

2021 (1H) priorities for the community

Akraino Technical Meetings - Spring 2021

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 **LF** EDGE

 **THE LINUX** FOUNDATION



What's Next in Akraino - 1H 2021



- › New blueprints and enhancements to existing blueprints
 - › Rural Edge for Tami-COVID19
 - › IoT Area
 - › Project Cassini - IoT and Infrastructure Edge
 - › Smart Cities
 - › Align Public Cloud Edge Interface with SDOs e.g. MEF LSO
 - › RECfully assembled and tested following the cloud ref. design of O-RAN
- › Continue API standardization and mapping
- › Define Platform Security Architecture and apply to blueprints
- › Enhance functionality and automation of edge workloads (e.g., Cloud Native)
- › Improvement of Release Process, CI/CD, Security Certification
- › Further collaborations with cross-LF Edge projects, downstream and upstream communities

Industry challenges & Akraino solutions (Key focus area in R4+)

Akraino welcomes cross-community collaborations to solve industry challenges



O-RAN Specifications



Requires Blueprints to run O-RAN workload & automation to test the integration



O-RAN & Akraino Alliance



Akraino Blueprints for O-RAN specifications (e.g., REC integration with RIC)



Public Cloud - Edge



Requires interfaces to Telco to deploy at Data Centers and Telco Premises



Align Interface & APIs with SDOs e.g. MEF LSO



Akraino Blueprint to support Public Cloud Edge interface



Multiple standards no implementation of Edge APIs



Requires unified Edge Developer and Infra APIs



Collaborations with ETSI, O-RAN, CNCF, etc.,



Akraino Edge APIs

Public Cloud Edge Interface (PCEI)



