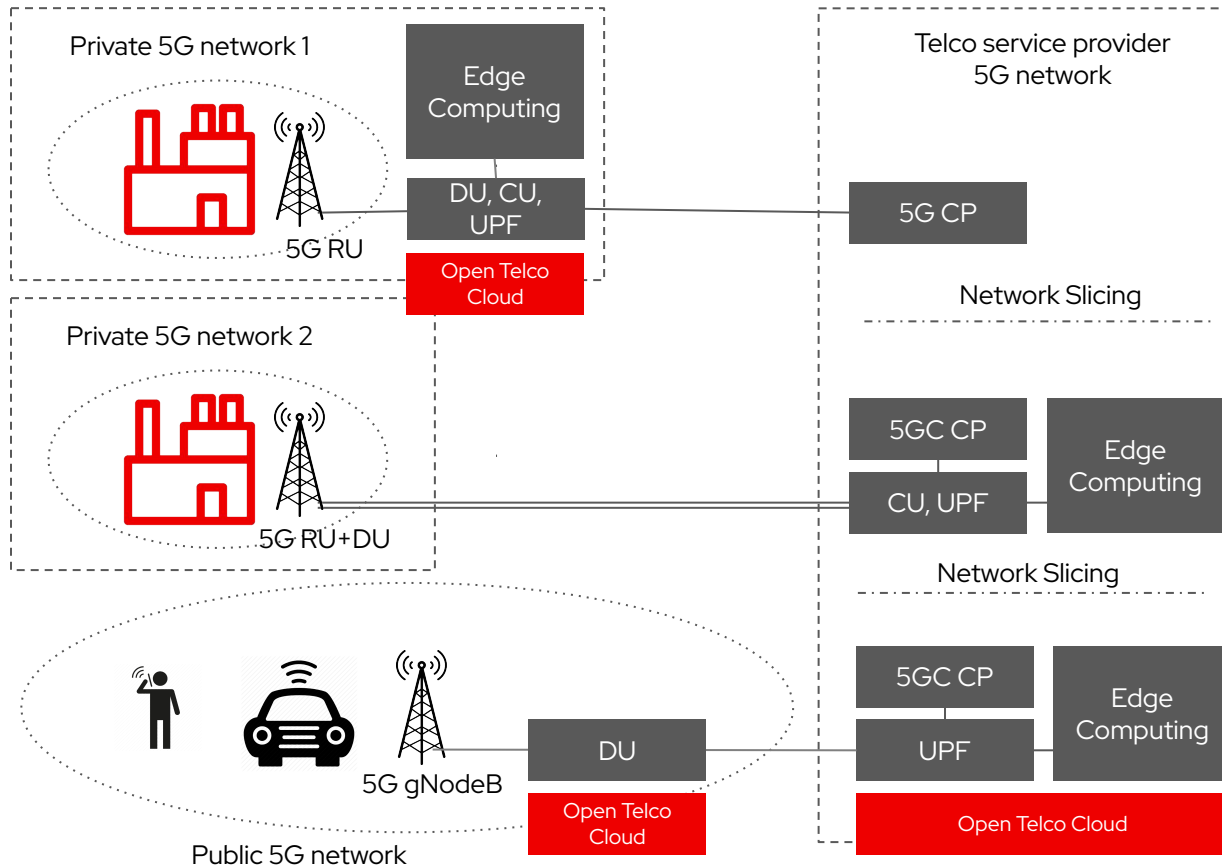
Consistent operations

Faster time to market

Increased innovation

Private 5G networks provided by telco service providers

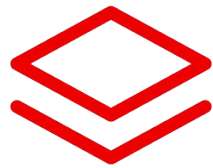
All network functions hosted by the same open telco cloud



Open telco cloud provides operational consistency across your architecture—all the way to the edge

Open source harnesses the power of collaboration to propel innovation and interoperability

Red Hat's approach to edge computing



Platforms and portfolio.....

Powerful building blocks including application services, management, storage, and services, with Red Hat OpenShift® and Red Hat Enterprise Linux® in the heart of all

..... Open source leadership

Enhancing the development of open standards while providing hardened, fully supported enterprise-grade platforms



Partner ecosystem.....

Partnering with hardware and software vendors to provide solutions that meet customer needs

