

Akraino Community Accomplishments

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 **LF** EDGE

 **THE LINUX** FOUNDATION



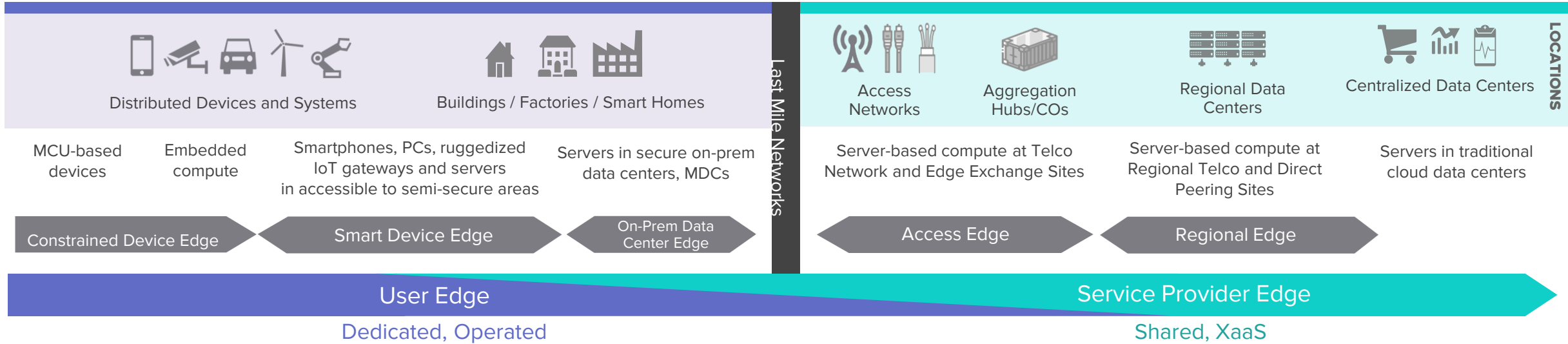
LF Edge Projects



Stage 1: At Large Projects
Baetyl, Open Horizon, Secure Device

Stage 2: Growth Projects
EVE, Fledge, Home Edge, State of the Edge

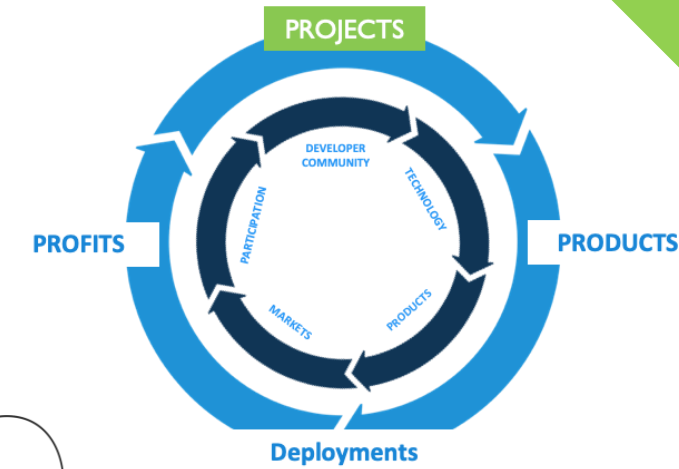
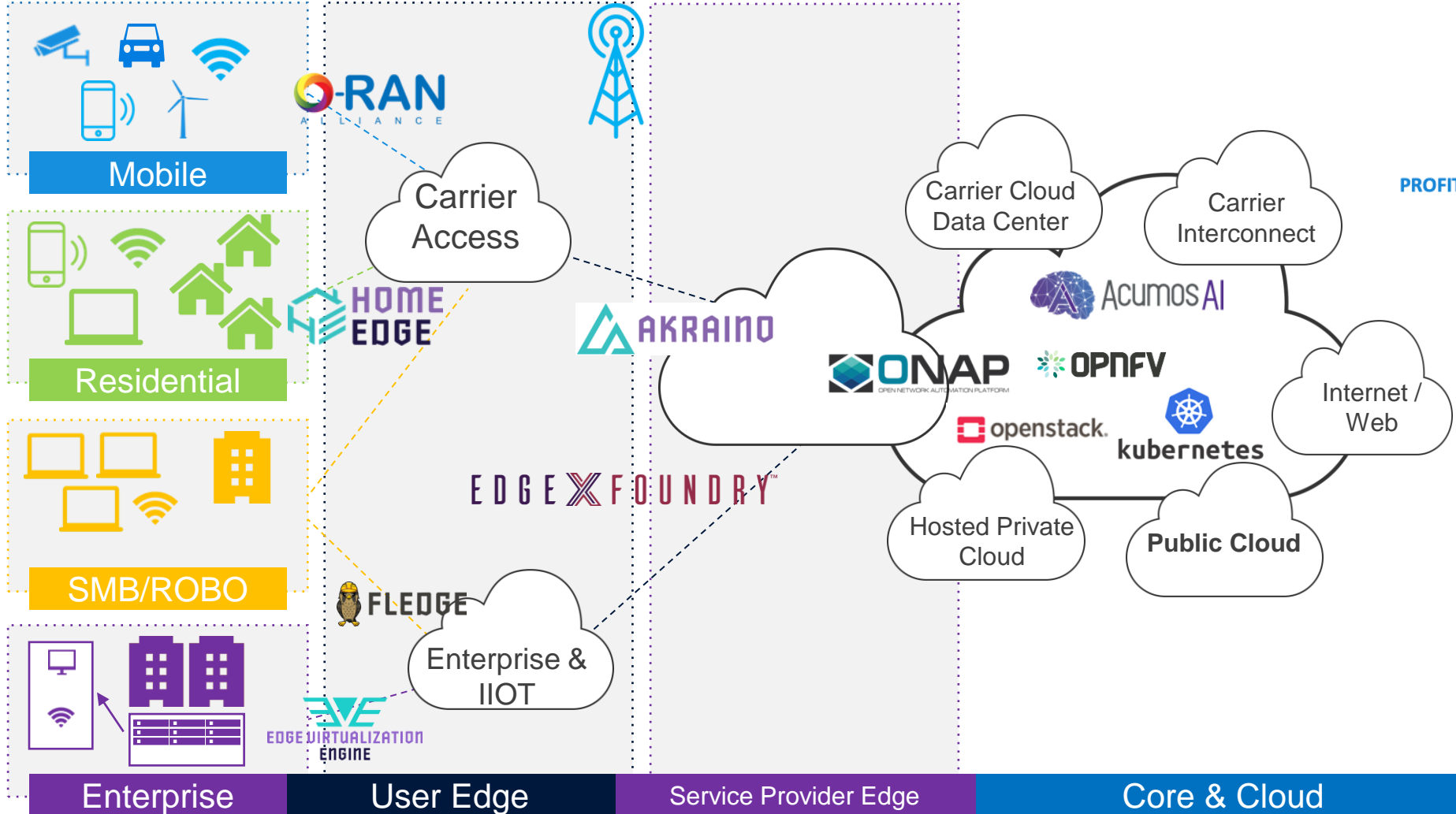
Stage 3: Impact Projects
Akraio, EdgeX Foundry



LF Edge - the end-to-end context

Deployment ready Open Source - use cases

OSS+SDO



ETSI ISG MEC
World Class Standards

AEECC
AUTOMOTIVE EDGE
COMPUTING CONSORTIUM

industrial internet
CONSORTIUM

X-Project Collaboration

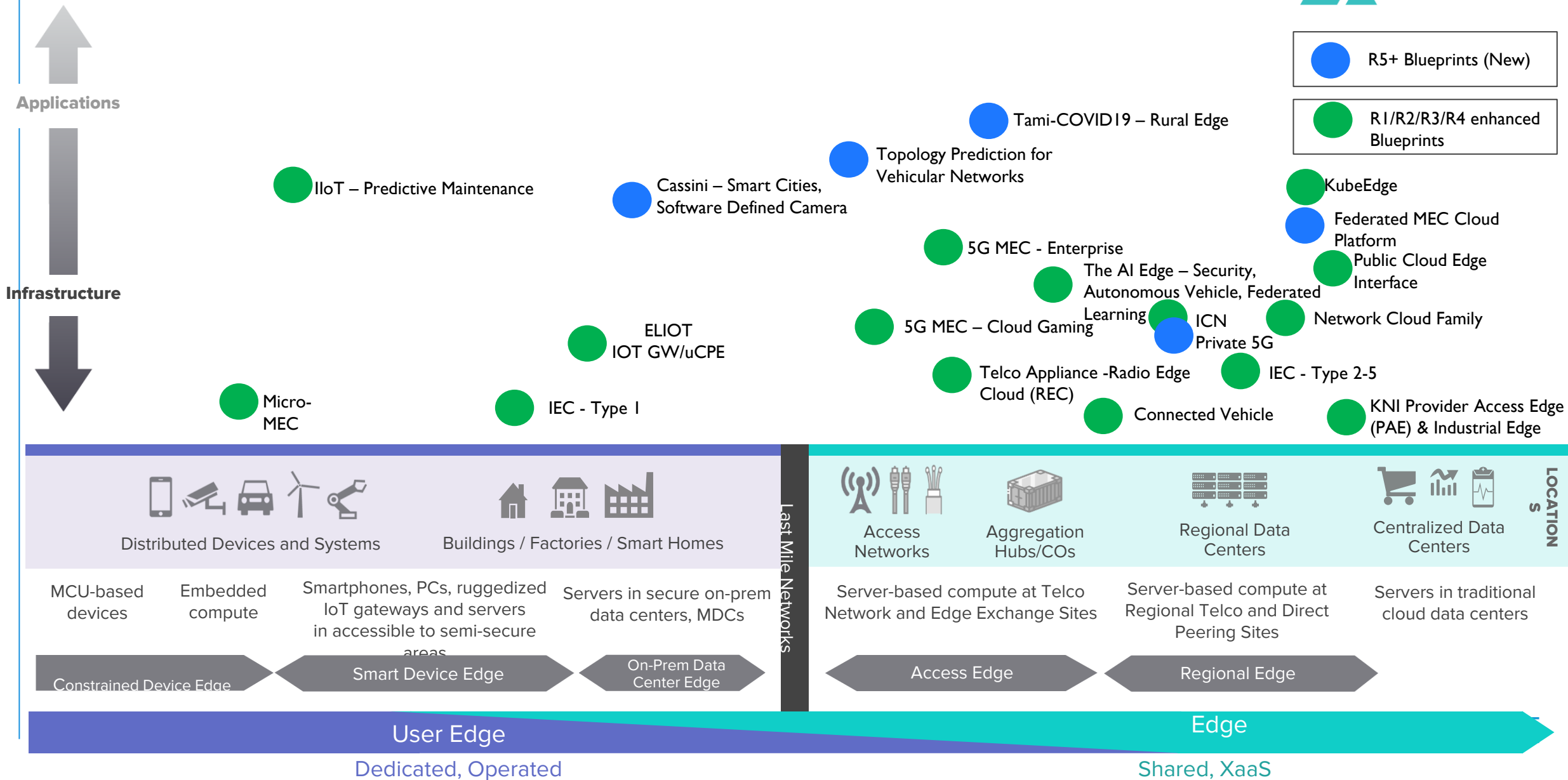
Akraino Release 5: Now available

Akraino Release 5 Enables Smart Cities, Cloud Native Automotive and Multi-tenant, and More

- *3 New Akraino R5 Blueprints (total of 30+)*
- *Akraino is cloud native with K8s- enabled blueprints across 4 different edge segments (Industrial IOT, ML, Telco, and Public Cloud)*
- *New and updated blueprints also target Smart Cities, ML, Connected Car, Telco Edge, Enterprise, AI, and more*

[LF Edge](#), an umbrella organization within the [Linux Foundation](#) that creates an open, interoperable framework for edge computing independent of hardware, silicon, cloud, or operating system, today announced the availability of [Akraino](#) Release 5 (“Akraino R5”). Akraino’s fifth release enables additional blueprints that support various deployments of Kubernetes across the edge, from Industrial IoT, to Public Cloud, Telco, Smart Cities, and Machine Learning (ML).

Akraino R5+ Blueprints



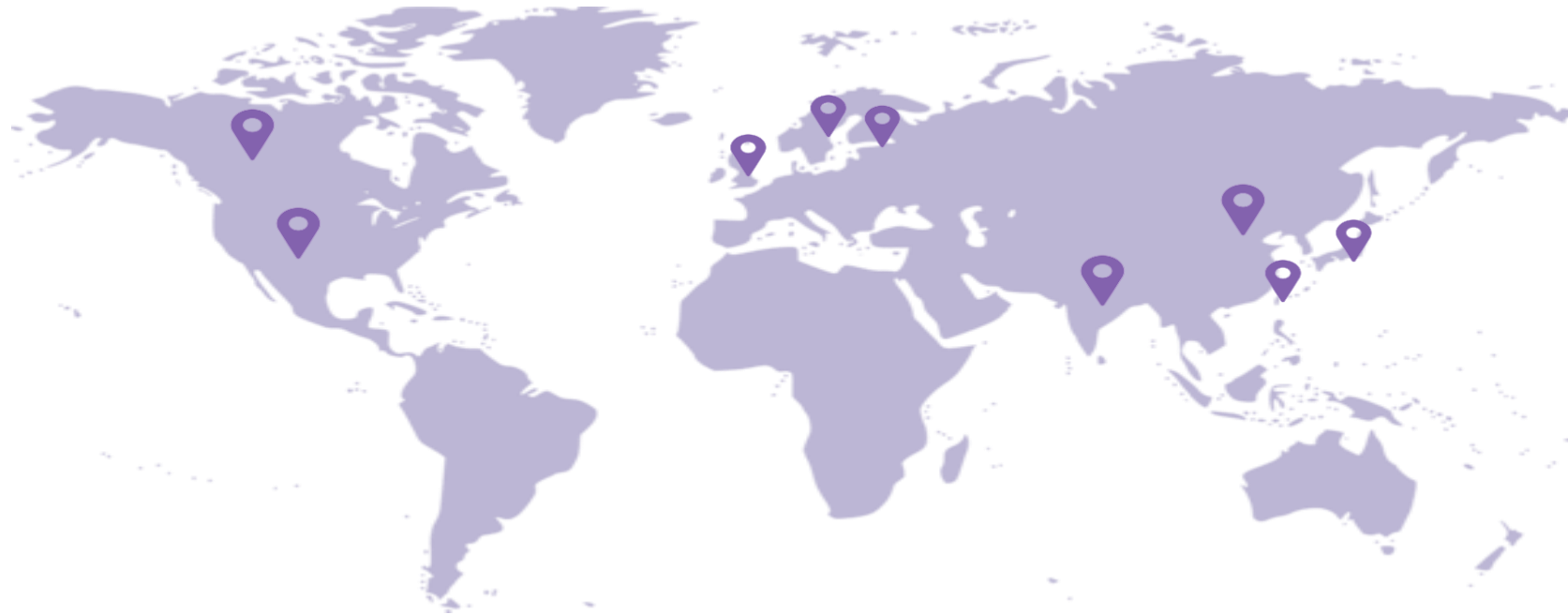
Akraino: Delivering a Fully Functional Edge Solutions

Unifying multiple industry sectors of edge across disciplines, including IoT, Enterprise, Telecom, and Cloud

- Ever since its launch in 2018, Akraino continues to **gain community support** for innovative creation of deployable Edge solutions with work going in more than **30+ Blueprints**.
- Akraino blueprints are now globally adopted in **commercial solutions** to address several edge use cases.
- Akraino hosts sophisticated community and multiple **user labs** to speed the edge innovation.
- Akraino delivered fully functional **new** Blueprints for deployment in R5 to address edge use cases such as Smart Cities, Cloud Native Multi-Tenant, Topology Prediction for Vehicular Network at the edge.
- Created framework for defining and **standardizing APIs** across stacks, via upstream/downstream collaboration and published an API map.
- Akraino enhanced **tools for automated Blueprint Validations**, security tools for Blueprint Hardening and Edge APIs in collaboration with LF Edge projects
- Akraino community has participated in several **industry outreach** events that featured participation to foster collaboration and engagement on edge projects across the entire ecosystem.