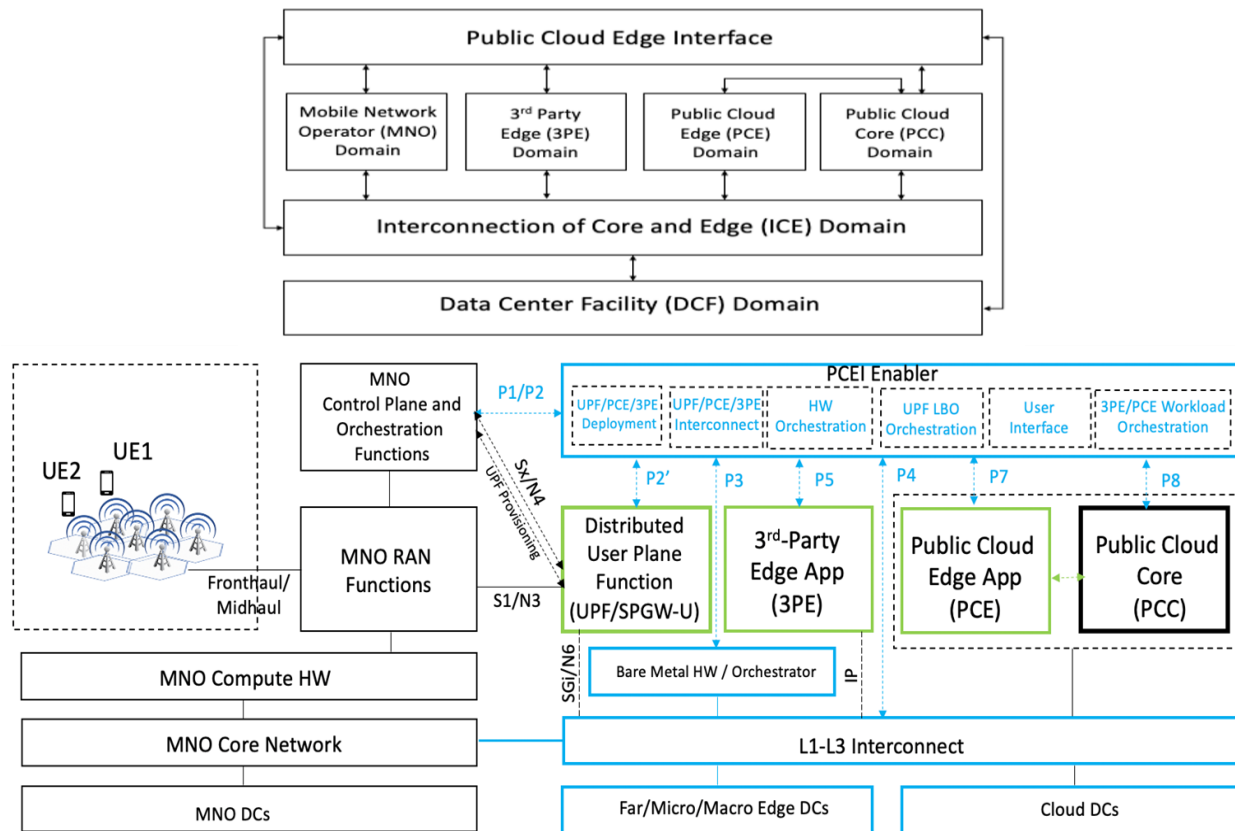
BP Family: Public Cloud Edge Interface

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

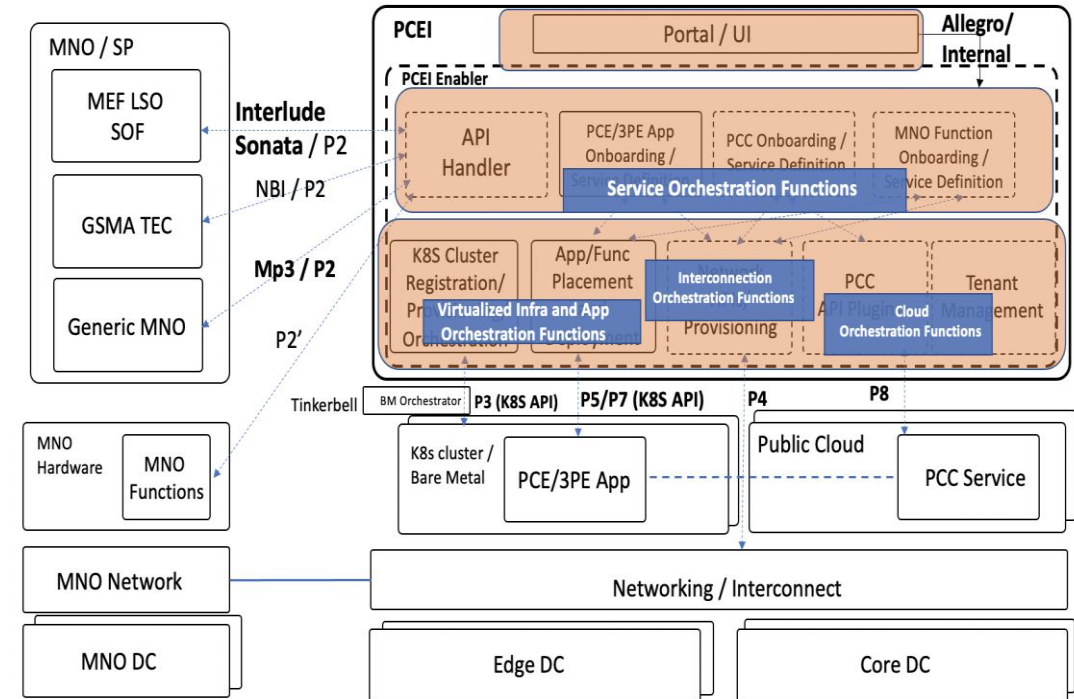
- Edge Multi-Cloud Orchestrator (EMCO) - PCEI Enabler
- Deployment of Azure IoT Edge Cloud Native PCE App
 - Using Azure IoT Edge Helm Charts provided by Microsoft
- Deployment of AWS Green Grass Core PCE App
 - Using AWS GGC Helm Charts provided by Akraino PCEI BP
- Deployment of PCEI Location API App
 - 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

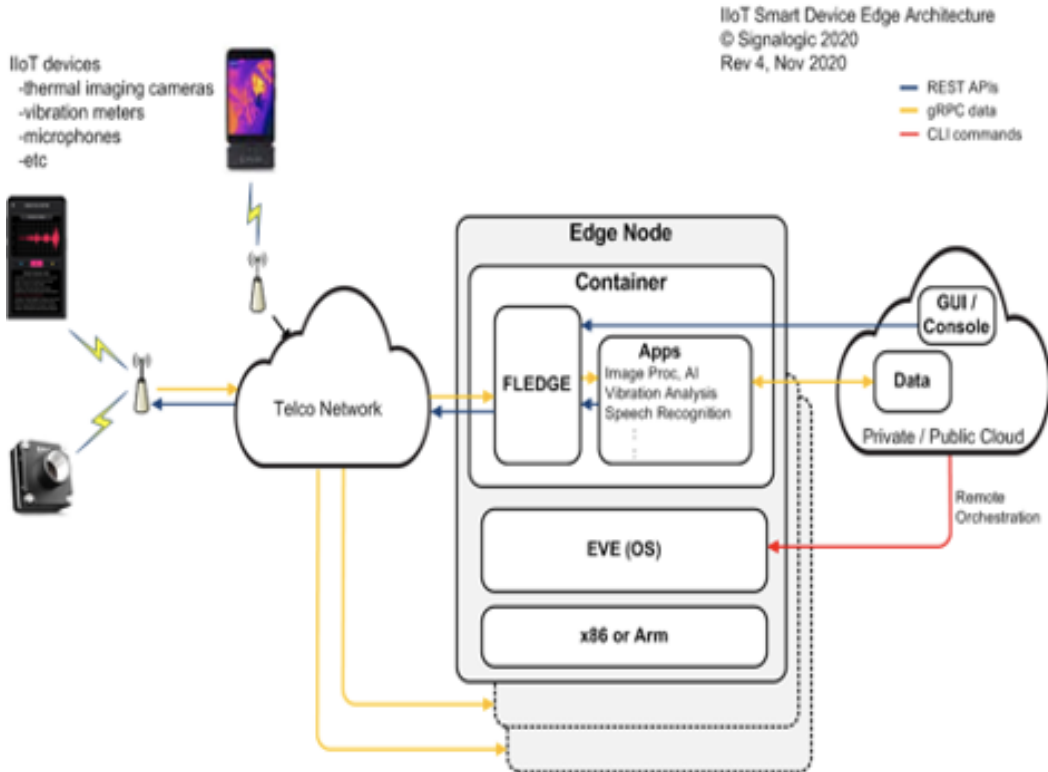
Public Cloud Edge Interface Architectural Alignment with MEF LSO