Open telco cloud with Red Hat OpenShift



Multi-cluster layer

Multicluster management

Observability : Discovery : Policy
: Compliance : Configuration : Workloads

Container registry

Container Builds : Security Scanning
: Geo Replication

Multicluster security

Kube native declarative security |
DevSecOps

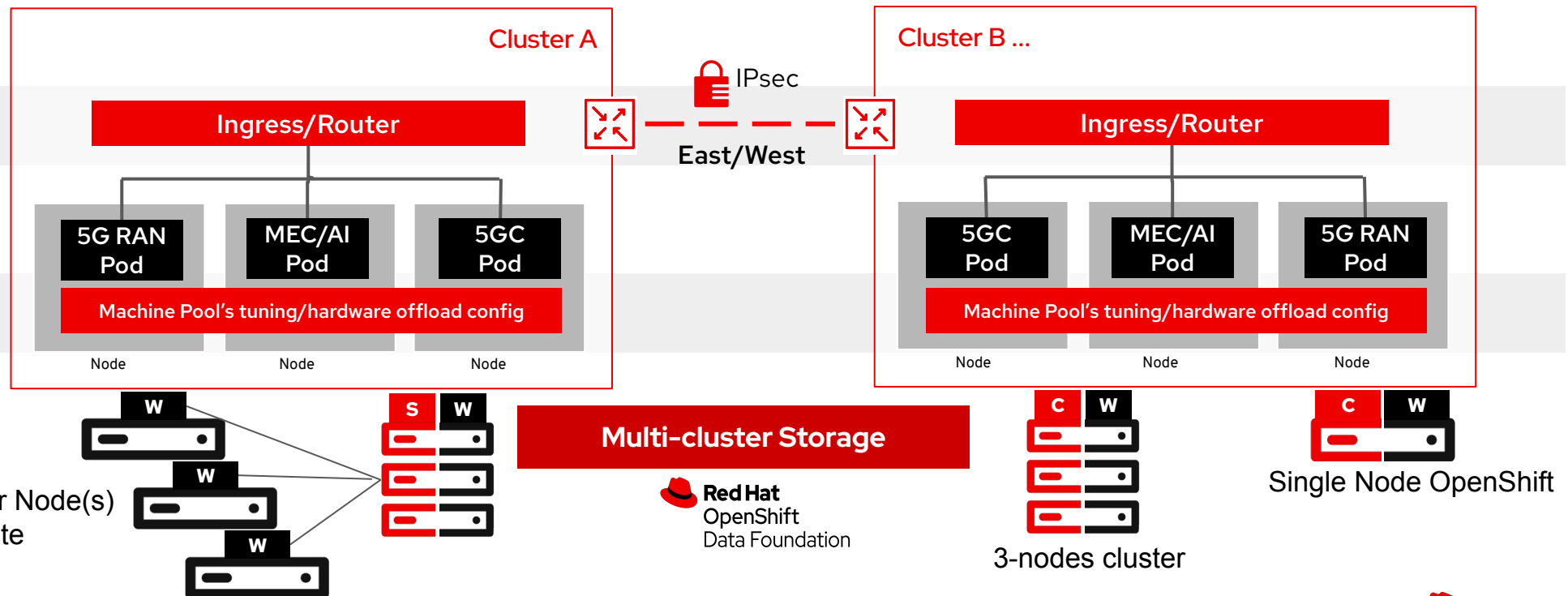
Global Ingress/Egress | Global LB | Service Mesh Federation