Robust Community Contribution

Deployable and fully functional edge stack for use cases across IIoT, Telco 5G Core & vRAN, uCPE, Provider Access Edge, SDWAN, Edge Media Processing, and Carrier Edge Media Processing



- ✓ 45+ companies are engaged across the globe
- ✓ 85% of LF Edge Premier Members are active in Akraino

Robust Cross-Industry Contribution- 2020.8 -2021.8

Deployable and fully functional edge stack for use cases across Public Cloud Edge Interface, IIoT, Telco 5G Core & vRAN, uCPE, SDWAN, Connected Vehicle, AR/VR, and Carrier Edge Media Processing

Summary

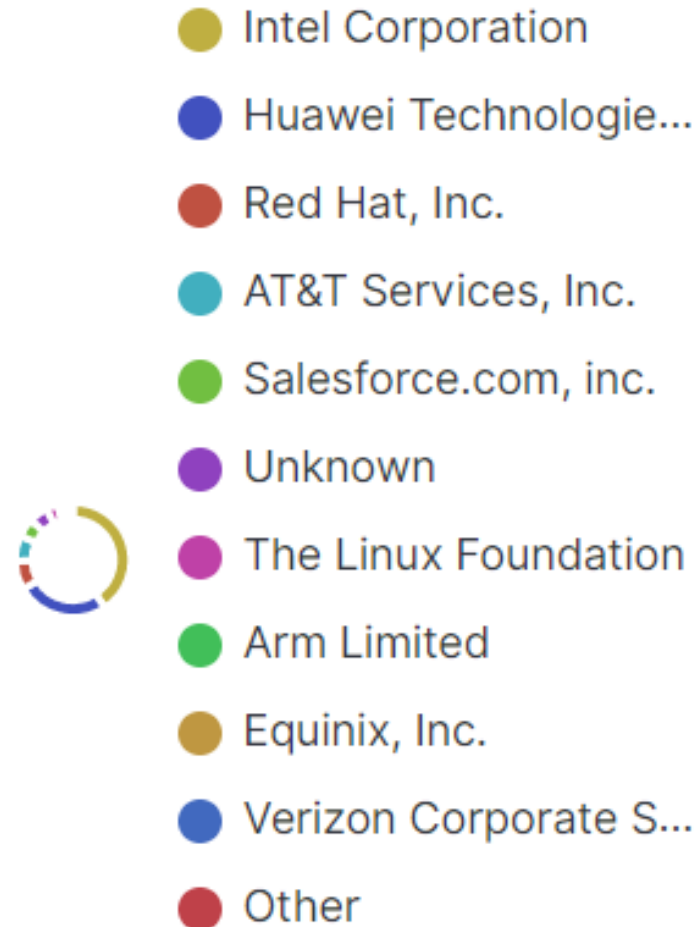
439
Commits

38
Submitters

23
Repositories

76
Document
Commits

Commits Percentage By ... ⓘ

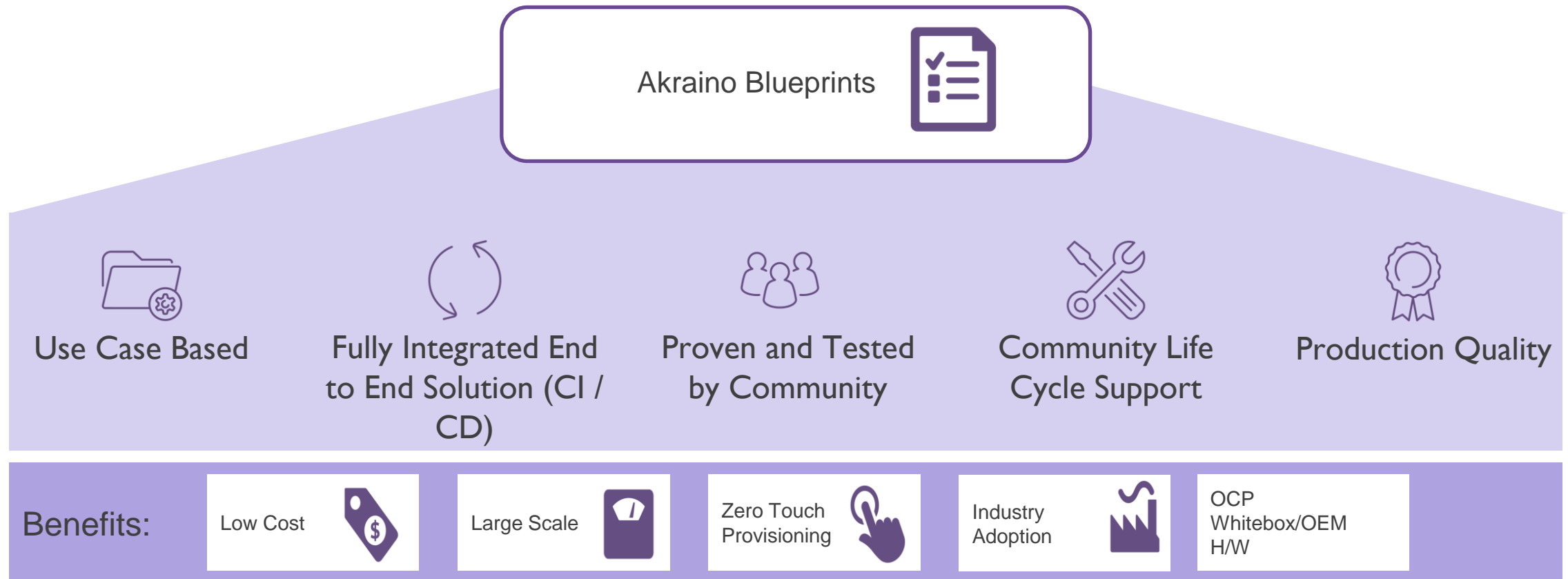


Lines Changed Percenta... ⓘ



What is an Akraino Blueprint?

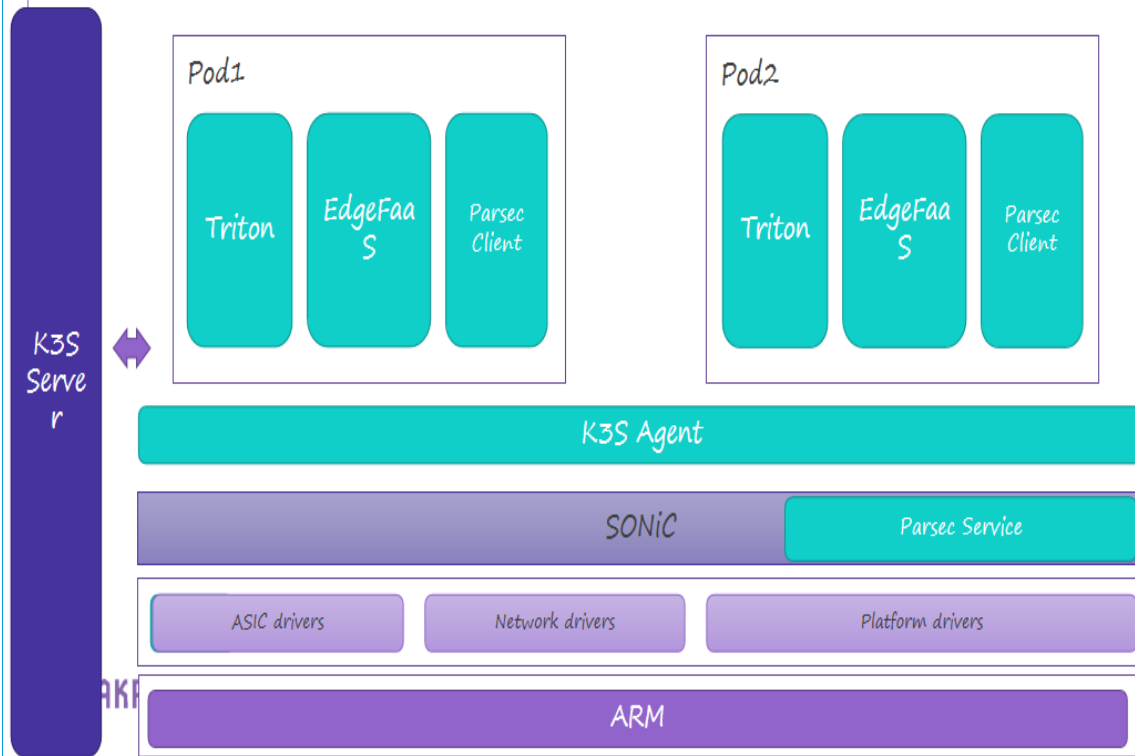
Community Integrated, tested, deployable, end to end Edge Stack



Since launch in 2018, Akraino continues to gain community support for collaboration and validation with 30+ blueprints

Smart Cities

BP Family: Project Cassini – IoT and Infrastructure Edge



Features:

- Smart Cities blueprint's security components is PARSEC.
- Parsec is the Platform AbstRaction for SEcURITY, a new open-source initiative to provide a common API to secure services in a platform-agnostic way.
- Parsec aims to define a universal software standard for interacting with secure object storage and cryptography services, creating a common way to interface with functions that would traditionally have been accessed by more specialized APIs.

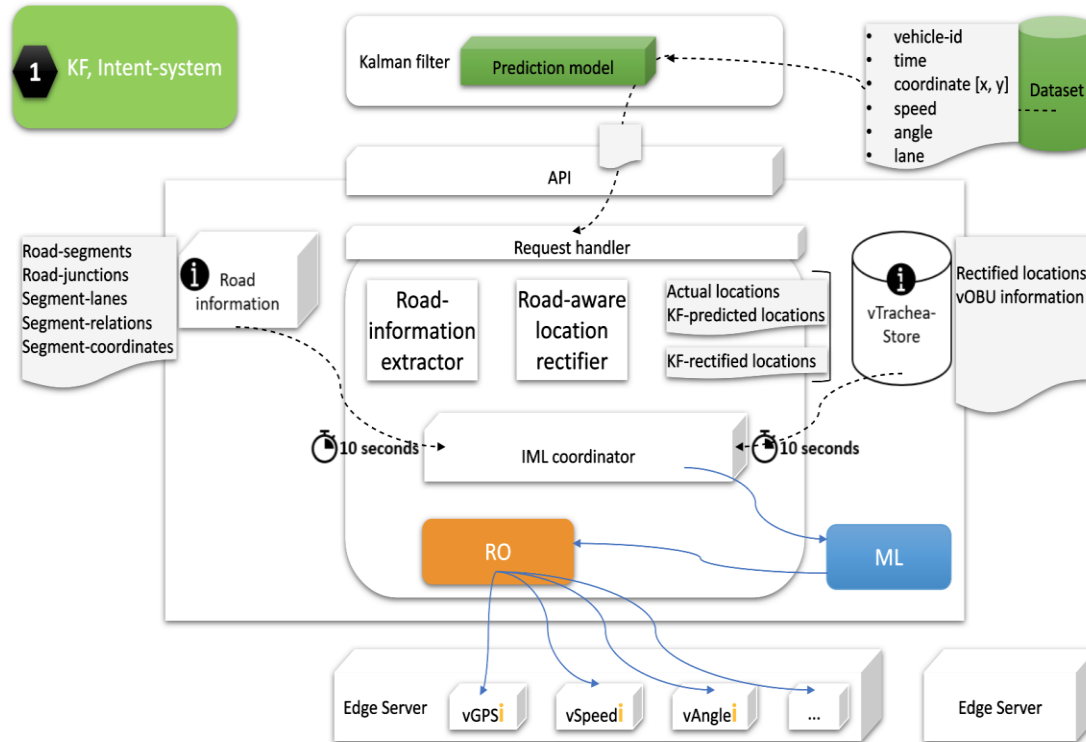
Use cases & Applications

- All of the use cases under Project Cassini
- Multiple workloads on devices and gateways, deployed through containers

Target Industry: Smart Energy, Smart building

MEC-based Stable Topology Prediction for Vehicular Networks

Area: Automotive



Features:

- Prediction of vehicle locations
- Rectification of predicted locations
- Intent-based design

Use cases & Applications

- The objective is to provide end-device information or the information of its surroundings at the edge.
- As it is a known fact that the installed sensors have different processing capacity because of which the provisioning of continuous data isn't possible.
- Focusing the problem, we intend to use the prediction and rectification techniques to enhance the process which provision information to MEC applications.
- This design and approach tends to solve the problem of latency and enables the MEC applications to be proactive.

