Blueprint Proposal: Public Cloud Edge Interface Family
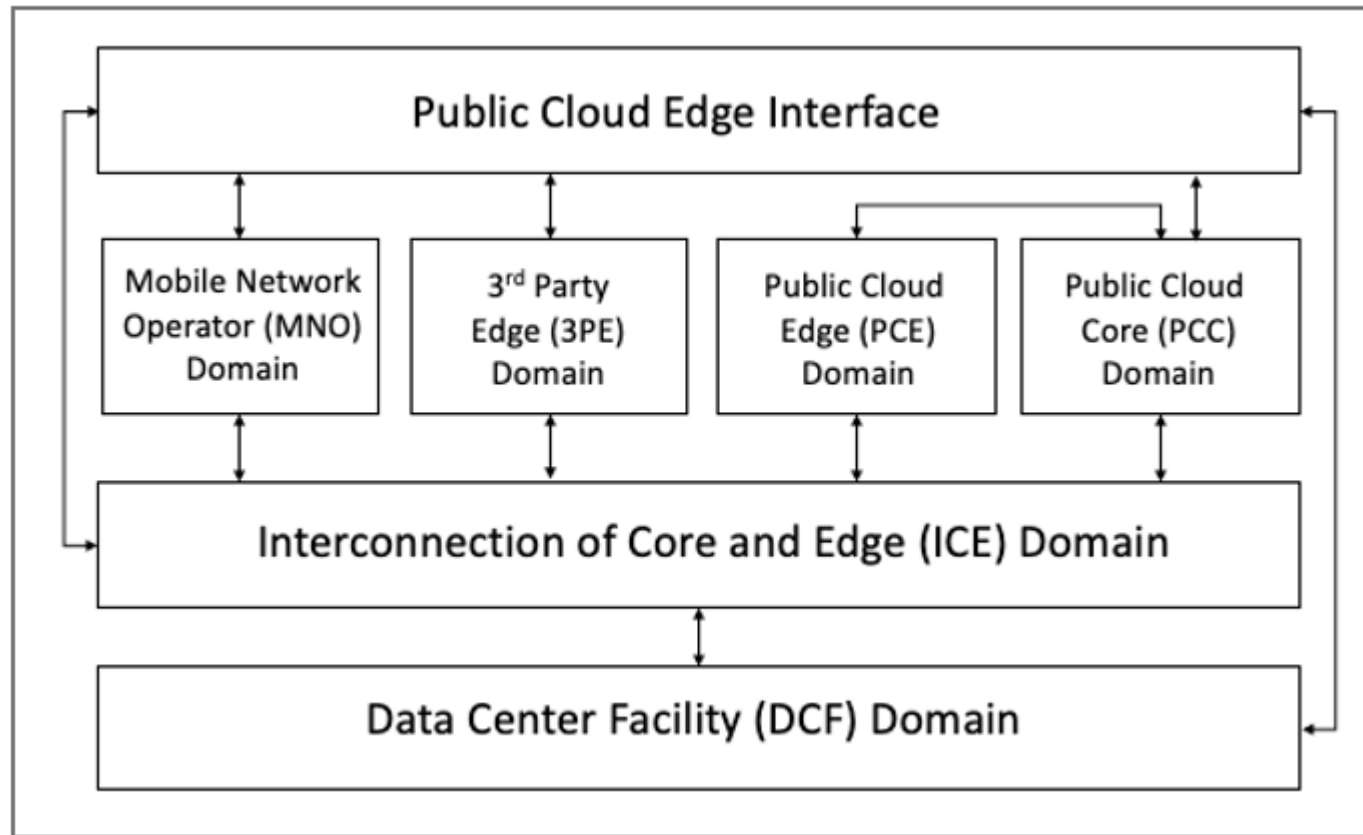## (Type 2: Federated Multi-Access Edge Cloud Platform)