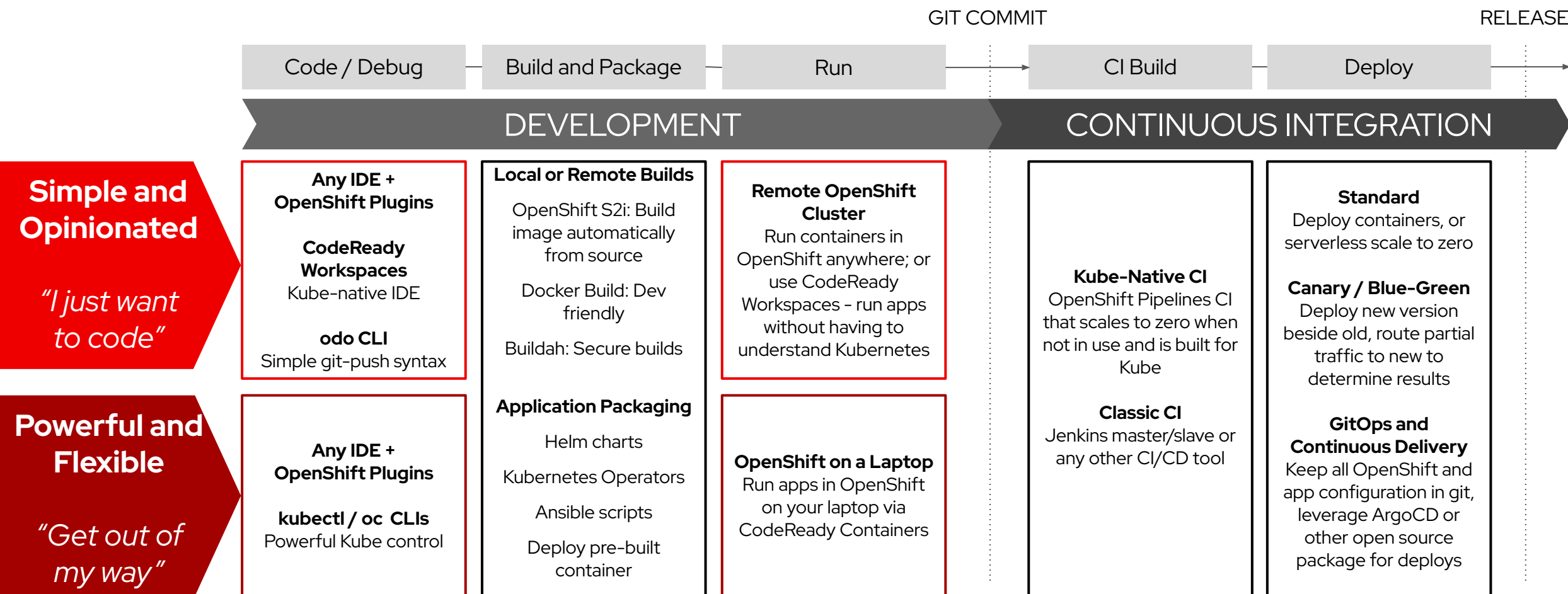
Router layer



Node layer



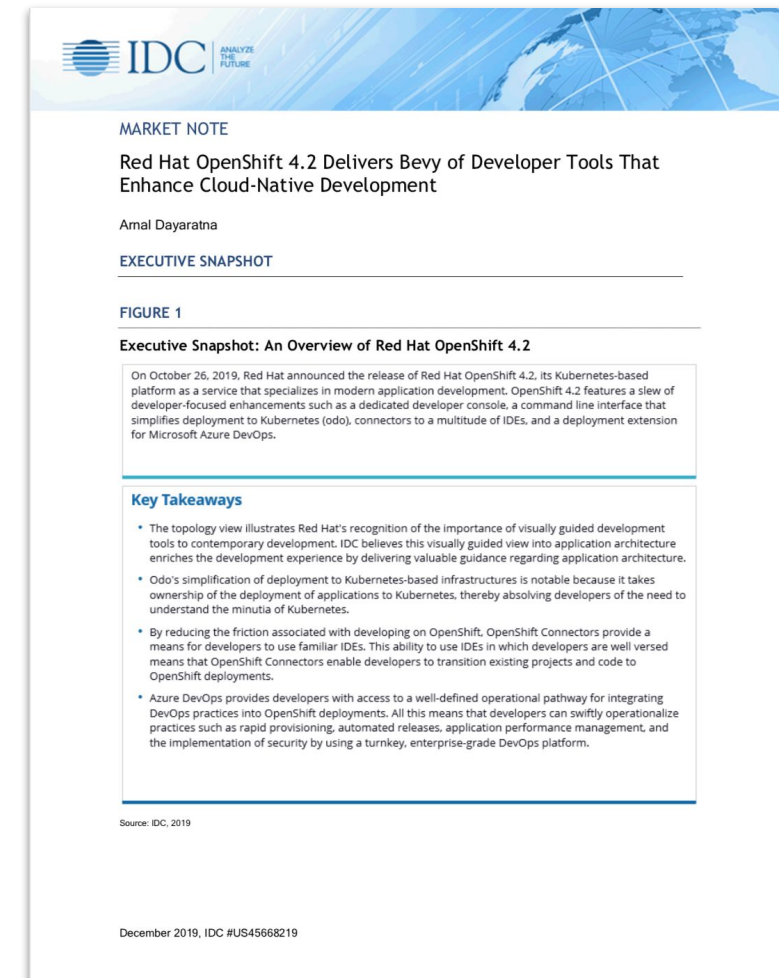
OpenShift cloud native development tools





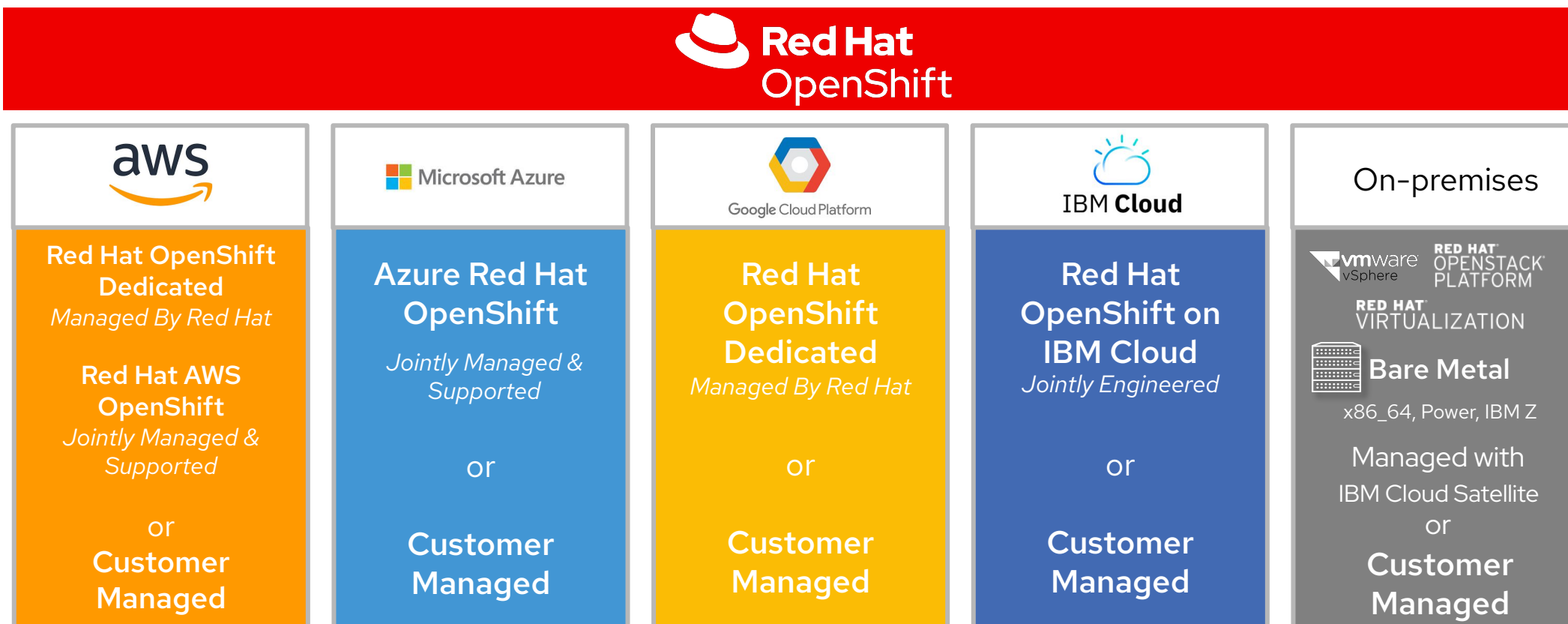
“Taken together with Red Hat's announcement of service mesh, serverless, and CI/CD functionality, Red Hat OpenShift 4.2 represents a breakthrough in the space of cloud-native development tools.”