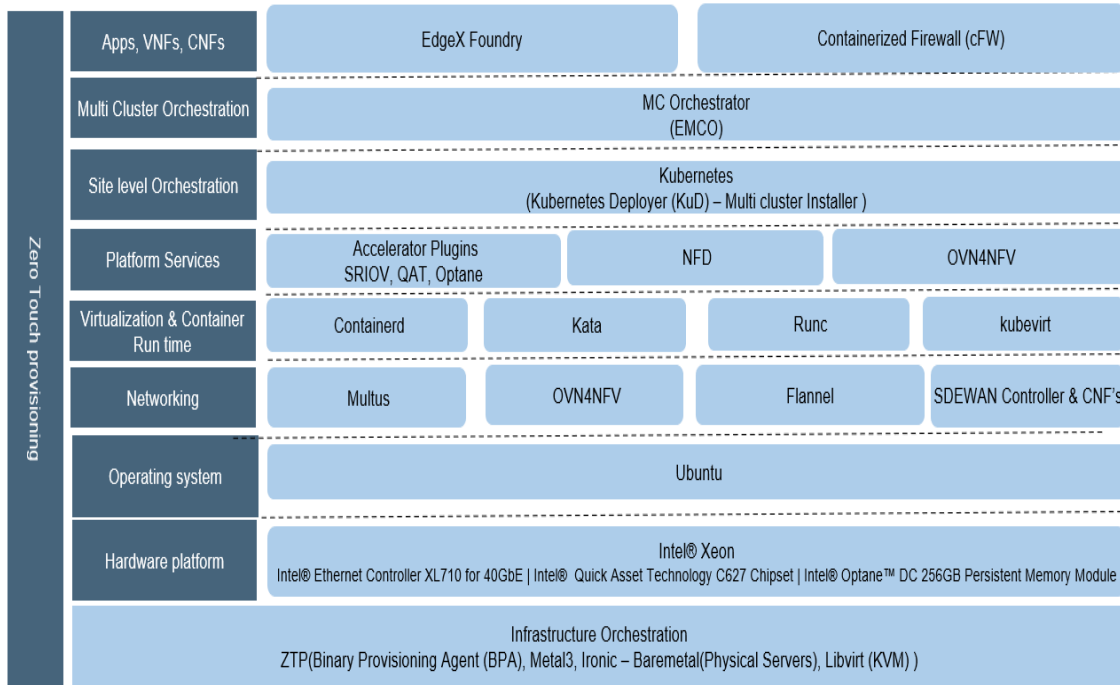
Target Industry: Internet of Vehicles (IoV)

Multi-Tenant Secure Cloud Native Platform



BP Family: ICN

ICN-MTSCN R5 Release



Features:

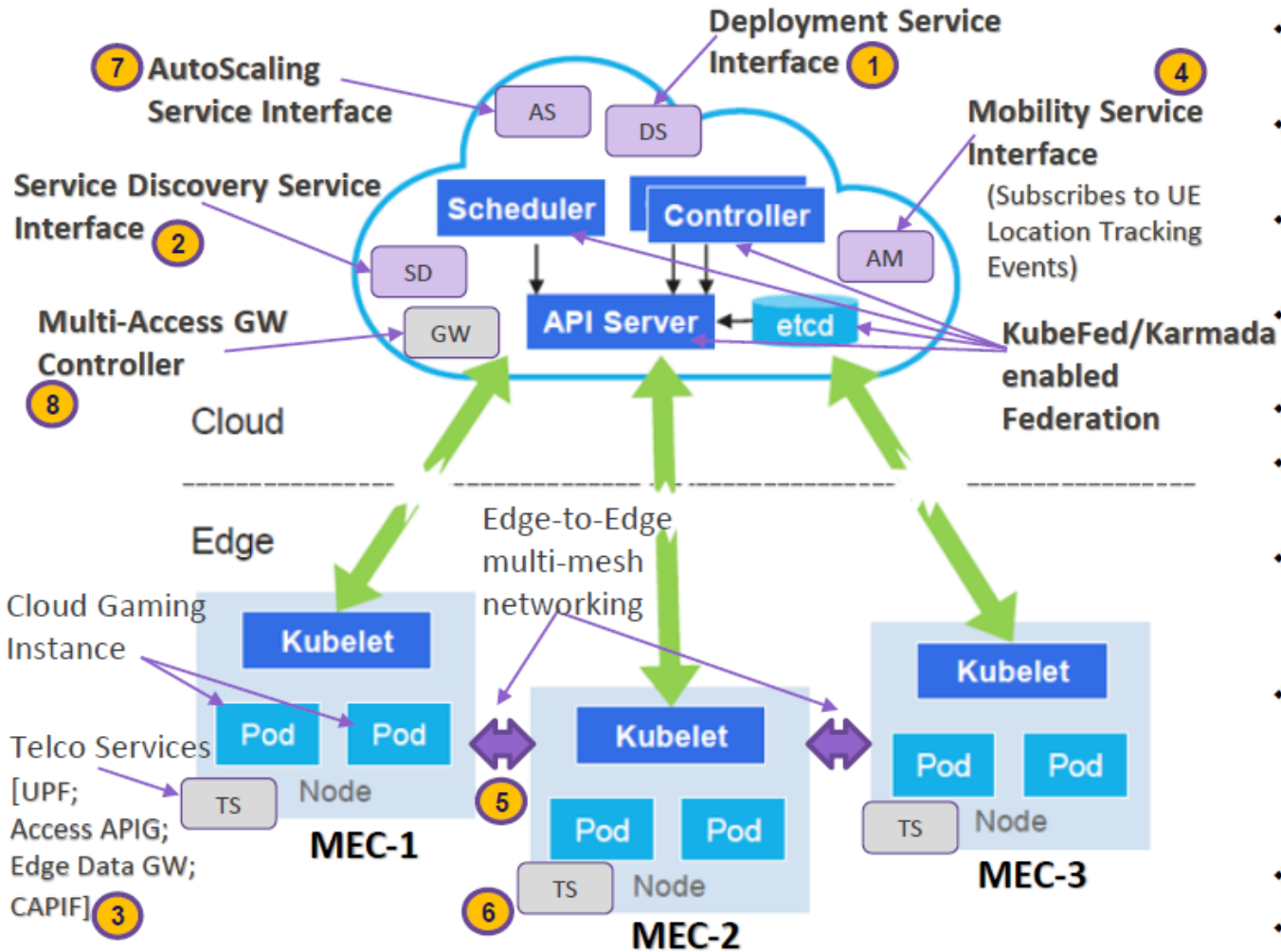
- Enables Kata Containers and Containerd that can be used for hard multitenancy use cases.
- Zero Touch provisioning (ZTP) using Binary provisioning agent (BPA) using Metal3, Ironic – Baremetal provider (Baremetal deployment) and libvirt provider (KVM)
- Kubernetes Deployer (KuD) is being containerized and a single solution deploy various addons such as Multus, OVN, Flannel, Accelerator plugins (SRIOV), QAT, NFD, Nodus, Multi cluster Orchestrator (EMCO), Application such Composite Containerized Firewall(cFW), and SDEWAN CNFs, SDEWAN Controller
- ICN enable nested K8s use case, where K8s is used to manage both under cloud (Baremetal provider) and Overcloud (k8s inside VM)

Target Industry: SDEWAN

Use cases & Applications

- Software Defined Edge WAN – SDEWAN controller, Composite vFW and Service Function Chaining (SFC), but also focuses on hard multitenancy use cases. enables the MEC applications to be proactive.

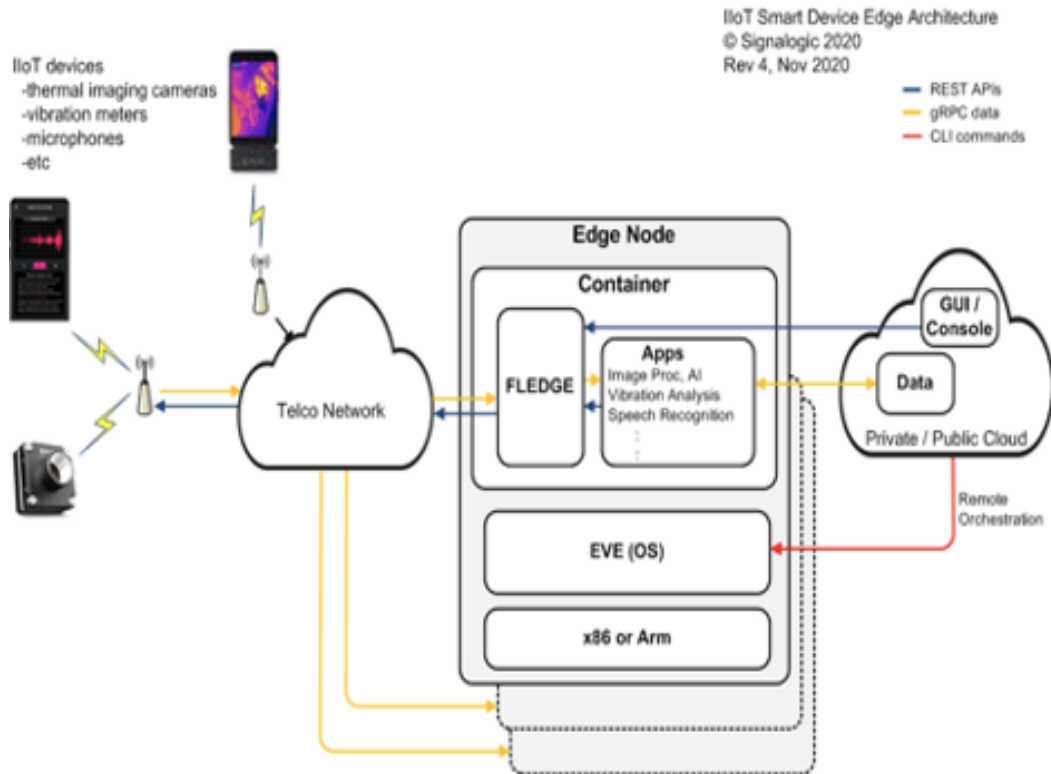
PCEI - Federated Multi-Access Edge Cloud Platform



- ❖ KubeEdge provides the logical MEC station abstraction by using K8S labels to group edge nodes into logical MEC stations. (1)
- ❖ Operator deploys cloud gaming workload to the specified MEC station/s in accordance to the MEC application placement policies. (1)
- ❖ UE retrieves the optimal location-aware endpoint address of the edge node (using cloud core side Service Discovery service interface). (2)
- ❖ UE establishes session to the retrieved edge cloud telco UPF service (provides support for multi-access protocols). (3)
- ❖ UE connects to the cloud gaming service instance on the edge node.
- ❖ Cloud Core side mobility service subscribes to UE location tracking events or resource rebalancing scenario. (4)
- ❖ Upon UE mobility or resource rebalancing scenario, mobility service uses Cloud core side Service Discovery service interface to retrieve the address of new appropriate location-aware edge node. (2)
- ❖ Cloud Core side mobility service initiates UE application state migration process between edge nodes.
 - ❖ Edge-to-Edge state migration (using east-west multi-mesh networking). (5)
- ❖ UE connects to new edge telco UPF service. (6)
- ❖ Redirect UE connection to the new cloud gaming service instance on the new edge node.

Predictive Maintenance with a Thermal Imaging Camera, vibration sensors, etc.

BP Family: IoT Workloads at the Smart Device Edge



Features:

- LF Edge's Project EVE-OS to provide remote management, Zero Trust security (physical and software)
- LF Edge's Fledge as an IloT framework for sensors, historians, DCS, PLC's, and SCADA systems and connectivity to public or private clouds
- Remote monitoring and updating of applications, without bricking the device
- AI Models, real time data capture, and cleansing at the device edge
- Sample application that can be customized to meet many different Use Cases

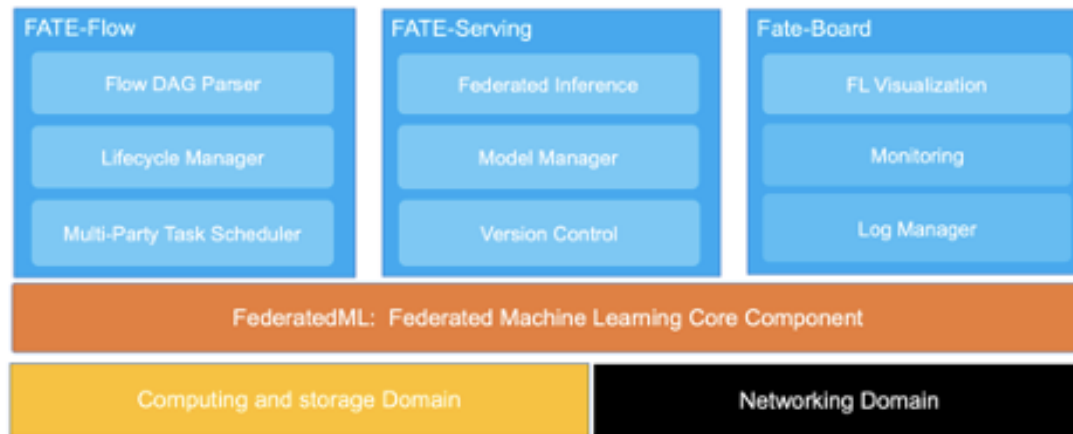
Use cases & Applications

- Predictive Maintenance
- Hazards monitoring (People detection in hazardous area)

Target Industry: Manufacturing, Industrial Shop Floor

The AI Edge: Federated ML Application at Edge

BP Family: AI Edge



Target Industry: Driverless cars, Warehouse

Purpose

To provide a Federated Learning Platform that trains Machine Learning algorithm across edge devices without them sharing the data that make up the models.

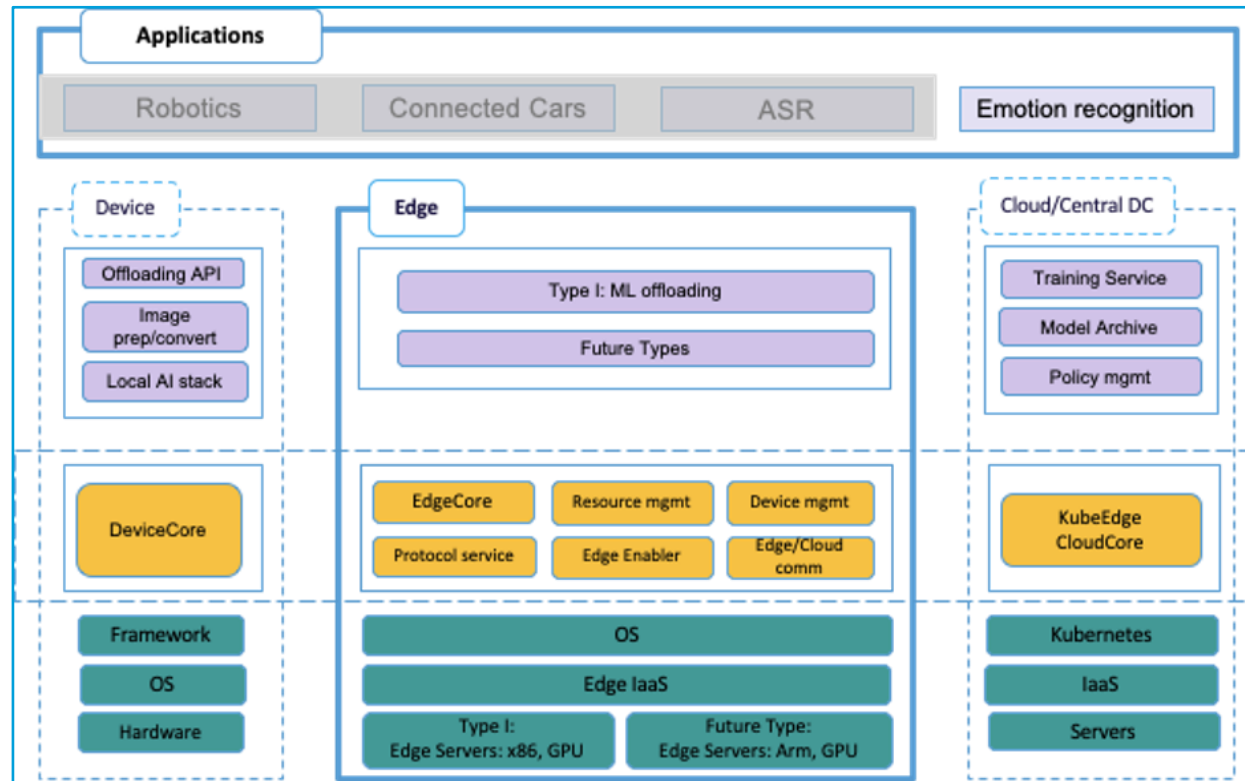
Features

- FATE first unsupervised learning algorithm: Hetero KMeans
- Add Data Split module: splitting data into train, validate, and test sets inside FATE modeling workflow
- Add Data Statistic module: compute min/max, mean, median, skewness, kurtosis, coefficient of variance, percentile, etc.
- Add PSI module for computing population stability index