- › Expose MEF LSO compliant API(s) for PCEI Orchestration Functionalities
 - › E.g. SONATA/INTERLUDE
- › Provide mapping between Public Cloud Core (PCC) service configuration parameters and external API attributes
 - › E.g. Azure IoT Hub configuration steps
- › Enable flexible South Bound Interface
 - › E.g. Terraform Providers for PCC and Interconnection



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

BP Family: IoT Workloads at the Smart Device Edge



Features:

- LfEdge's Project EVE-OS to provide remote management, Zero Trust security (physical and software)
- LfEdge's Fledge as an IIoT framework for sensors, historians, DCS, PLCs, 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

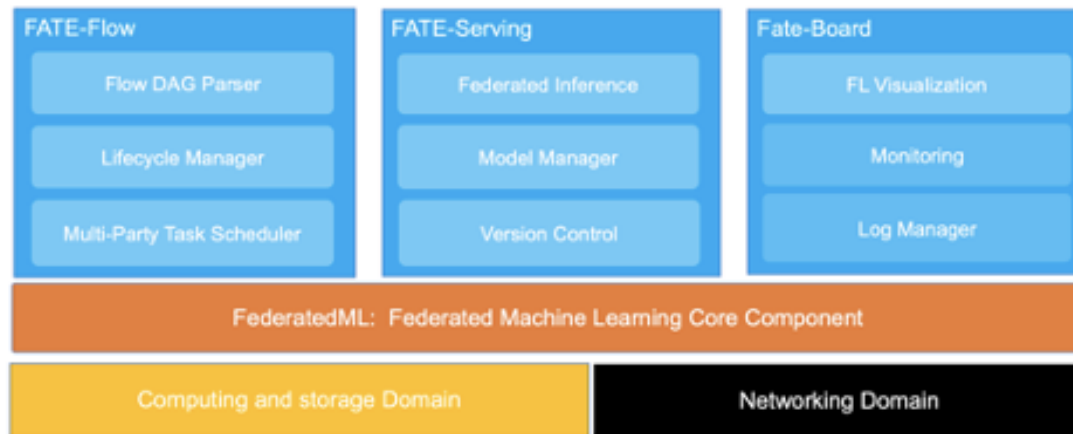
- Predictive Maintenance
- Hazards monitoring (People detection in hazardous area)

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.