-- Arnal Dayaratna, IDC Analyst



OpenShift offers the broadest set of hybrid cloud services

"Develop once, deploy anywhere"



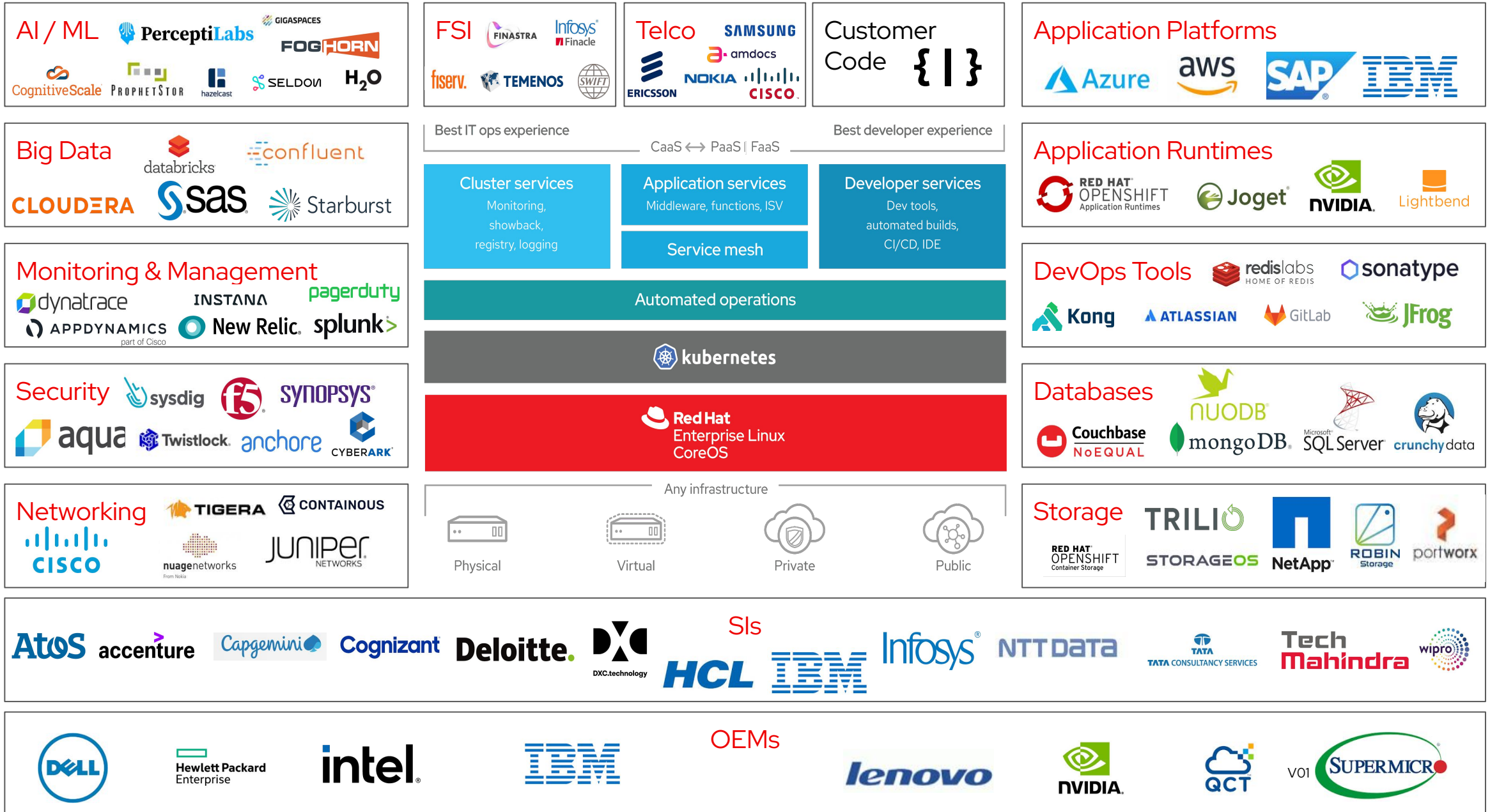
THE FORRESTER WAVE™
Multicloud Container Development Platforms
Q3 2020



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IT ecosystem: over 150 partners that have certified over 1800 container images on OpenShift



IT ecosystem: over 150 partners that have certified over 1800 container images on OpenShift

The image displays a grid of logos for various IT ecosystem partners, categorized by technology area. A large red box in the center contains text about OpenShift's appeal.