Landing Applications of The AI Edge: Federated ML application at edge

KubeEdge Edge Service

BP Family: KubeEdge



Purpose:

- First Release will focus on the ML inference offloading Use Case

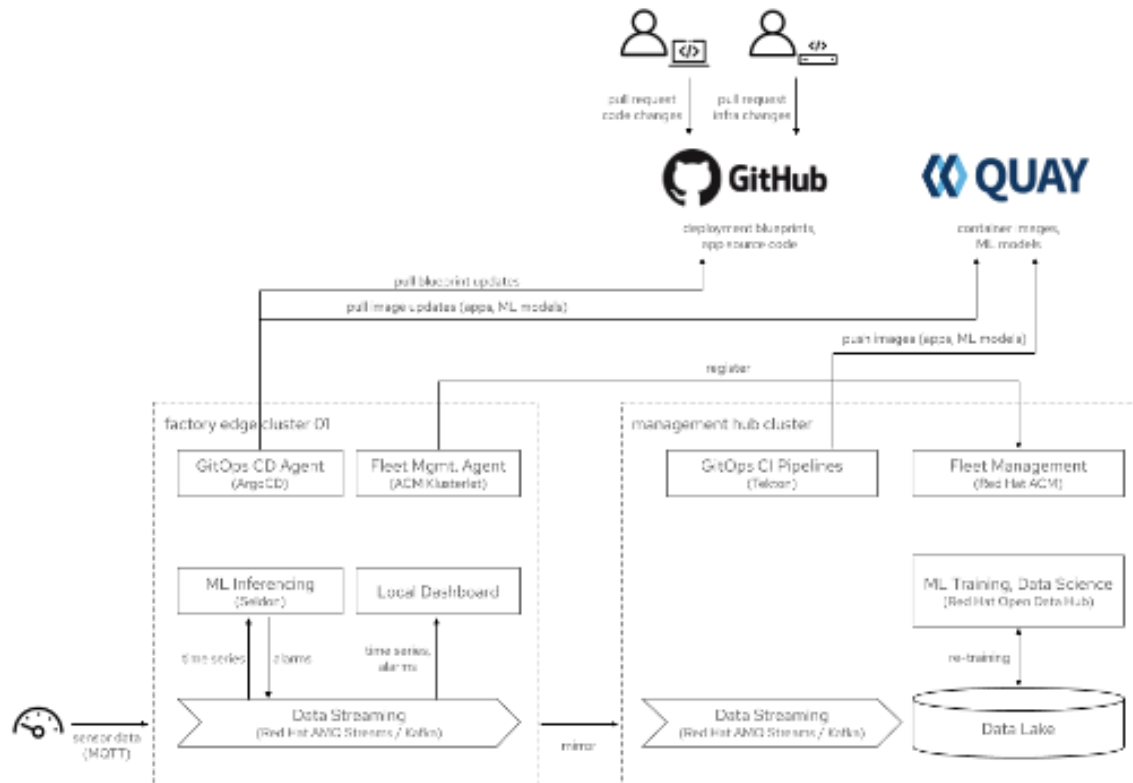
Features:

- KubeEdge managed Application deployment and life cycle management
- ML offloading to Edge server
- Cloud(training), Edge (Inference), Device collaboration

Target Industry: Smart road, Cold chain logistics, Smart building, etc.

Kubernetes Native Infrastructure for Industrial Edge

BP Family: KNI



Target Industry: Manufacturing

Purpose/Features:

- Managing edge computing clusters from a central management hub by using Advanced Cluster Manager
- GitOps based application deployment with ArgoCD
- Cloud Native CI/CD Pipelines with Tekton
- Event streaming from edge to core with Kafka AMQ Streams and Mirror Maker
- Machine learning as a data scientist with Jupyter Notebook.

Use cases & Applications

- Machine inference-based anomaly detection

The AI Edge: Intelligent Vehicle-Infrastructure Cooperation System (I-VICS)



BP Family: AI Edge



Purpose/Features:

- Autonomous Valet Parking

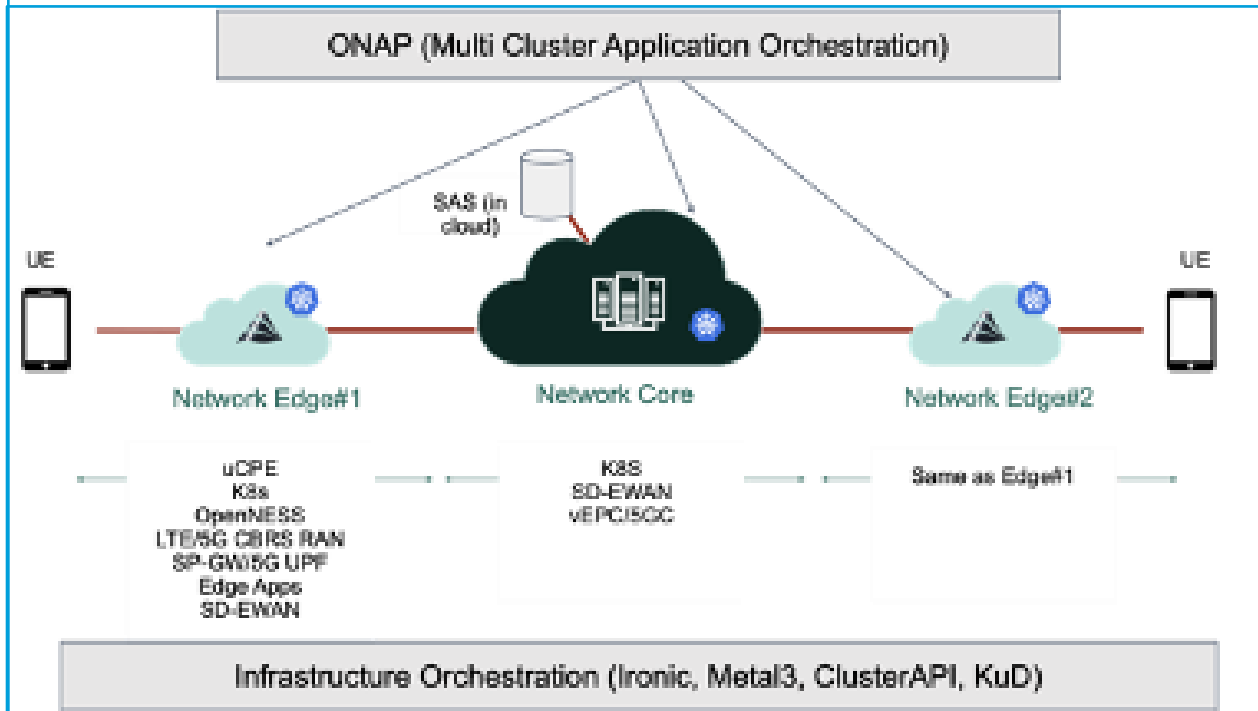
Use cases & Applications

- Starting and testing the behavior planner
- Starting and testing the global planner
- Initializing the NDT localizer
- Running the EKF filter for localization
- Trajectory Following

Target Industry: Autonomous Vehicles

Private LTE/5G ICN

BP Family: ICN



Purpose/Features:

Creating a EPC/5G “in a box” to enable enterprises and operators to deploy LTE/5G
 Uses OSS such as free5GC/Magma

Target Industry: Manufacturing, Retail, Farming, Mining

Public Cloud Edge Interface (PCEI)

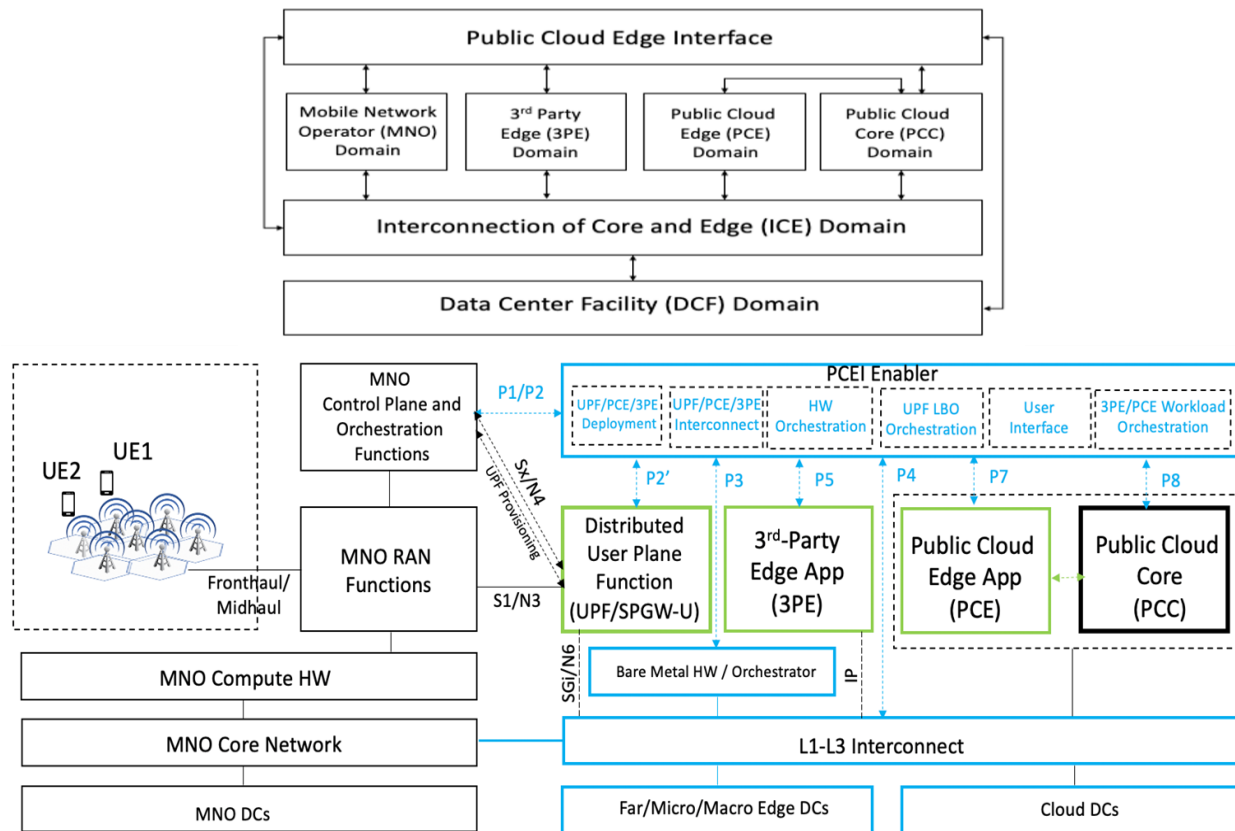
BP Family: Public Cloud Edge Interface

Purpose/Features:

The purpose of Public Cloud Edge Interface (PCEI) Blueprint is to specify a set of open APIs and orchestration functionalities for enabling Multi-Domain Inter-working across functional domains that provide Edge capabilities/applications and require close cooperation between the Mobile Edge, the Public Cloud Core and Edge, the 3rd-Party Edge functions as well as the underlying infrastructure such as Data Centers, Compute hardware and Networks

Use cases & Applications

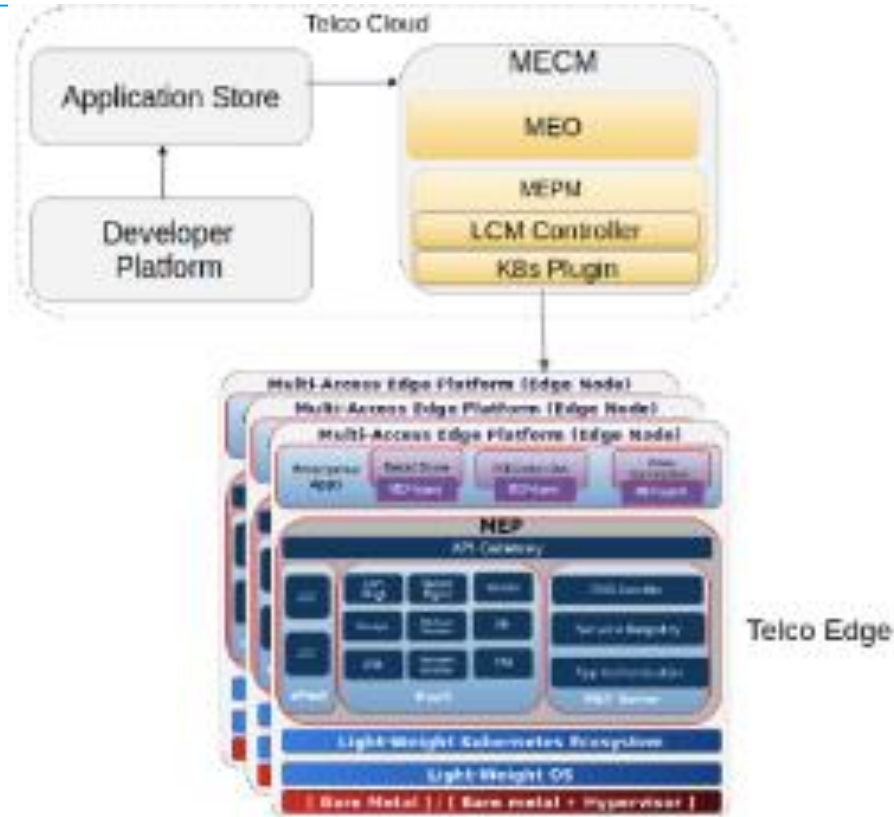
- Edge Multi-Cloud Orchestrator (EMCO) - PCEI Enabler
- Deployment of Azure IoT Edge Cloud Native PCE App
 - Using Azure IoT Edge Helm Charts provided by Microsoft
- Deployment of AWS Green Grass Core PCE App
 - Using AWS GGC Helm Charts provided by Akraino PCEI BP
- Deployment of PCEI Location API App
 - Using PCEI Location API Helm Charts provided by Akraino PCEI BP
- PCEI Location API Implementation based on ETSI MEC Location API Spec
- Simulated IoT Client Code for end-to-end validation of Azure IoT Edge
- Azure IoT Edge Custom Software Module Code for end-to-end validation of Azure IoT Edge



Target Industry: IoT, Developers, Operators, Clouds, DCs, Interconnection

Enterprise Application on Light weight 5G Telco Edge (EALTEdge)

BP Family: 5G MEC/Slice



Target Industry: Telco operators

Purpose/Features:

Provides a complete ecosystem for enterprise applications on light weight 5G Telco Edge. Can be leveraged by Telco operators to provide edge computing capability to it's enterprise users. Overall objective of this blueprint is to provide the following main features.