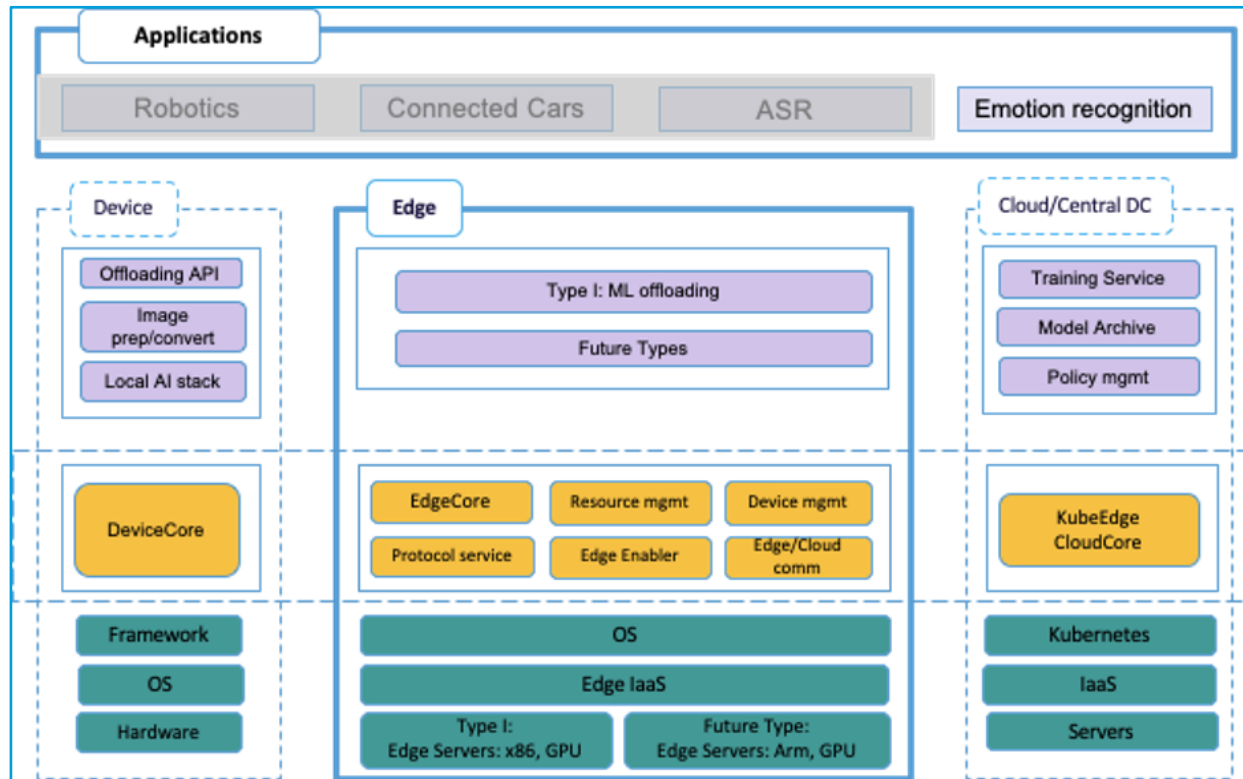
Features

- 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



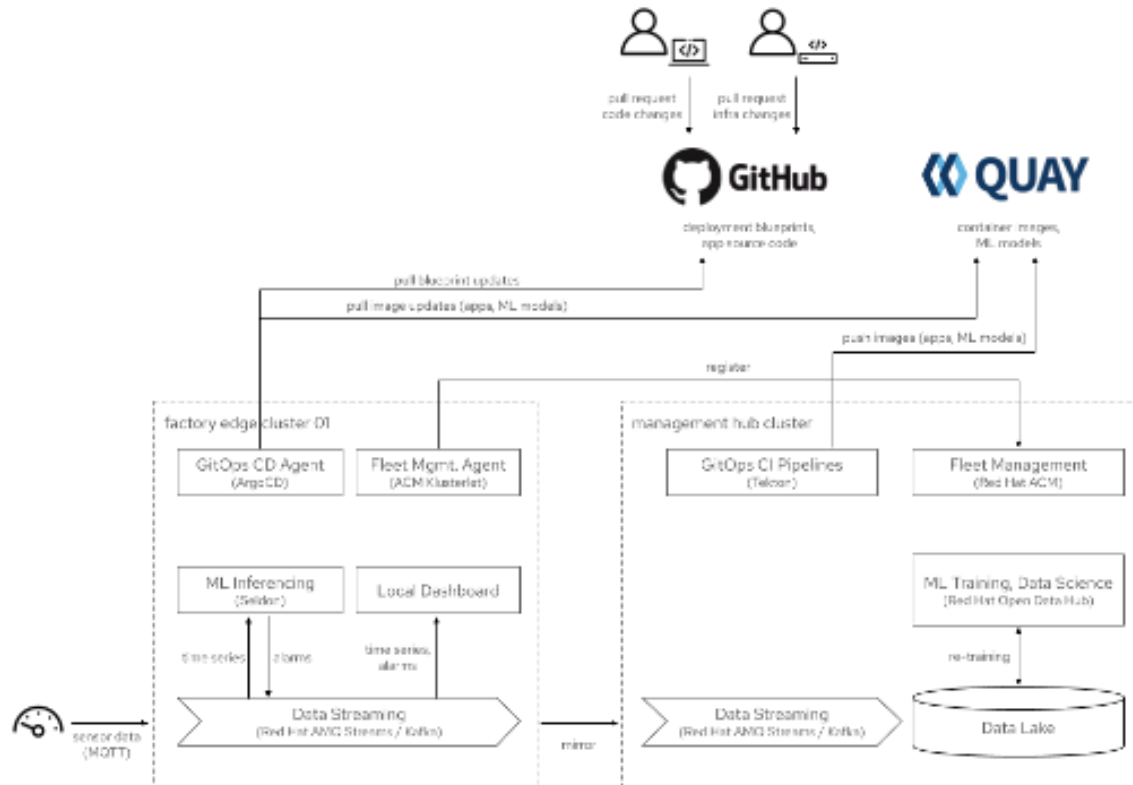
BP Family: KNI

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



Target Industry: Manufacturing

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



BP Family: AI Edge

NEW!