AI / ML

- PerceptiLabs, GIGASPACE, FOGHORN, CognitiveScale, PROPHETSTOR, hazelcast, SELDON, H2O

FSI

- FINASTRA, Infosys Finacle, FISERV, TEMENOS, SWIFT

Telco

- SAMSUNG, amdocs, NOKIA

Customer Code

- { | }

Application Platforms

- Azure, aws, SAP, IBM

Big Data

- databricks, CLOUDERA, sas

Monitoring & Management

- dynatrace, INSTANA, APPDYNAMICS (part of Cisco), New Relic

Security

- sysdig, aqua, Twistlock, and

Networking

- TIGERA, CISCO, nuagenetworks

on Runtimes

- Joget, NVIDIA, Lightbend

Tools

- redislabs (HOME OF REDIS), sonatype, ATlassian, GitLab, JFrog

Database

- nuODB, mongoDB, Microsoft SQL Server, crunchydata

Storage

- TRILION, STORAGEOS, NetApp, ROBIN Storage, portworx

Partners

- Atos, accenture, Capgemini, Cognizant, Deloitte, DXC technology, HCL, IBM, Infosys, NTT DATA, TATA CONSULTANCY SERVICES, Tech Mahindra, wipro

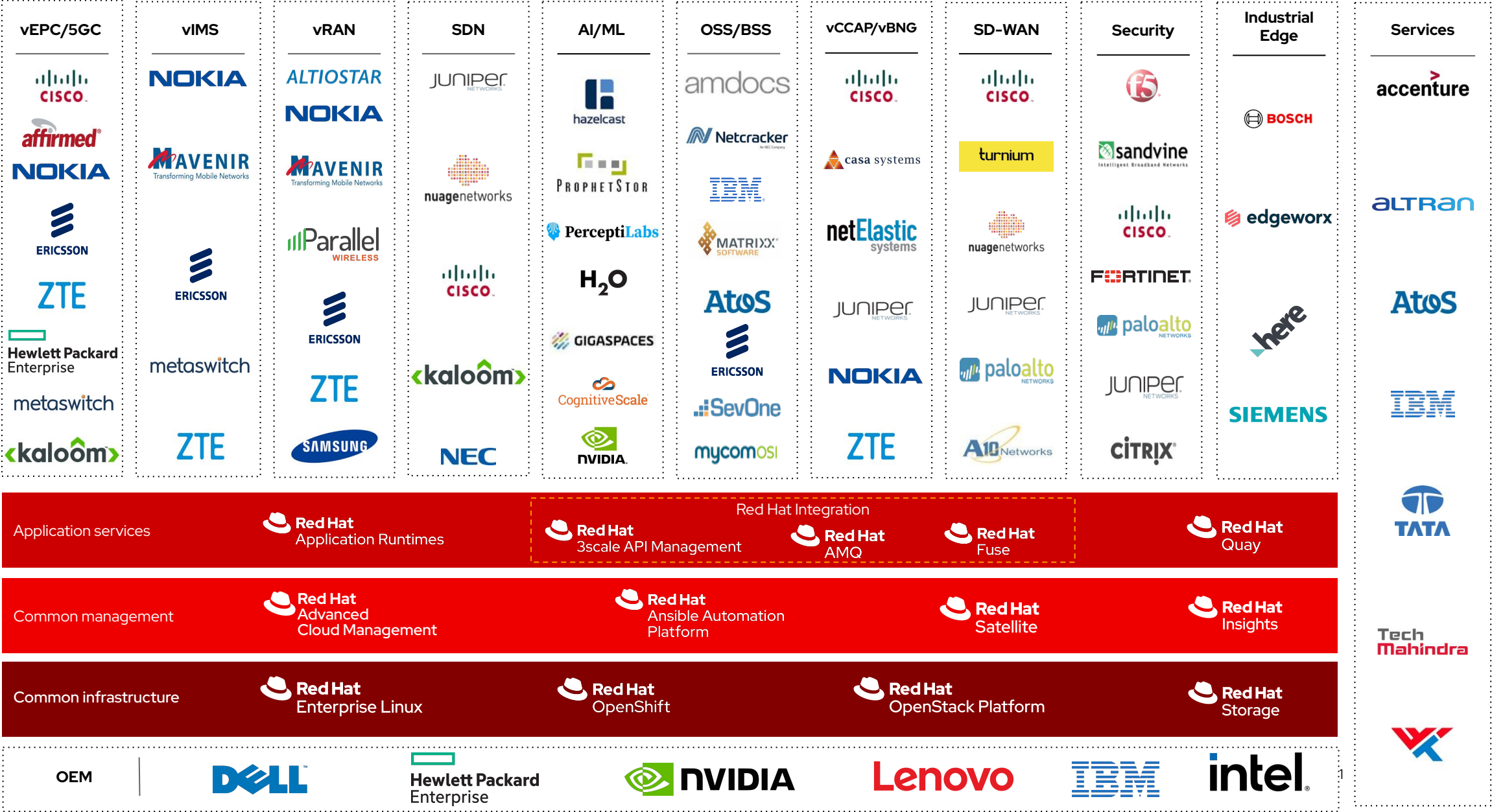
OEMs

- DELL, Hewlett Packard Enterprise, intel, IBM, lenovo, NVIDIA, QCT, V01, SUPERMICRO