R4 Improvements

- Leverage EdgeGallery to add application/MEC Edge Orchestrator, Dev Platform, Dev and Tenant Portals
- Built a sample ROBO

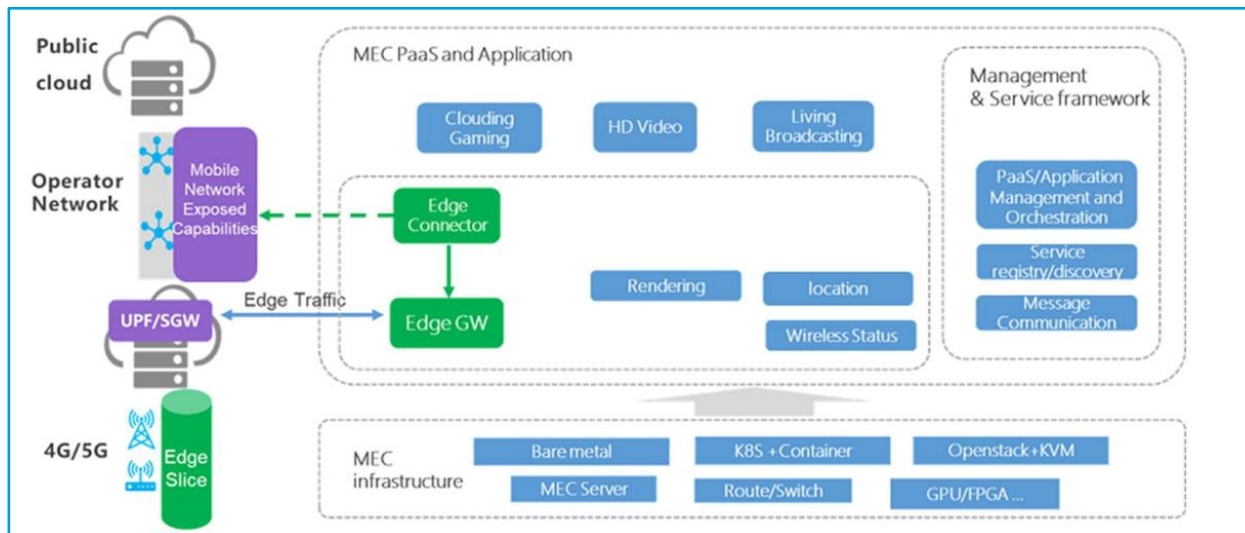
Use cases:

ROBO(Remote office Branch office): Due to limited resource and disaster prone of ROBO sites, edge native storage, Backup and restore on lightweight telco edge is supported. Smart retail with automatic shelf management on ROBO sites is developed and integrated.

Machine Vision on Campus Networks: Centralized processing using wireless cameras, real-time response for detection/feedback; provide shared GPU

5G/MEC Slice System to Support Cloud Gaming, HD Video & Live Broadcast

BP Family: 5G MEC/Slice



Target Industry: Gaming, Video, Broadcast

Purpose/Features:

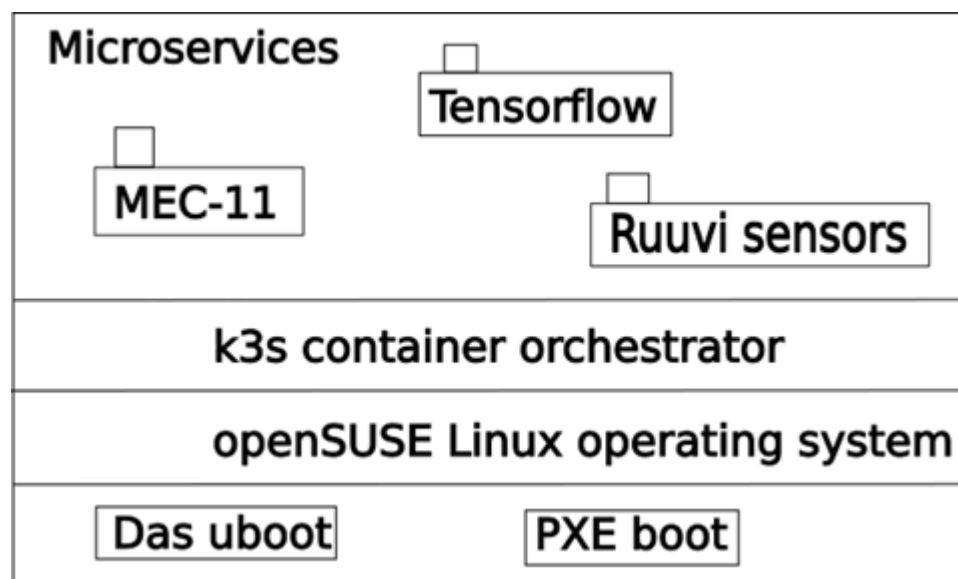
The 5G MEC BP consists of two network elements. One is the edge connector which is deployed in the cloud to enable traffic offloading, subscribe edge slice and implement application lifecycle management etc. The other is the edge gateway which is deployed close to the 4G/5G network to perform traffic steering, Local DNS service and traffic management etc.

Use cases & Applications

- Cloud Gaming
- HD Video
- Live Broadcasting
- Small deployment targeting MEC in access sites or enterprise
- Medium deployment targeting MEC in central offices

Micro Multi-access Edge Computing (MEC)

BP Family: uMEC



Target Industry: Telco Networks

Purpose/Features:

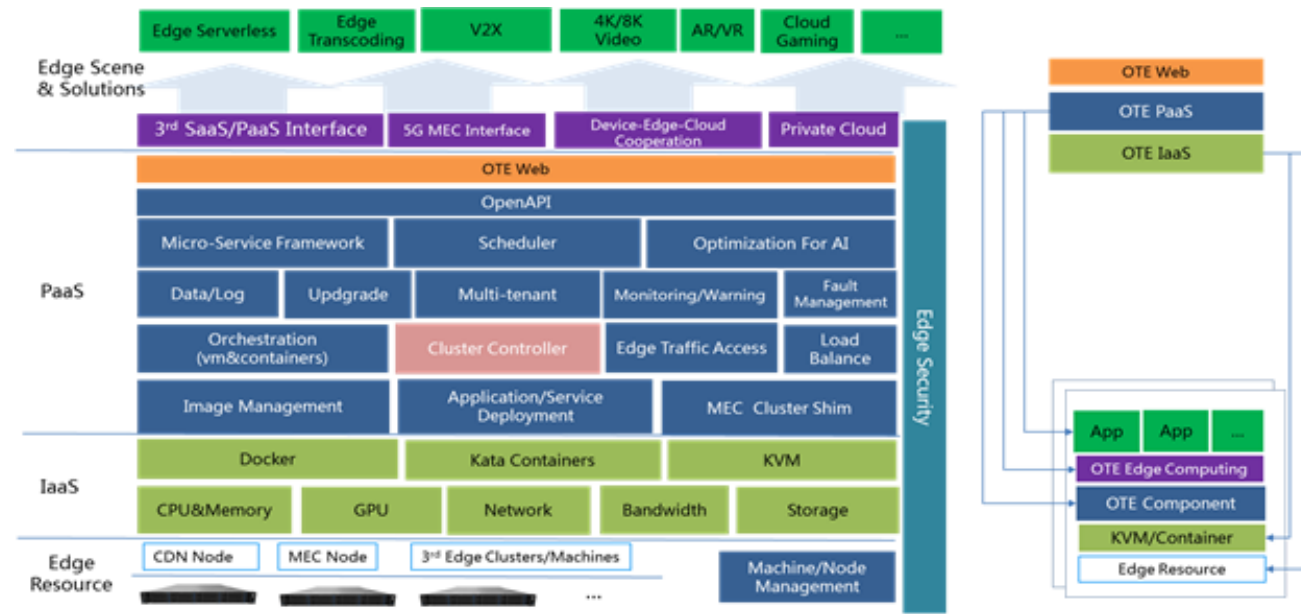
Enables new functionalities & business models on network edge. Benefits include better latencies for end users; less load on network, since more data can be processed locally; and better security and privacy, since sensitive data need not be transferred to a centralized location.

Use cases:

- Fixed installation as part of 5G NR base stations; enables new services that leverage especially low latency, such as AR/VR
- As an extension of the previous, the “Smart City” deployments have additional functions such as weather stations, cameras, displays, or drone charging stations. The control software for these functions would run on the uMEC
- In an Industry 4.0 use case set, the uMEC is deployed as part of a 5G network and would provide a platform for running services for the factory floor
- In a train, the uMEC can collect and store surveillance camera data for later uploading

AI Edge: School/Education Video Security Monitoring

BP Family: AI Edge



Purpose/Features:

Focuses on establishing an open source MEC platform combined with AI capacities at the Edge; can be used for safety, security, and surveillance sectors as well as Intelligent Vehicle-Infrastructure Cooperation Systems.

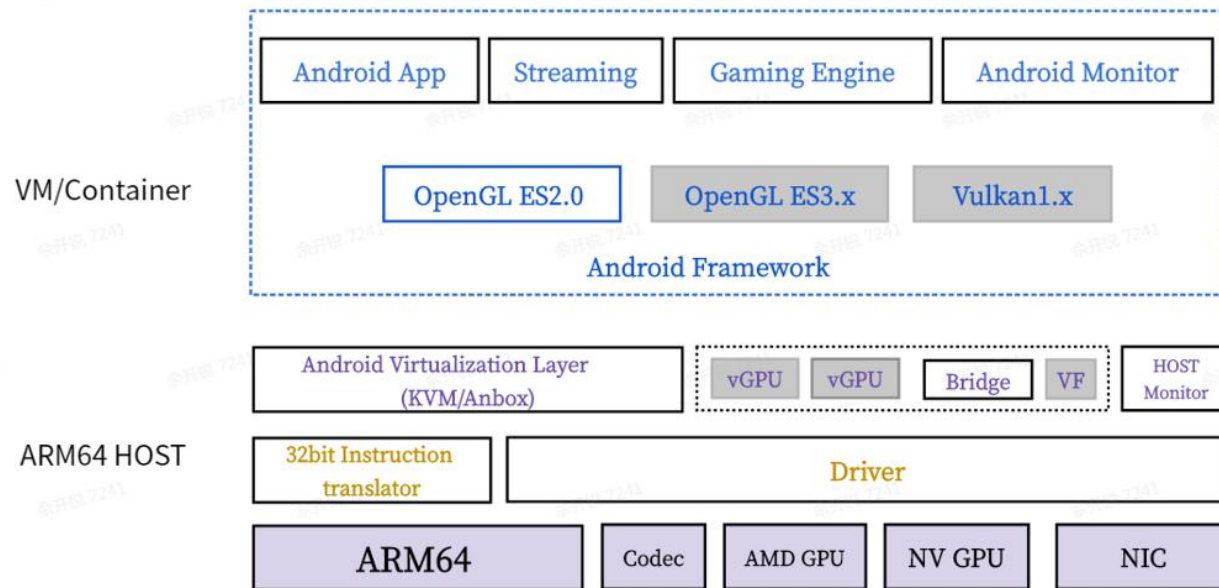
Use cases:

- Hierarchical cluster management
- Duplex channel between cloud center and edge cluster
- Kubernetes native support
- Accurate routing of messages between clusters
- Support both x86 and arm64

Target Industry: Education, Home

IEC Type 3: Arm-Enabled Android Cloud Applications

BP Family: IEC



Target Industry: Gaming

Purpose/Features:

Supports Android applications and services running on Arm-enabled cloud architectures with GPU/vGPU EC management. Arm-based- cloud games need basic “cloud” features, such as flexibility and broad availability, which this blueprint provides.

R4-

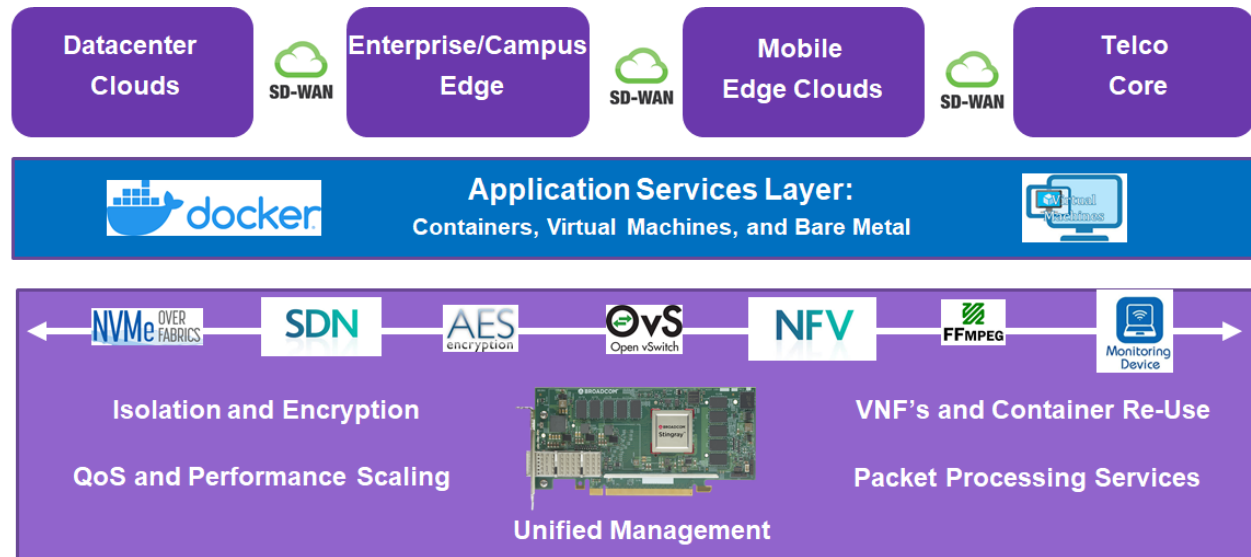
- Android application environment based on Robox
- GPU Support

Use cases:

- **Android Cloud Games:** compress the rendering of game scenes into video and audio streams on the edge Android platform. Then edge cloud server transmits the compressed game pictures to the players' game terminals through a 5G network, and obtains the players' input instructions to realize interaction. End to end latency better $\leq 20\text{ms}$.
- **AR/VR Android Applications**

IEC Type 5: SmartNIC

BP Family: IEC



Target Industry: Telco and other carriers

Purpose/Features:

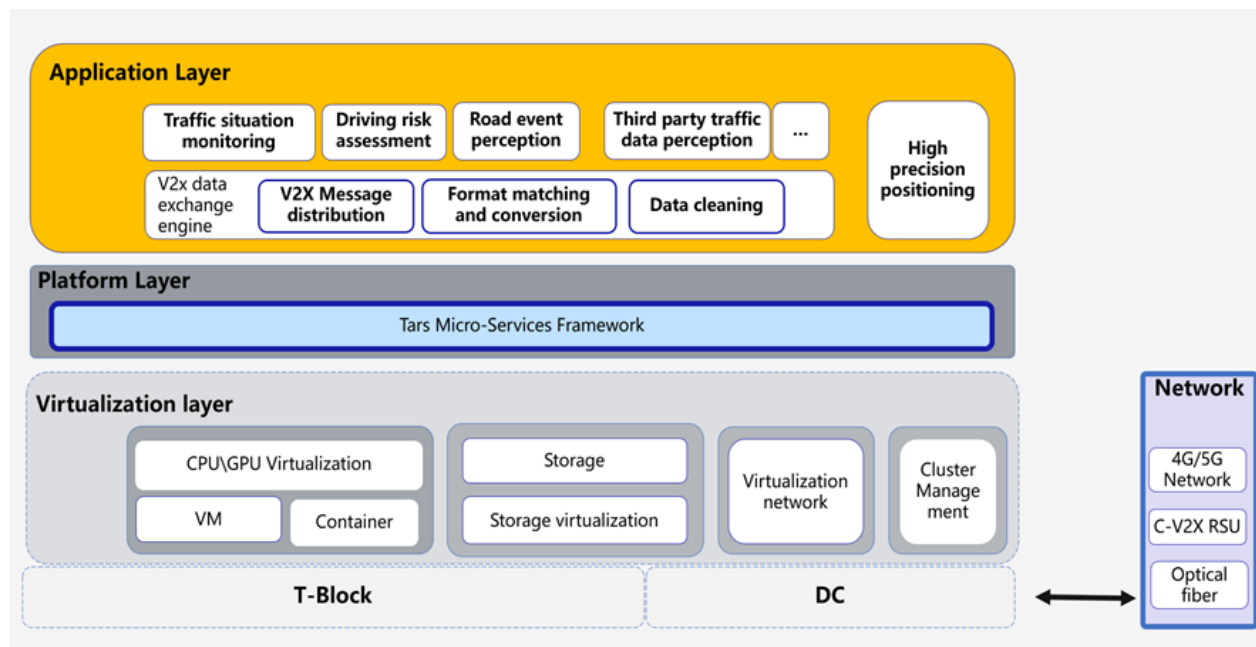
IEC Type 5 is focused on SmartNIC, which can accelerate network performance and provide more management convenience. In general, the architecture consists of two layers: IaaS (IEC), SmartNIC layer. But in R4, we have two simple layers: Host Layer, SmartNIC Layer.

Use cases:

- **CT based OVS-DPDK offload into SmartNic:** accelerates network performance, saves computing resources and providing security managements.
- **Part of the UPF and VPC functions,** like load balancing, forwarding, dpi, etc offloaded into SmartNIC to enhance the performance of UPF that will be deployed in carrier's edge cloud datacenters

Akraino R4 Connected Vehicle Blueprint

Connected Vehicle



Target Industry: Transportation, Auto, Enterprise, IOT, Telecom

Purpose/Features:

Establish OSS edge MEC platform for customized v2x application development. Tested on BM, VM and containers.

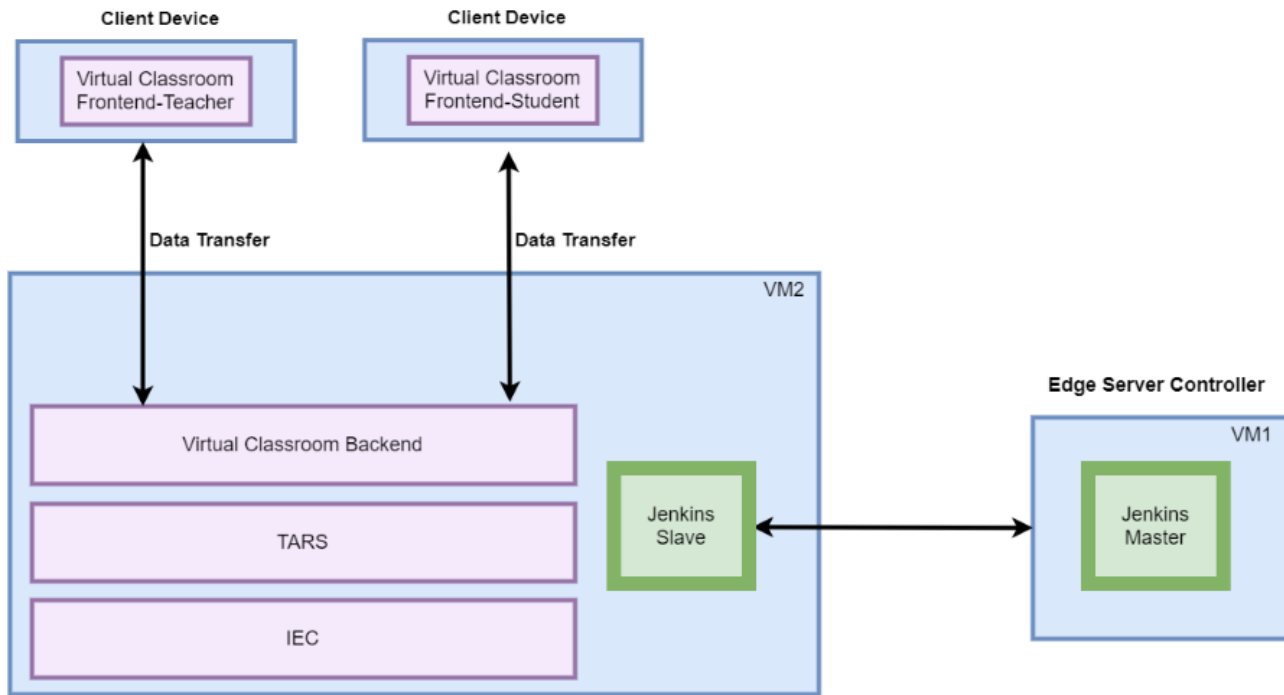
Use cases:

- **Smarter Navigation:** Real-time traffic info, reduced latency - minutes to seconds.
- **Reduce traffic violation:** Alerts drivers to local traffic laws.
- **Cooperative vehicle and infrastructure system:** Identifies potential risks not be seen by driver.

Akraino R2 Integrated Edge Cloud

IEC Type 4: AR/VR Oriented Edge Stack

Updated



Purpose/Features:

- Architecture consists of three layers: IaaS(IEC), PaaS(Tars), SaaS(AR/VR Application)

Use cases:

- (now available) **Virtual classroom:** Simulates virtual classroom, improves online education experiences
- (in progress) **Operation Guidance:** Predicts next step for operations (e.g., assembling Lego blocks, cooking sandwiches, etc)
- (in progress) **Sports Live:** Augments/ simulates sports live, providing immersive watching experience
- (in Progress) **Gaming:** Augments/ simulates game scenario, provides immersive game world

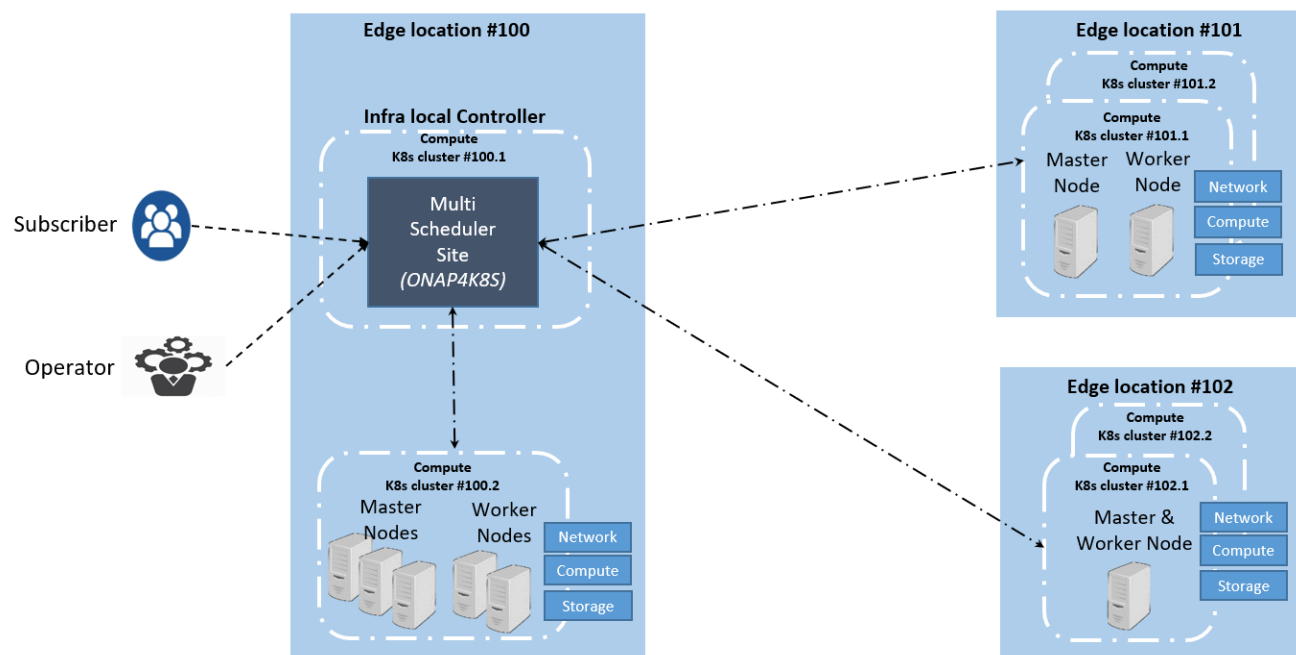
Target Industry : Entertainment, Gaming, Cloud

Akraino R4 Integrated Cloud Native

Integrated Cloud Native (ICN)

Updated

ICN Infrastructure



Purpose/Features:

- Addresses overall challenges of edge deployments

Use cases:

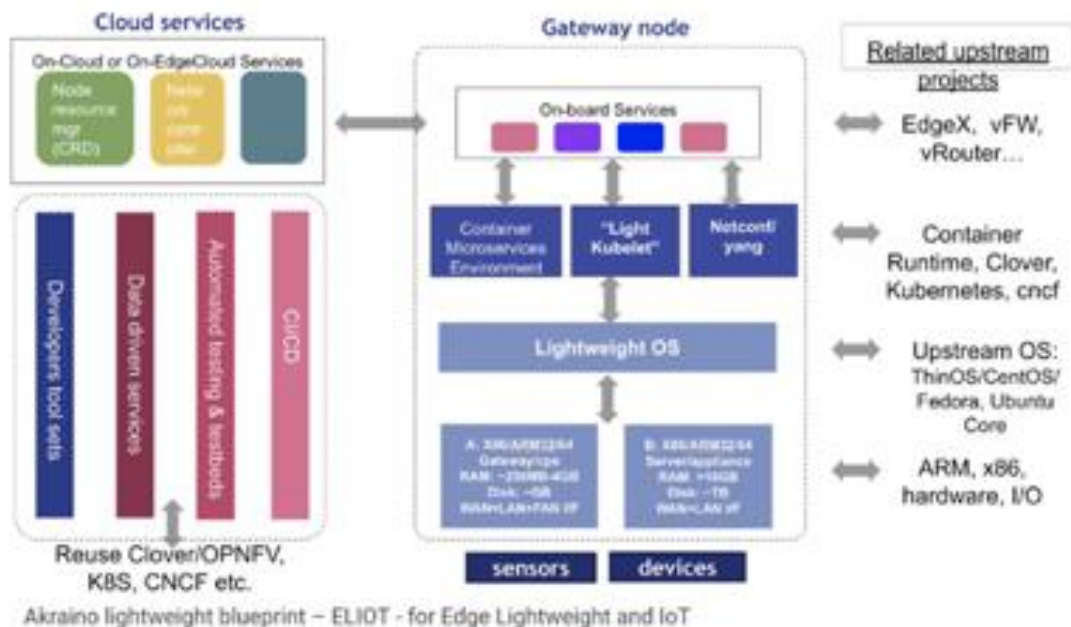
- Zero Touch provisioning (ZTP) using BPA (Metal3, Ironic), BM provider (BMdeployment) and libvirt provider (KVM)
- Kubernetes Deployer (KuD) is being containerized - single solution deploys Multus, OVN, Flannel, accelerator plugins (SRIOV & QAT), NFD, OVN4NFV, EMCO; applications such as Edgex Foundry (IoT Framework), Containerized Firewall (cFW), and SDEWAN
- Enables nested k8s: K8s used to manage both under cloud (BM provider) & over cloud (k8s inside VM)

Target Industry: Telco, Cloud, Enterprise, IOT

Akraino R2 Blueprint IOT & Far Edge

Edge Lightweight & IoT (ELIOT) - Gateway & uCPE Blueprints

Updated



Target Industry: IoT, Enterprise, Telco

Purpose/Features:

- Addresses IOT & Universal CPE use case
- Targets IOT Appliances
- Very thin OS and Orchestration
- Full CI/CD deployment ready and verified
- Platform is ready to support different IOT Gateway use cases for Edge computing. Video Analytics is one of use case verified on this platform.

Updates in R2:

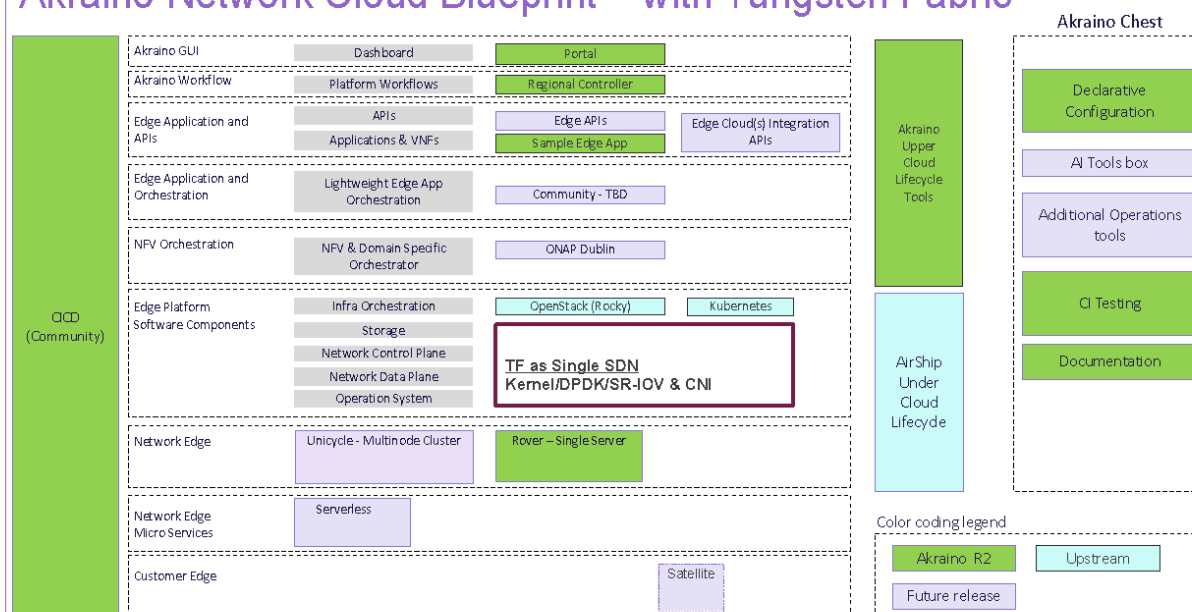
- Integrated EdgeX framework for IIOT
- Supported/verified on Tailored OS, Ubuntu and CentOS
- Single- click installation
- Portal for IOTgateway or uCPE with enabled features like application and platform management
- Enables community validation testing in CI for Hardware, OS and K8s layers.
- OPC-UA test enabled on ELIOT platform.