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

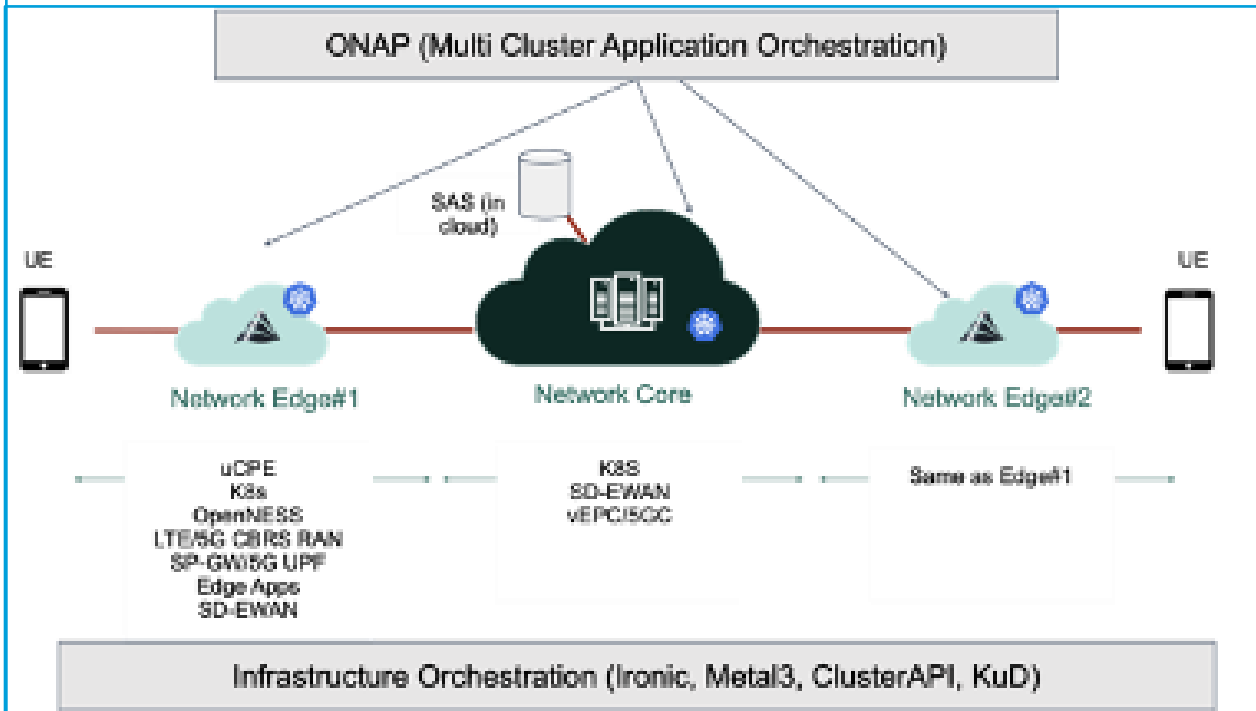
Private LTE/5G ICN

BP Family: ICN



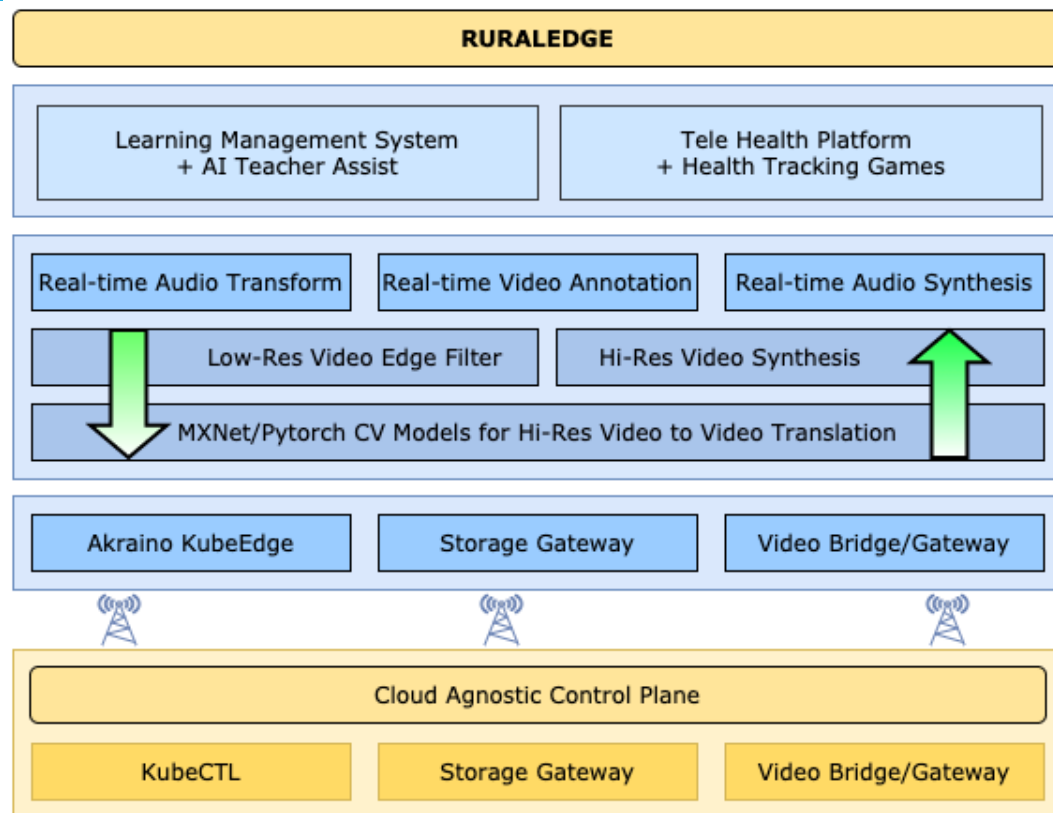
Purpose/Features:

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

BP Family: Tami COVID-19



Target Industry: HealthCare, Education in Rural/Remote areas

Purpose/Features:

- ML Audio/Video Enhancements using GAN
- Tele-Health, and LMS on the edge.
- Control plane on the cloud
- Media plane close to customer site such as MEC servers in telco central offices.