Center Text:

This makes OpenShift a very attractive platform for developing applications, on any footprint, including at the edge

Red Hat's VNF/CNF ecosystem



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Validated 5G cores on OpenShift

Red Hat Ecosystem Catalog 1/3

 5G Common Core by ZTE ZTE is the first in the world to launch a 2G/3G/4G/5G/Fixed full access-based Common Core solution based on the SBA architecture to achieve the deep integration of multiple access and help the carrier... Vendor validated	 5G Core with Network Slice Manager and 5GLAN, TSN support functions by Cumucore 5G Core network functions for Non Public Mobile Networks with Network Slice Management Service, 5GLAN and Time Sensitive Network (TSN) component with application functions for integration with fixed... Vendor validated	 A10 Thunder Container ACOS 5 by A10 Networks A10 Networks Thunder Containers is a cloud-native, light-weight set of container-based solutions for secure application services Vendor validated	 Affirmed UnityCloud 5G Core by Affirmed Networks Affirmed UnityCloud™ is a cloud-native solution built on an open, web-scale architecture that enables mobile operators to build an innovative 5G network while reducing the operating cost... Vendor validated	 Casa Axyom™ 5G Multi Access Core by Casa Systems Casa Systems is pioneering advanced ultra-broadband 5G solutions for mobile, fixed, wireline and converged service providers. Casa's suite of web-scale, high performance core and access solutions... Vendor validated	 Cloud Mobile Gateway (CMG) by Nokia The Nokia Cloud Mobile Gateway performs gateway and related functions within the packet core. It is built to help you address the growth of enhanced broadband and deliver new Internet of Things (IoT)... Vendor validated	 Cloud Mobility Manager (CMM) by Nokia The Nokia Cloud Mobility Manager (CMM) is a control plane function in 3GPP networks that provides the Access and Mobility Management function (AMF) in 5G networks, the Mobility Management Entity (MME)... Vendor validated	 cSRX Container Firewall by Juniper Networks The Juniper cSRX Container Firewall protects your container applications, workloads and environments with advanced security services, including content security, intrusion prevention system (IPS)... Vendor validated
 Alepo Converged Core Solution by Alepo Alepo's Converged Core solution comprises cloud-native 3GPP standards-compliant 5G+4G core network functions (NFs). These NFs are responsible for implementing subscription services, providing secured... Vendor validated	 Altiplano Access Controller by Nokia Altiplano offers a complete suite of Management and Control functions required to operate a broadband network. It's open and programmable architecture addresses needs of both today and tomorrow. Vendor validated	 Avesha Smart Application Load Balancer by Avesha Avesha Smart Application Load Balancer enriches service to service communication across clusters spanning network domains. The load balancer takes defined objectives as inputs, monitors them... Vendor validated	 BIG-IP Service Proxy for Kubernetes (BIG-IP SPK) by FS Networks BIG-IP SPK gives multi-protocol ingress/egress signaling control, security, and visibility for cloud-native 5G, supporting the transition from 4G. Vendor validated	 Exium Secure 5G Core by Exium Exium's 5G network service is built on an open, programmable, reliable, and software-driven Intelligent Cybersecurity Mesh™ that enables secure and private end-to-end connectivity and provides the... Vendor validated	 FortiWeb: Web Application Firewall (WAF) & API Protection by Fortinet FortiWeb, Fortinet's Web Application Firewall, protects your business-critical web applications from attacks that target known and unknown vulnerabilities. The attack surface of your web applications... Vendor validated	 HPE 5G Authentication Server Function (HPE 5G AUSF) by Hewlett Packard Enterprise HPE 5G Authentication Server Function is a cloud native network function. It manages 5G User Equipment (UE) authentication, as per 3GPP standards. Vendor validated	 HPE 5G Core Charging Function by Hewlett Packard Enterprise HPE 5G Core Charging Function (CHF) is 5G SA core network function, supporting 3GPP Converged Charging System functionality. CHF supports online and offline charging feature for multiple services... Vendor validated