Akraino R2 Network Cloud & Tungsten Fabric

Network Cloud Powered by Tungsten Fabric

Updated

Akraino Network Cloud Blueprint – with Tungsten Fabric



Target Industry: Telco, Cloud, Enterprise

Purpose/Features:

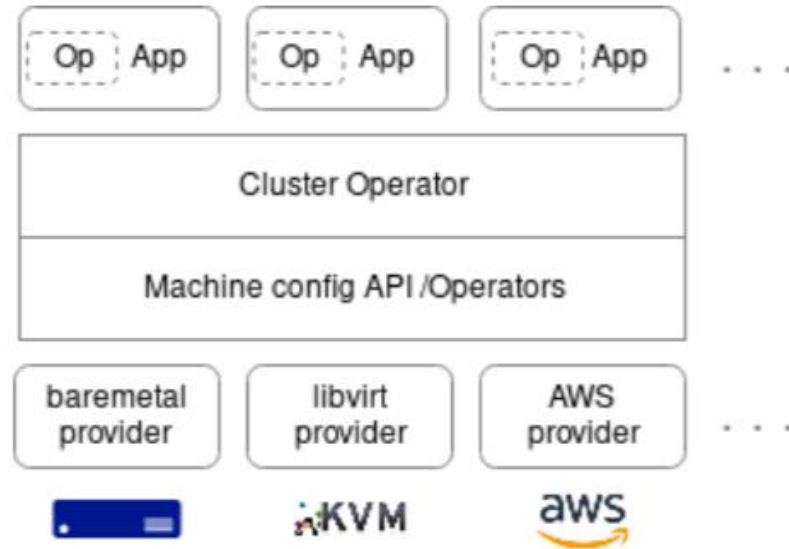
- Implements the Network Cloud with Tungsten Fabric as an SDN Controller, supports CNI for K8s & Neutron plugin for OpenStack
- Enables telco operators to take control of infrastructure

Use cases:

- Supports telco grade applications and a wide variety of VNFs & CNFs
- Offers advanced networking features supported by Tungsten Fabric, such as service chaining, network policies, security, VRRP, route advertisement, flow management, etc.
- Enables deployment of multiple remote edge sites from a single regional controller
- Consolidates settings into a single input file that defines the edge site configuration

Kubernetes Native Infrastructure (KNI)

Updated



Purpose/Features:

- Leverage the best-practices and tools from the Kubernetes community to declaratively and consistently manage edge computing stacks from the infrastructure up to the workloads.
- Supports both containerized and VM-based applications

Use Cases/Key Features for R2:

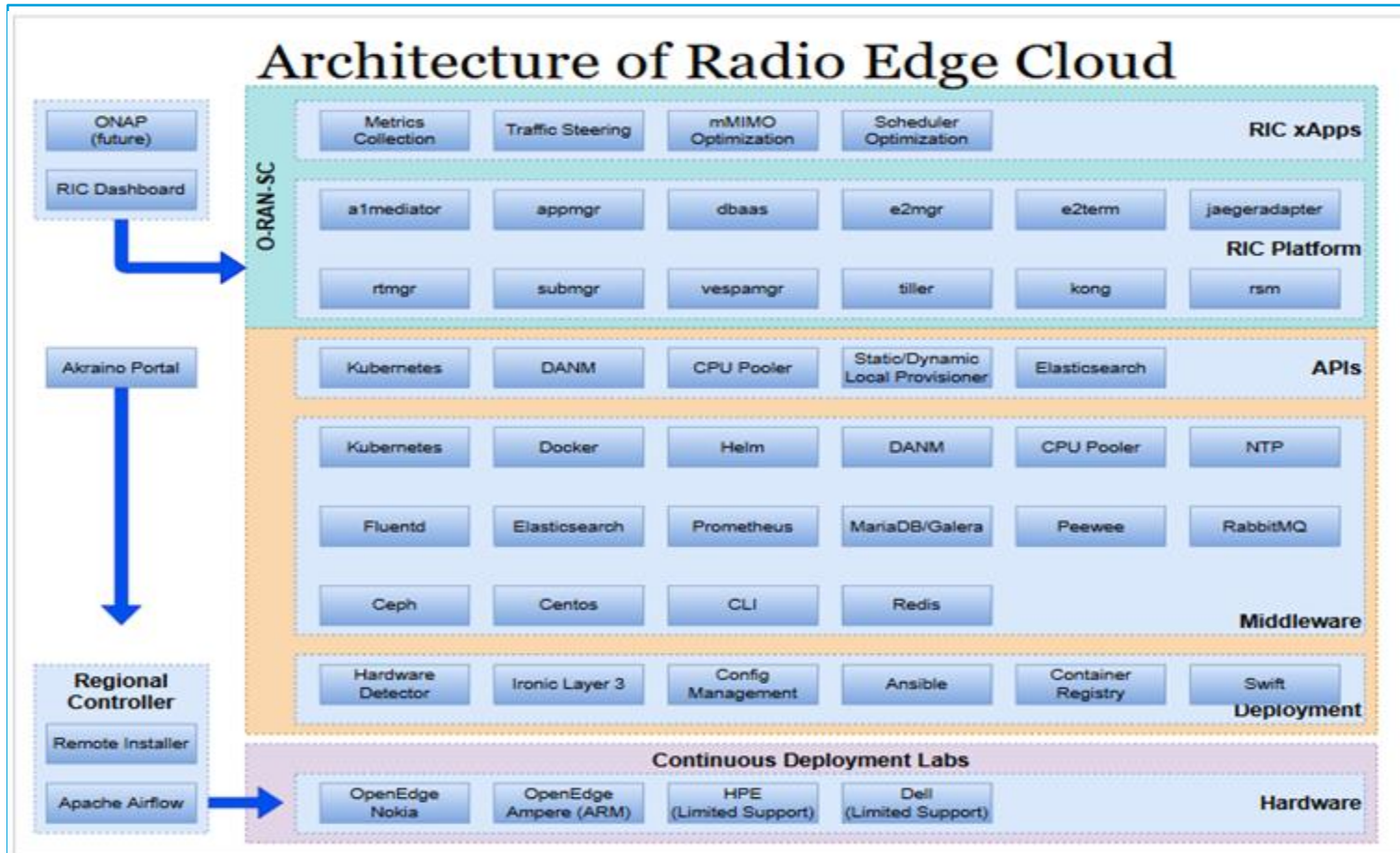
- Lightweight, self-managing clusters based on CoreOS and Kubernetes (OKD distro)
- Support for VMs (via KubeVirt) and containers on a common infrastructure
- Application lifecycle management using the Operator Framework
- Support for real-time workloads using CentOS-rt

Target Industry: Enterprise, IoT

Akraino 5G RAN Telecom Access Use Cases



Updated



Target Industry: Teleco 5G, Enterprise

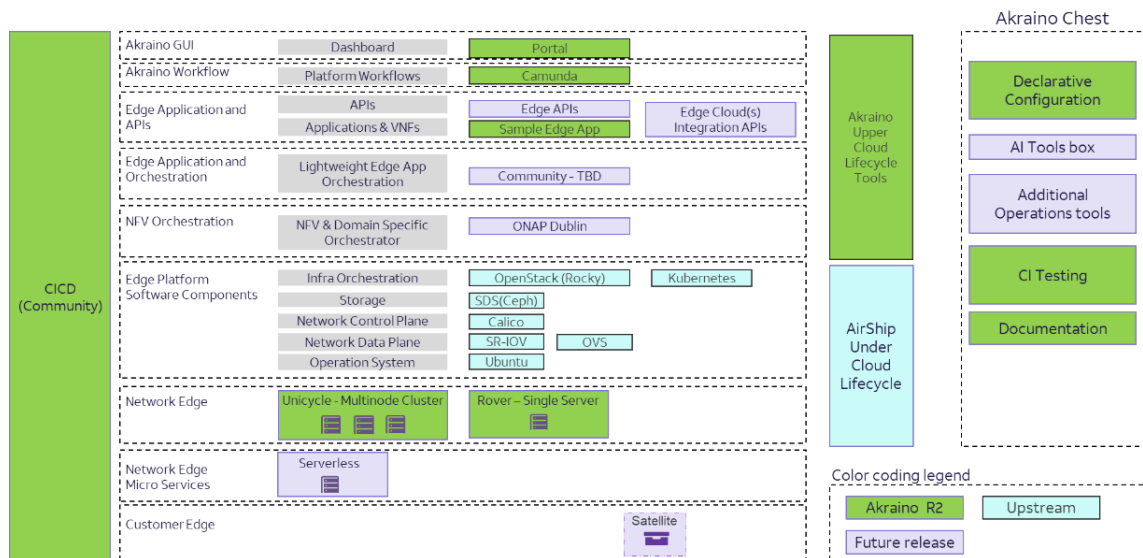
Purpose/Features:

- Telco- grade edge cloud platform for near-real time container workloads.
- open-source RAN Intelligent Controller (RIC)
- RIC enables telcos to deploy customizations, in the form of apps, that tailor cell network for specialized needs of customers' own industries
- Automated CD pipeline testing the full software stack
- Integrated with Regional Controller (Akraino Feature Project) for “zero touch” deployment of REC to edge sites

Akraino R2 Network Cloud Blueprint



Network Cloud Blueprints: Unicycle with Rover & SR-IOV



Purpose/Features in R2:

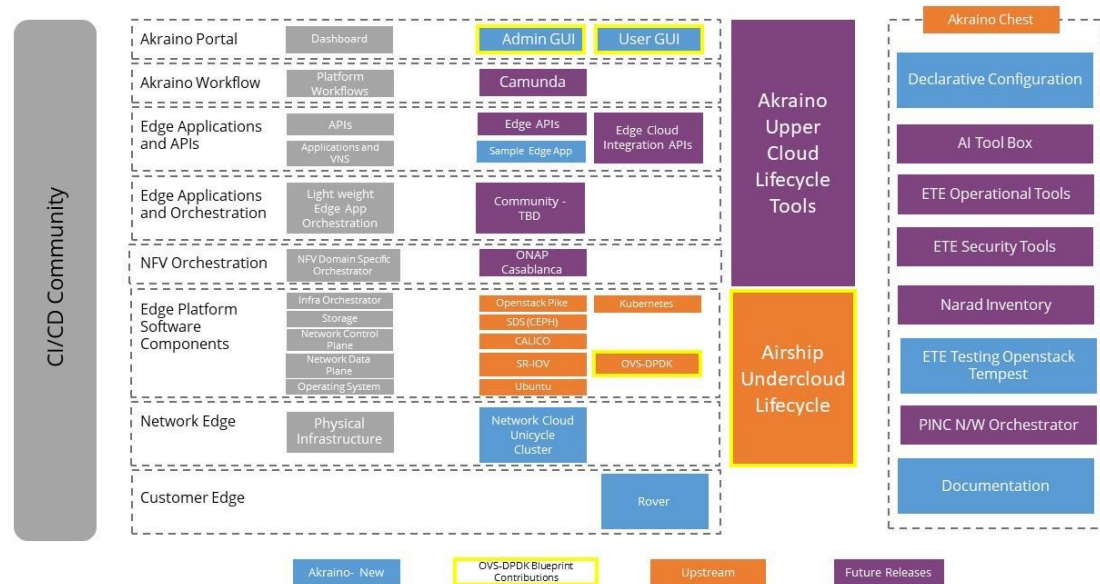
- enables hardware configuration and automated deployment of multiple edge sites from a remote Regional Controller
- Supports telco-grade applications and a wide variety Virtual Network Functions (VNFs)
- Enables deployment of multiple remote edge sites from a single Regional Controller
- Consolidates settings into a single input file that defines the edge site configuration
- Supports single server (Rover) and multi-server (Unicycle) deployments
- Deploys Openstack using Airship Treasuremap release v1.3

Target Industry : Telco, Enterprise

Akraino R2 Network Cloud Blueprint



Network Cloud Blueprints: Unicycle with OVS-DPDK



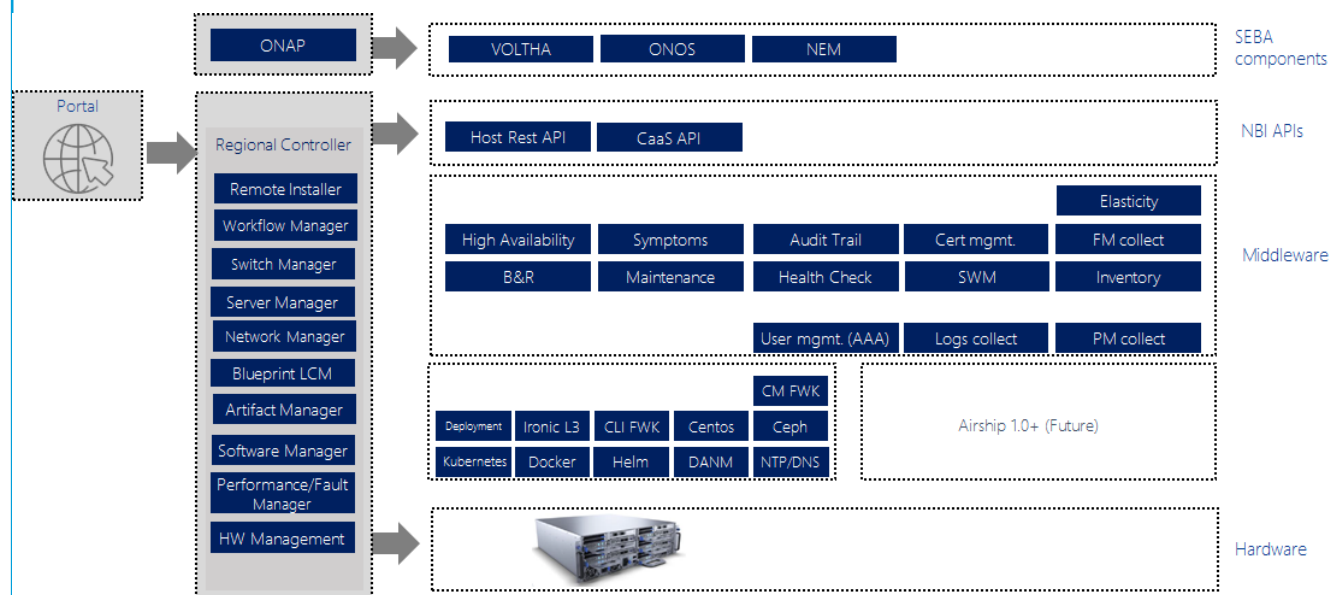
Purpose/Features in R2:

- OVS-DPDK support into existing Network Cloud Unicycle Blueprint Family
- Joint community effort by Ericsson and AT&T
- Integration with Akraino feature project to add OVS-DPDK support to Airship distribution
- Based on Dell PowerEdge R740XD Servers to deploy kubernetes (undercloud) and containerized Openstack platform (overcloud) using Airship
- Network Cloud Edge use cases to support vRAN & 5G core Telco grade applications

Target Industry : Telco, Enterprise

Akraino R2 SEBA for Telco Appliance

SDN-Enabled Broadband Access (SEBA)



Purpose/Features:

- Provides an appliance tuned to support the [ONF SDN-enabled Broadband Access](#) (SEBA) platform.