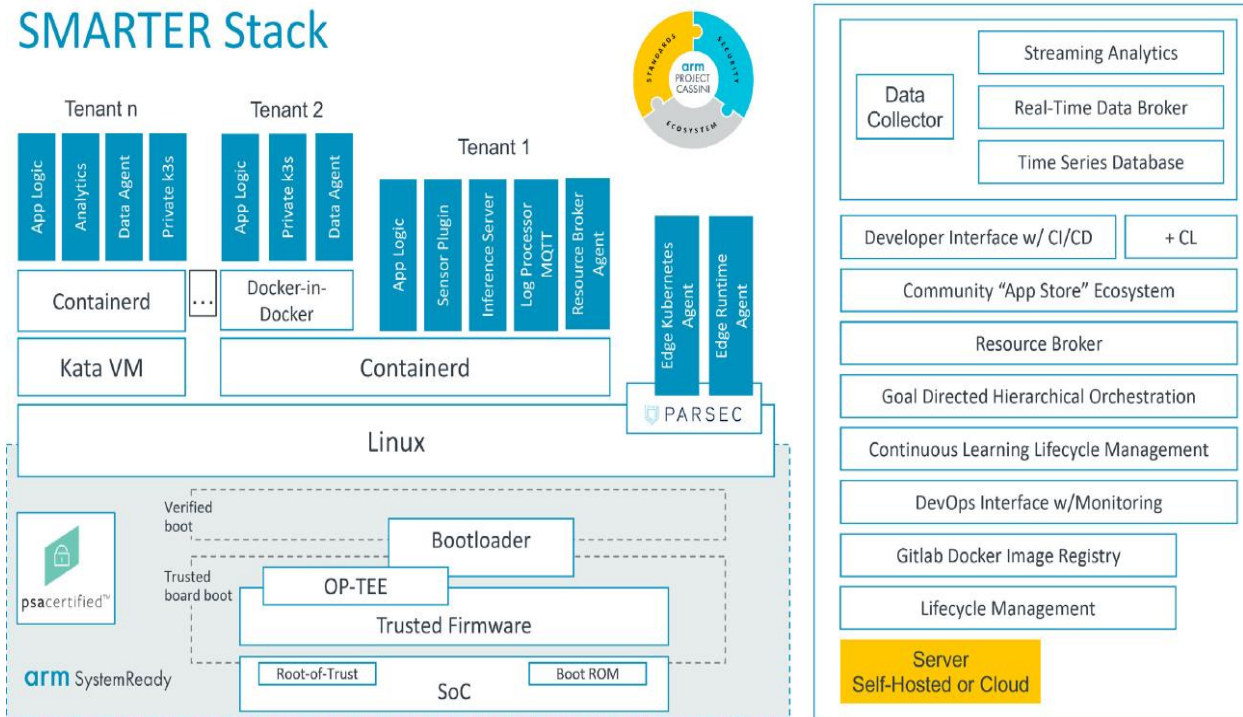
Use cases & Applications

- Video Processing : Enhance Engagement Quality, Augment Video with information, Create Virtual environment, Transcribe engagements
- Telehealth : Appointment Scheduling, Payment Processing, Electronic Health Records
- Gamification : Reinforce Corrective Behavior, Track Progress, Generate Trends
- Learning Management System : AI Teacher Assist, Early Progress Prediction

Smart Cities

BP Family: Project Cassini - IoT and Infrastructure Edge

SMARTER Stack



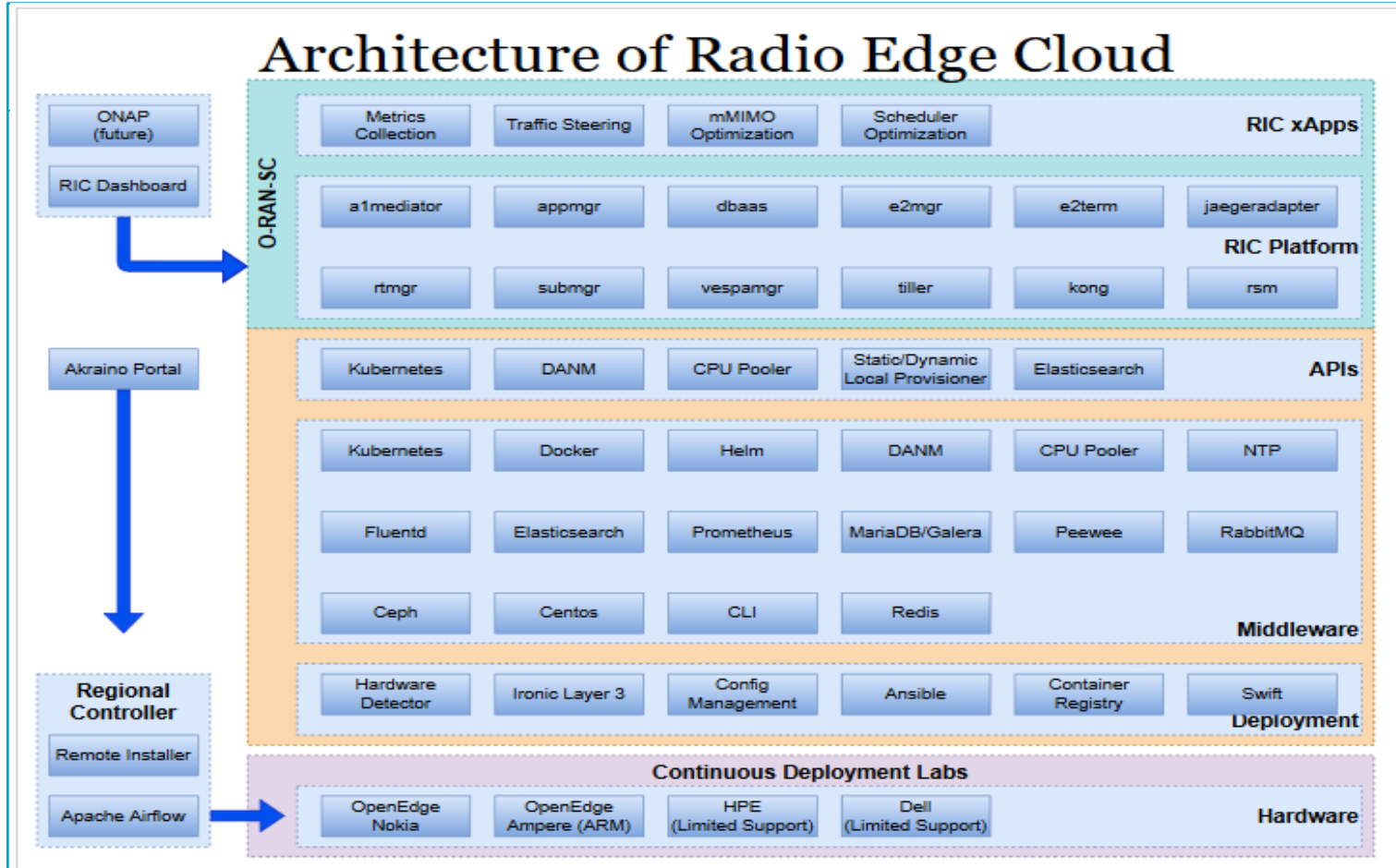
Target Industry: Autonomous driving and package delivery; Smart Energy, water and waste management; Public health and safety, emergency services; Smart buildings; Smart retail and logistics