Validated 5G cores on OpenShift

Red Hat Ecosystem Catalog 2/3

 Hewlett Packard Enterprise HPE 5G Core Policy Control Function by Hewlett Packard Enterprise HPE PCF is a Carrier grade software solution used to implement convergent policy management and real-time policy decision solutions for the network service providers across the BSS/OSS domain, core... Vendor validated	 Hewlett Packard Enterprise HPE 5G Unified Data Management (HPE 5G UDM) by Hewlett Packard Enterprise HPE 5G Unified Data Management is a cloud native network function, and it controls network user data in a centralized manner, as per 3GPP standards. Vendor validated	 ZTE Industrial 5G Core - ZXUN-i5GC(V7.21) by ZTE ZXUN-i5GC(V7.21) adopts the 5GC private network deployment and the operator-level 5G infrastructure to meet the private network and long-term evolution requirements of the ToB campus. Vendor validated	 JUNIPER NETWORKS Juniper Junos cRPD (Containerized Routing Protocol Daemon) by Juniper Networks The Junos cRPD supports a high-performance, scalable, resilient, control plane stack for both off-box use cases such as routing at the host as well as on-box use cases with SONIC-enabled network... Vendor validated	 VIAVI NITRO Mobility Platform by VIAVI A portable platform layer for End-to-End applications delivering unique visibility to Service Providers, NEMs and Enterprises. With orchestration and workflows enabled through Machine Learning and AI... Vendor validated	 NOKIA Nokia Converged Charging by Nokia Nokia's Converged Charging is designed to successfully monetize every opportunity of the 5G economy. It combines the flexibility, agility and scalability of the cloud, with the demanding technical... Vendor validated	 Radisys Radisys Engage Media Server by Radisys Radisys Engage Media Server enables voice and video processing for real-time communication applications, audio and video mixing, transcoding, speech and video analytics, and other advanced media... Vendor validated	 SAMSUNG Samsung 5G Core CNF by Samsung Samsung 5G Core CNF is fully containerized with CNCF compliant open source toolsets. They are based on stateless and micro service architecture and provides Infra agnostic agile cloud native core... Vendor validated
 JUNIPER NETWORKS Juniper Session Smart SD-WAN by Juniper Networks The Juniper Session Smart SD-WAN fuels an advanced, service-centric networking solution that takes software-defined routing to a new level. Ideal for today's digital businesses, the Session Smart... Vendor validated	 Fii Foxconn Industrial Internet 富士通工业互联网 Local 5G Small Cell by Foxconn FHK today develops leading platform solutions for 5G NR Small Cells. Offering the whole RRU, R-Hub, BBU, 5GC and NMS total solution stack based on the ORAN model, allowing interworking with other... Vendor validated	 MATRIX Software MATRIX Digital Commerce Platform (DCP) by MATRIX Software MATRIX Software's Digital Commerce Platform offers a cloud native, 5G-ready standards compliant Converged Charging Solution (CCS) /Online Charging System (OCS) that includes the commerce capabilities... Vendor validated	 NEC NEC 5G Core by NEC A major characteristic of NEC's cloud native 5GC is multicloud compatibility. In addition to the virtualized Evolved Packet Core (VEPC) technology developed since 4G, efforts are underway to deploy... Vendor validated	 BENU NETWORKS SD- Edge Platform by Benu Networks The SD-Edge Platform is a cloud-native solution that virtualizes key network functions (WAG, BNG, 5G AGF) and empowers operators to layer revenue-generating services on top of broadband connectivity. Vendor validated	 turnium Turnium SD-WAN by Turnium A layer 3 overlay that distributes packets across multiple circuits and aggregates the bandwidth of those circuits. Red Hat certified		

Validated private 5G solution on OpenShift

Red Hat Ecosystem Catalog 3/3

 HPE 5G Core Policy Control Function by Hewlett Packard Enterprise HPE PCF is a Carrier grade software solution used to implement convergent policy management and real-time policy decision solutions for the network service providers across the BSS/OSS domain, core... Vendor validated	 HPE 5G Unified Data Management (HPE 5G UDM) by Hewlett Packard Enterprise HPE 5G Unified Data Management is a cloud native network function, and it controls network user data in a centralized manner, as per 3GPP standards. Vendor validated	 Industrial 5G Core - ZXUN-i5GC(V7.21) by ZTE ZXUN-i5GC(V7.21) adopts the 5GC private network deployment and the operator-level 5G infrastructure to meet the private network and long-term evolution requirements of the ToB campus. Vendor validated	 Juniper Junos cRPD (Containerized Routing Protocol Daemon) by Juniper Networks The Junos cRPD supports a high-performance, scalable, resilient, control plane stack for both off-box use cases such as routing at the host as well as on-box use cases with SONiC-enabled network... Vendor validated	 NITRO Mobility Platform by VIAVI A portable platform layer for End-to-End applications delivering unique visibility to Service Providers, NEMs and Enterprises. With orchestration and workflows enabled through Machine Learning and AI... Vendor validated	 Nokia Converged Charging by Nokia Nokia's Converged Charging is designed to successfully monetize every opportunity of the 5G economy. It combines the flexibility, agility and scalability of the cloud, with the demanding technical... Vendor validated	 Radisys Engage Media Server by Radisys Radisys Engage Media Server enables voice and video processing for real-time communication applications, audio and video mixing, transcoding, speech and video analytics, and other advanced media... Vendor validated	 Samsung 5G Core CNF by Samsung Samsung 5G Core CNF is fully containerized with CNCF compliant open source toolsets. They are based on stateless and micro service architecture and provides Infra agnostic agile cloud native core... Vendor validated
 Juniper Session Smart SD-WAN by Juniper Networks The Juniper Session Smart SD-WAN fuels an advanced, service-centric networking solution that takes software-defined routing to a new level. Ideal for today's digital businesses, the Session Smart... Vendor validated	 Local 5G Small Cell by Foxconn FHK today develops leading platform solutions for 5G NR Small Cells. Offering the whole RRU, R-Hub, BBU, 5GC and NMS total solution stack based on the ORAN model, allowing interworking with other... Vendor validated	 MATRIX Digital Commerce Platform (DCP) by MATRIX Software MATRIX Software's Digital Commerce Platform offers a cloud native, 5G-ready standards compliant Converged Charging Solution (CCS) /Online Charging System (OCS) that includes the commerce capabilities... Vendor validated	 NEC 5G Core by NEC A major characteristic of NEC's cloud native 5GC is multicloud compatibility. In addition to the virtualized Evolved Packet Core (VEPC) technology developed since 4G, efforts are underway to deploy... Vendor validated	 SD- Edge Platform by Benu Networks The SD-Edge Platform is a cloud-native solution that virtualizes key network functions (WAG, BNG, 5G AGF) and empowers operators to layer revenue-generating services on top of broadband connectivity. Vendor validated	 Turnium SD-WAN by Turnium A layer 3 overlay that distributes packets across multiple circuits and aggregates the bandwidth of those circuits. Red Hat certified		