Use cases:

Utilizes a reusable set of modules introduced by the [Radio Edge Cloud \(REC\)](#), from Akraino R1:

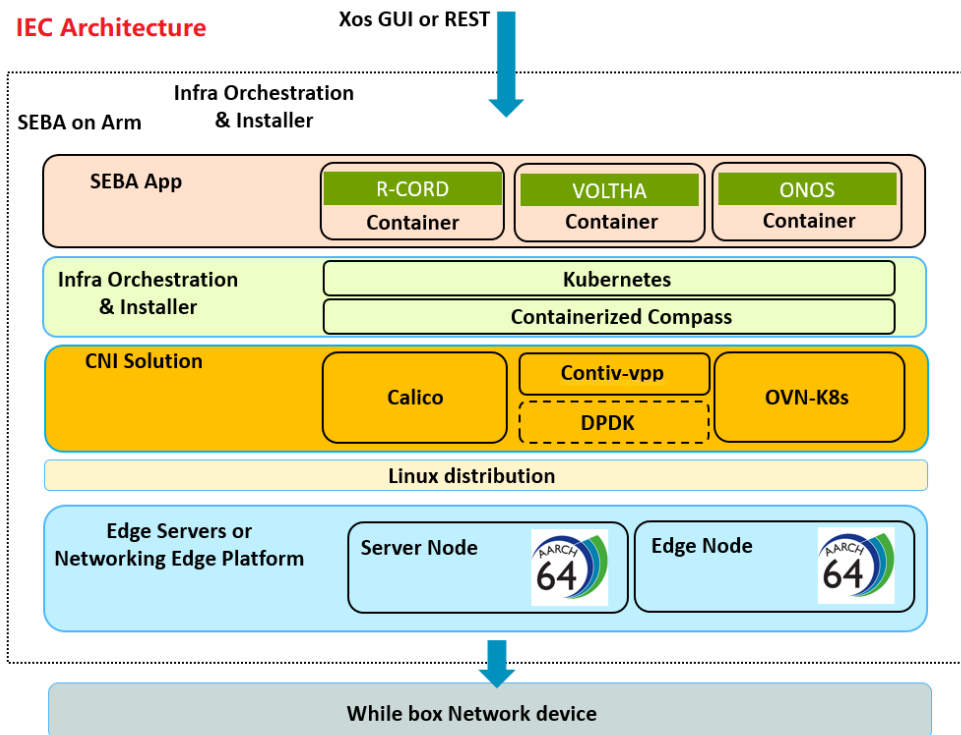
- Installation of host OS
- Configuration of network
- Installation/setup of Kubernetes cluster
- Installation/validation for SEBA components
- Utilization of reusable components of the “Telco Appliance” blueprint family
- Automated Continuous Deployment pipeline testing the software stack (bottom to top, from firmware up to but not including application)
- Integration with Regional Controller (Akraino Feature Project) for “zero touch” deployment of SEBA to edge sites

Target Industry: Telco

Akraino R2 Blueprint IOT & Remote Edge Use Cases



Integrated Edge Cloud Types 1 & 2



Target Industry: Telco, IoT, Enterprise

Purpose/ Features:

- Addresses IOT use cases
- Targets telco edge applications & medium edge cloud deployments with Arm
- Based on Kubernetes and Calico
- Automated installation, integrated with SDN-Enabled Broadband Access (SEBA) use case

Updates in R2:

- Supports both single node deployment and a 3-node deployment
- Deployment is automated in CI
- The SEBA (on Arm) use-case is integrated with the IEC platform
- Uses project [Calico](#) as main container networking solution
- Running environment deployment with multiple VMs
- PONSIm installation support
- SEBA-charts submodule update, multi-arch etcd yaml files, etc.

Akraino Commercial updates



中国移动
China Mobile

POC & Deployment

- SmartNic: In R4 provides the POD environment for ByteDance, realized the offload of CT based OVS-DPDK for SmartNiC, to increase the throughput of edge network VPC and provides the security management needs.
- Android: In R3, used ANBOX to deploy a containerized Android system on used an Arm-based server and conducted initial functional tests. Cooperated with ByteDance and Mozhiyun respectively to provide private Lab environment, implement CI/CD environment deployment in the private lab;
- PCEI: transplant ETSI MEC location APIs and will verify them in China Mobile private lab in China.

Community Contribution Focus

- SmartNic: Focus on offloading network functions, improving network throughput and enhancing management of network card resources.
- Android: Focus on the virtual deployment of Android cloud native applications on the Arm edge cloud.
- PCEI: Focus on provide the 5G core network functions to public cloud, improve the ETSI MEC APIs and build a unique API enabler between Telco and Cloud.

Lab resource: China Mobile provides MEC POD environment in Beijing for multiple BPs. 5G resources and accesses are under coordinating.



EQUINIX

Public Cloud Edge Interface (PCEI) Blueprint

PCEI blueprint pursues development of multi-domain interworking capabilities to enable Mobile Operators, Public Clouds Core and Edge Compute providers as well as 3rd-Party Edge Compute providers utilize distributed data center infrastructure, interconnection and edge services for mobile edge cloud use cases such as Mobile Hybrid/Multi-Cloud, Multi-MEC access.

- Joined PCEI blueprint as Project Technical Lead
- Proposed PCEI Reference Architecture
- Participated in the development of first PCEI feature based on OMA Zonal Presence API / ETSI MEC Location API
- Lead development and implementation of PCEI for Akraino Release 4 demonstrating EMCO orchestrator and deployments of Public Cloud Edge apps from Azure and AWS



- **KubeEdge Edge Service Blueprint**
- This blueprint family showcases an end-to-end solution for edge services with KubeEdge centered edge stack. The first release will focus on the ML inference offloading use case.
 - Initiated blueprint project
 - Proposed the Architecture
 - Contributing to the development of end-to-end lab validation environment
- **Contributed to ELIOT: Edge Lightweight and IoT Blueprint Family project**

Akraino Commercial updates



- **Open Source ONAP software company** focusing on 5G/edge computing application automation
- New ONAP integration in the [Akraino Private LTE/5G Blueprint](#)
- Successfully completed 12 ONAP engagements
- [Aarna Networks ONAP Distribution 4.0](#) (El Alto) available
- Recently joined [PAWR](#), [5G Open Innovation Lab](#) to drive 5G use cases with ONAP
- Number#1 Instructor led ONAP training provider



Enabled Arm architecture based hardware and software support for multiple blueprint families. These include several blueprints that share a similar set of use cases, software, and continuous integration and deployment.

- Connected Vehicle Blueprint
- Edge Lightweight and IoT (ELIOT)
 - IoT Gateway Blueprint
 - SD-WAN/WAN Edge/uCPE Blueprint
- Integrated Edge Cloud - Type 1 - 5
- Telco Appliance
 - Radio Edge Cloud (REC)
 - SDN Enabled Broadband Access (SEBA)
- 5G MEC System
 - Ent Apps on Lightweight 5G Telco Edge
 - Slice System to Support Cloud Gaming, HD Video and Live Broadcasting
- Micro MEC
- AI Edge
 - School/Education Video Security Monitoring
 - Federated ML application at Edge
 - Intelligent Vehicle-Infra Coop System(I-VICS)
- Public Cloud Edge Interface
- IIoT

Predictive Maintenance with a FLIR Camera



POC & Deployment

AI Edge supports video security monitoring, classroom concentration analysis, factory safety production, kitchen hygiene monitoring, and also scenarios in Intelligent Vehicle Infrastructure Cooperation System. In R3, cooperated with Arm, Intel, and Huawei, set up a private lab environment, implemented CI/CD environment. More AI application for Arm architecture will be released in the future.

Community Contribution Focus

Focuses on establishing an MEC platform that combined with AI capacities at the Edge site. And it also could be used to enable the autonomous driving industry.

Akraino Commercial updates



As part of Akraino R4, Huawei is associated with following blueprints family:

Enterprise Applications on Lightweight 5G

Telco Edge : BP intends to provide an ecosystem for enterprise application on light weight 5G Telco Edge which can be leveraged by Telecom operators to its enterprise users. BP having following salient features:

- Lightweight MEC Solution with reference to ETSI MEC Architecture.
- Developer Centric approach empowering developers to innovate & ship faster:
- Rich platform capabilities (Network, PaaS, aPaaS etc.) for Enterprise use cases.
- Autonomous Edge Sites

Enterprise Lightweight IOT Blueprint family:

Contributing two Blueprints under this BP Family :

1. ELIOT IoT Gateway
 2. ELIOT SD-WAN/WAN Edge/uCPE Blueprint
- Develop an lightweight edge platform for Industrial IoT and SDWAN use cases.



Intel co-founded Akraino Edge Stack, continuously supported and contributed to the growth of the Edge ecosystem.

- Donated IA servers in Akraino Community Lab, plus supporting partners working on ICN and 5G MEC w/ Intel hosted PODs.
- Drove Integrated Cloud Native BP Family created SW Platforms for Enterprise, IoT and Telco markets, including MICN BP and Private 5G BP.
- Enabled Akraino R3 active community BPs with Intel architecture based hardware and software supported:
 - 5G MEC Slice System to Support Cloud Gaming, HD Video and Live Broadcasting BP
 - Connected Vehicle BP
 - Edge Lightweight and IoT (ELIOT) - ELIOT SD-WAN/WAN Edge/uCPE BP
 - Kubernetes Native Infrastructure (KNI) – Provider Access Edge BP
 - The AI Edge - School/Education Video Security Monitoring BP
 - The AI Edge: Intelligent Vehicle-Infrastructure Cooperation System(I-VICS)



- Juniper Network has been an active contributor in the Akraino community from the early days of its formation. They have been contributor for all three Akraino releases.

- **Network Cloud with Tungsten Fabric Blueprint**

This blueprint is part of release 3 which integrates Tungsten Fabric in Network Cloud. It integrates with Regional Controller to deploy edge sites that supports both Kubernetes as well OpenStack based workloads. Tungsten Fabric provides advanced networking SDN features to the edge sites.

- Juniper is also engaged with in the [Akraino Private LTE/5G Blueprint](#)

Akraino Commercial updates

NOKIA

- Worked on validating the O-RAN Near-Real Time Radio Intelligent Controller (RIC) in a live network, using the Akraino REC project
- Promoted the emerging ETSI MEC ecosystem
- The RAN Intelligent Controller Project utilized the NokiaAirframe Open Edge Server Hardware that is based on Open Compute Project Design. Open Edge provides Ultra-small footprint for easy installation at the network edge; an extended temperature range, robust seismic tolerance enabling deployment worldwide; and provides the performance and low latency required by Cloud RAN and MEC.



New

- NVIDIA Mellanox Networking is a leading supplier of end-to-end Ethernet and InfiniBand intelligent interconnect solutions and services for servers, storage, and hyper-converged infrastructure
- Mellanox offers a choice of high performance solutions: network and multicore processors, network adapters, switches, cables, software and silicon, that accelerate application runtime and maximize business results.
- Mellanox is the leading SmartNIC supplier for BareMetal and Virtualized Cloud services. The BlueField DPU (Data Processing Unit) offloads critical network, security, and storage tasks from the CPU, making it the ideal solution to address performance, efficiency, and cyber-security in next generation Data Centers. The R3 Release of Akraino IEC Type 5 (SmartNIC for Integrated Edge Cloud) runs on the BlueField SmartNIC and demonstrates an unmatched combination of OVS-DPDK performance and efficiency.

Akraino Commercial updates



POC & Deployment

- Connected Vehicle Blueprint can be flexibly deployed in physical machines, virtual machines, containers and other environments. TARS framework is an important open source component of Connected Vehicle Blueprint, which can efficiently complete the massive deployment and governance of micro-services.
- IEC Type 4 AR/VR applications, in general, the architecture consists of three layers: IaaS(IEC), PaaS(TARS), SaaS(AR/VR Application). TARS framework can efficiently complete the massive deployment and governance of micro-services, and make AR/VR applications deployed in physical machines, virtual machines, containers and other environments.
- 5G MEC/Slice system to support cloud gaming, HD video and live broadcasting: provides an edge connector and edge gateway to enable traffic offloading to edge applications, and supports application lifecycle management by using openNESS in R3. Means to subscribe edge slice, intelligent traffic management and enhanced local DNS will be provided in the future release.

Community Contribution Focus

- Connected Vehicle Blueprint, focuses on Internet of Vehicles (IoV) application MEC platform, which helps the rapid landing of IoV applications.
- IEC Type 4 focuses on AR/VR applications running on edge.
- PCEI: Focus on use the 5G MEC open API provided by operator to support 5G MEC solution based on public cloud(i.e., ECM)



1. POC & Deployment

The AI Edge: Federated ML application at edge provide Federated Learning Platform for data stored locally, improves accuracy in the edge computing. FedVision is provided in R3. More federated applications and quick validations will be provided in the future release.

2. FedVision

A machine learning engineering platform to support the development of federated learning powered computer vision applications.

3. Community Contribution Focus

Focuses on providing a federated learning platform which can be used in privacy protected and distributed edge applications such as vision, financial technology, Marketing Intelligence.



- Proof of Concept (PoC) completed for Akraino KNI R2 release on baremetal servers in 5G Lab.
- Proof of Concept (PoC) completed for Akraino KNI R3 release on virtual baremetal in 5G Lab.
- Implementing OpenAirInterface (OAI) use case on KNI R3.
- Showcasing Akraino and KNI blueprint to customers

Akraino Executive Summary



Akraino is an Edge project targeted to

- › Address Telco, Cloud, Enterprise and Industrial IoT use cases

Zero Touch Edge Cloud
Automation

Akraino Mission:

1. Create end to end configuration for a particular Edge Use case which is complete, tested and production deployable meeting the use case characteristics {Integration Projects - Blueprints}.
Production deployable means the blueprint has passed unit and integration testing and meets the blueprint's use case characteristics.
2. Develop projects to support such end to end configuration. Leverage upstream community work as much as possible to avoid duplication. {Feature Projects}
3. Work with broader edge communities to standardize edge APIs {Upstream Open Source Community Coordination - For example, Socialization, so community tools and Blueprints can interoperate. This work can be a combination of an upstream collaboration and development within the Akraino community [i.e. a feature project]}
4. Encourage Vendors and other communities to validate Edge applications and VNFs on top of Akraino blueprints {Validation Project - ensures the working of a Blueprint}