Purpose/Features:

- A city is smart when investments in human and social capital, traditional infrastructure and disruptive technologies fuel sustainable economic growth and higher quality of life, with a wise management of natural resources, through participatory governance. This results from many diverse smart solutions across all sectors of society, filed by a combination of disruptive technologies and social innovation.

Use cases & Applications

- Traffic management to reduce congestion, monitor vehicle violations
- Applications that can be managed remotely using cloud native practices

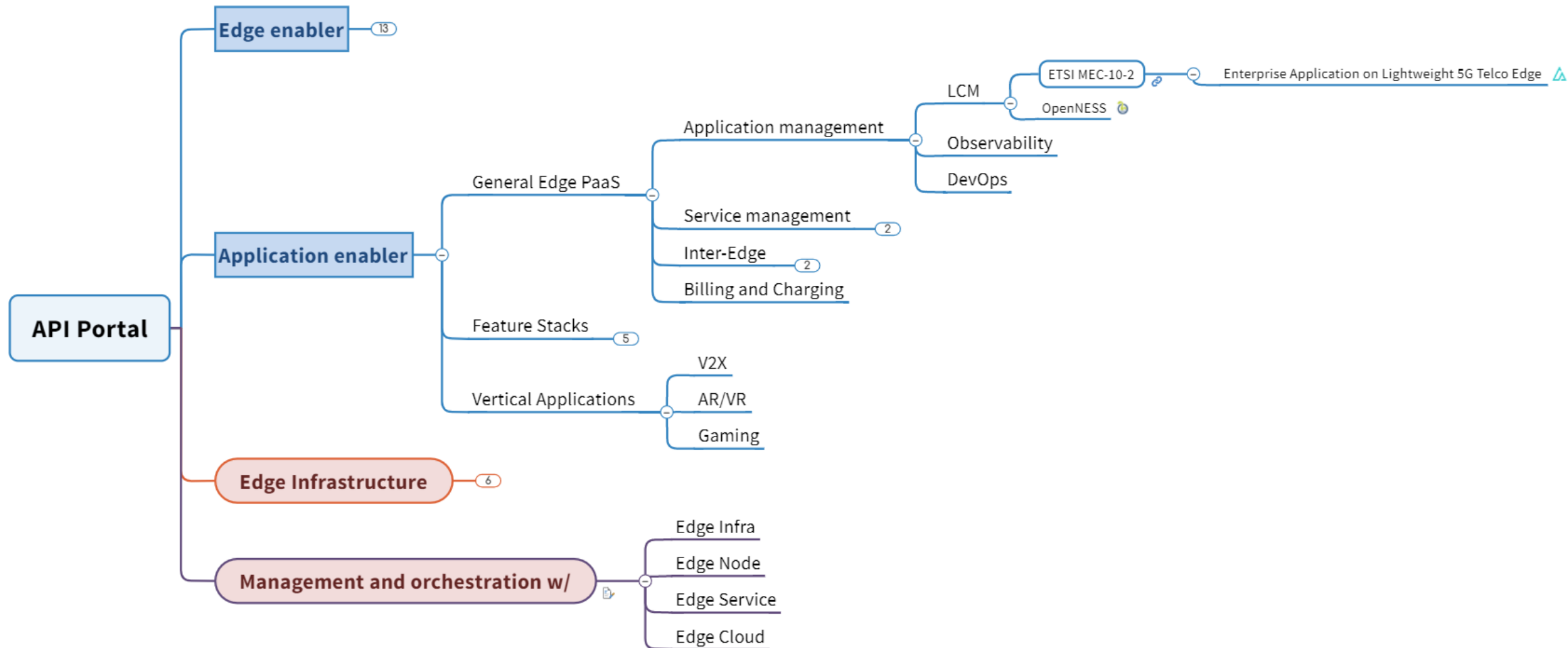


Target Industry: Teleco 5G, Enterprise

Purpose/Features:

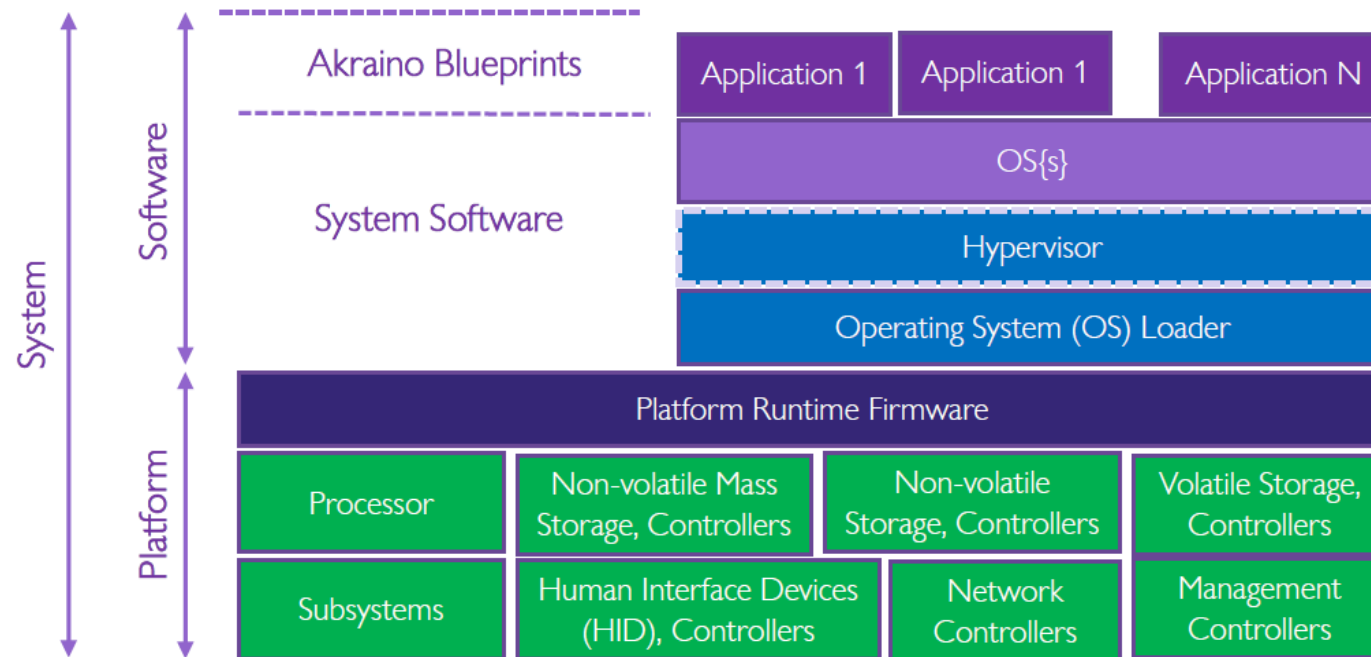
- Telco- grade edge cloud platform for near-real time container workloads.
- open-source RAN Intelligent Controller (RIC)
- RIC enables telcos to deploy customizations, in the form of apps, that tailor cell network for specialized needs of customers' own industries
- Automated CD pipeline testing the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

Continue API standardization and mapping



Define Platform Security Architecture and apply to blueprints

Akraino System Components Overview



Security of Akraino execution environment (or System) consists both Platform and Software security:

- Containerized environment security (Akraino Blueprints)
- System software security (OS loader, Hypervisor and OS{s})
- Firmware Security
- Platform Devices Security

Akraino Release Process Improvement Considerations

› **Goals**

- › Streamline Sub-committee reviews for blueprints (Doc, API, Upstream)
- › Improve BluVal vulnerability fix/compliance experience
- › Provide opportunity for Blueprint technology deep-dives

› **Considerations**

- › Establish clear policy for BP Release compliance readiness
 - › E.g. Deadlines, number of extensions, duration of extensions, conditional approvals
- › Separate BP technology reviews from Release compliance reviews
 - › E.g. Tech reviews on Tuesday TSC calls, Release compliance and TSC matters on Thursday TSC calls
- › Asynchronous Sub-committee reviews
 - › E.g. PTL submits review request via email
 - › Sub-committee reviews asynchronously or, if agreed with PTL, synchronously (joint call)
 - › PTL's must respond to Sub-committee emails
- › BluVal Fix Knowledge Base – detailed instructions for known/resolved issues
- › Automation of fixes (e.g. scripts for Kube-Hunter fixes)
 - › LF funding will be required

Akraino Commercial updates



中国移动
China Mobile

POC & Deployment

- SmartNic: In R3 provide the POD environment for ByteDance, realized the offload of OVS-DPDK for SmartNIC, to increase the throughput of edge network VPC; In R4, China Mobile will provide a POD environment, with one BF card from Mallnix;
- 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 EIJOT: 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](#) (EI 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 Nokia Airframe 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

Tencent

POC & Deployment

- Connected Vehicle Blueprint can be flexibly deployed in physical machines, virtual machines, containers and other environments. TARSframework 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). TARSframework 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.
- PCI: Focus on use the 5G MEC open API provided by operator to support 5G MEC solution based on public cloud(i.e., ECM)

WeBank

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}

Akraino Mission:

Delivering a Fully Functional Edge Stack



Zero Touch Edge Cloud
Automation

1. Unify multiple sectors of edge across disciplines, including IoT, Enterprise, Telecom, and Cloud
1. Deliver tested and validated deployment-ready blueprints
1. Create framework for defining and standardizing APIs across stacks, via upstream/downstream collaboration

Role of Akraino Blueprints in Open Source Lifecycle

Successful Open Source Development depends on the complete life cycle of projects, products that market will adopt and deploy

- Akraino's blueprint model enables rapid transition from projects to PoC/deployment, cutting down integration time significantly.
- Blueprints augment Open Source Projects to address & accelerate Interoperability, Packaging, and Testing under Open and neutral governance.