Solution Blueprints : Simplifying the creation of edge stacks

Bringing the Red Hat portfolio and ecosystem together – from services to the infrastructure

Blueprint as code

Go beyond documentation using
GitOps process to simplify deployment

From POC to production

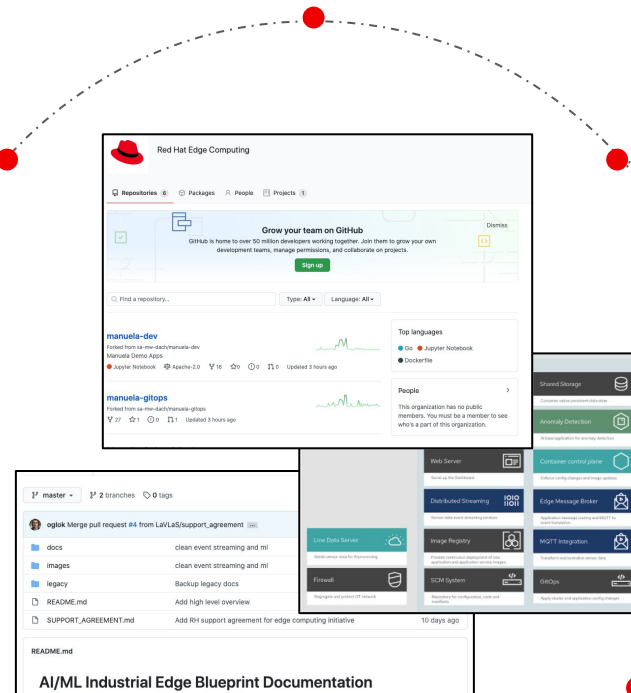
Ensure your teams are ready
to operate at scale

Highly reproducible

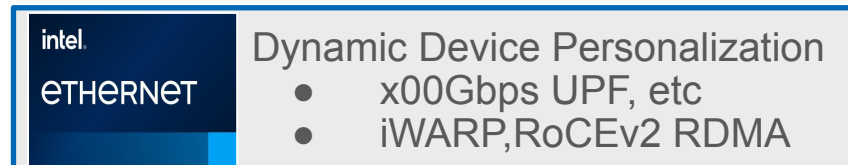
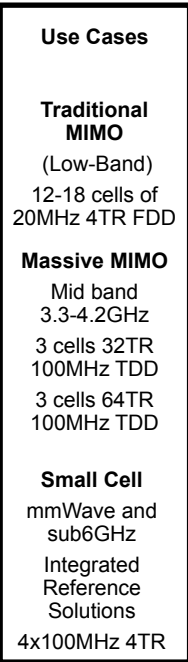
So that you can scale out your
deployments with consistency

Open for collaboration

Anyone can suggest improvements,
contribute to it



ISVs



Solutions/blueprints for private 5G networks and edge computing

Powered by Red Hat OpenShift



Foxconn Industrial Internet solution, 5G for Industry 4.0



casa systems



NBYCOMP
NearbyComputing



5G in a box solution for private networks



Tofino P4-programmable
Ethernet switch ASIC

Distributed Edge solution with OpenShift control plane,
UPF and switching fabric in just 3 RUs



Citizens Broadband Radio Service
(CBRS) and MEC reference architecture

[Industry 4.0 - The Future of 5G](#), Red Hat YouTube video with Foxconn

[Local 5G Small Cell Provided by Foxconn](#), Red Hat Ecosystem Catalog entry, extract from October 2021

[5G in a Box: The Game-Changer for Telco Industry Leaders](#), Lenovo solution brief, August 2021

[Kaloôm and Red Hat Unified Solution for the Distributed Edge](#), Kaloôm solution brief, August 2020

[Reference Architecture Guide – Dell Technologies Multi-access Edge Computing \(MEC\) 1.1](#), August 2021

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Thank you

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