KubeEdge MEC Team

March, 2021

PCEI Overview

The purpose of Public Cloud Edge Interface (PCEI) Blueprint family is to specify a set of open APIs 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.
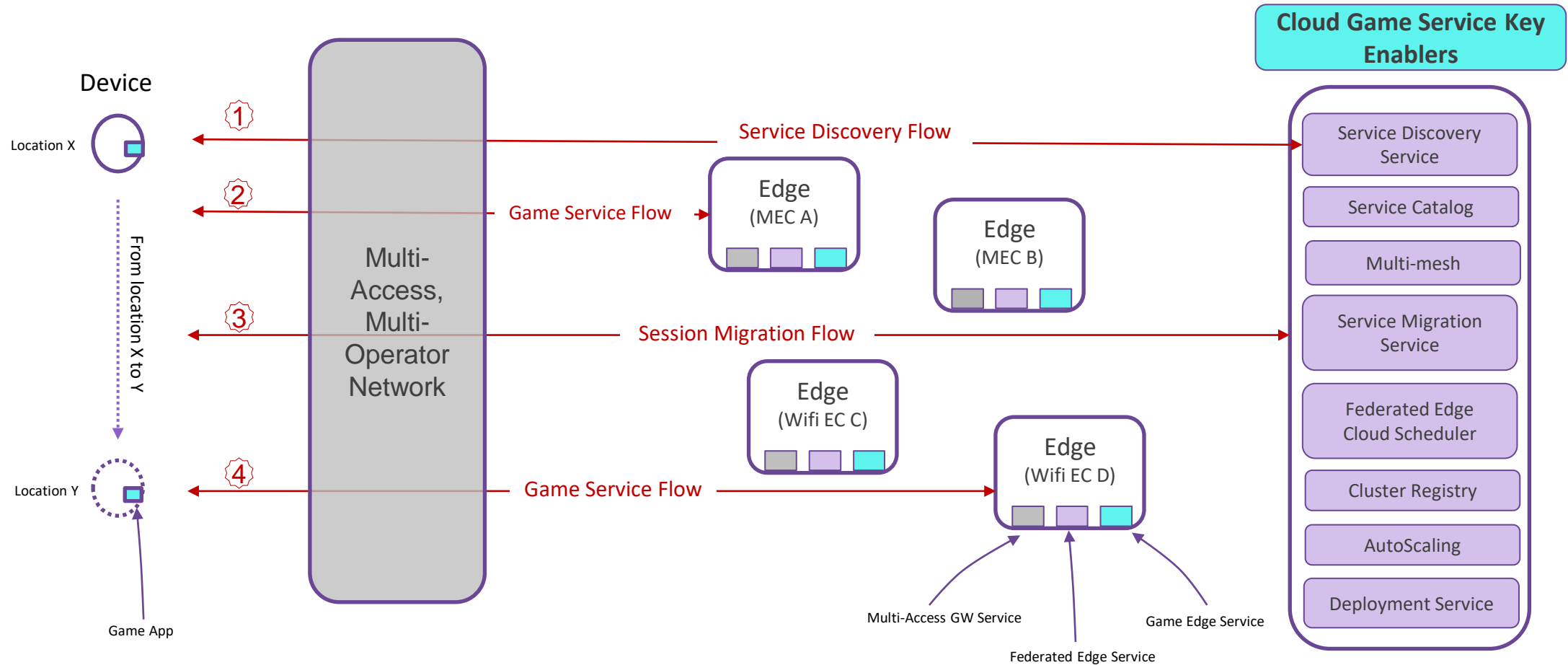
Typical PCEI Use Cases

- <mark>Distributed Online/Cloud Gaming</mark>.

- **Traffic Steering/UPF Distribution/Shunting capability** -- distributing User Plane Functions in the appropriate Data Center Facilities on qualified compute hardware for routing the traffic to desired applications and network/processing functions/applications.

- **Location Services** -- location of a specific UE, or identification of UEs within a geographical area, facilitation of server-side application workload distribution based on UE and infrastructure resource location.

- **QoS acceleration/extension** – provide low latency, high throughput for Edge applications. Example: provide continuity for QoS provisioned for subscribers in the MNO domain, across the interconnection/networking domain for end-to-end QoS functionality.

- **Network Slicing provisioning and management** - providing continuity for network slices instantiated in the MNO domain, across the Public Cloud Core/Edge as well as the 3Rd-Party Edge domains, offering dedicated resources specifically tailored for application and functional needs (e.g. security) needs.

- **Mobile Hybrid/Multi-Cloud Access** - provide multi-MNO, multi-Cloud, multi-MEC access for mobile devices (including IoT) and Edge services/applications

- **Enterprise Wireless WAN access** - provide high-speed Fixed Wireless Access to enterprises with the ability to interconnect to Public Cloud and 3rd-Party Edge Functions, including the Network Functions such as SD-WAN.

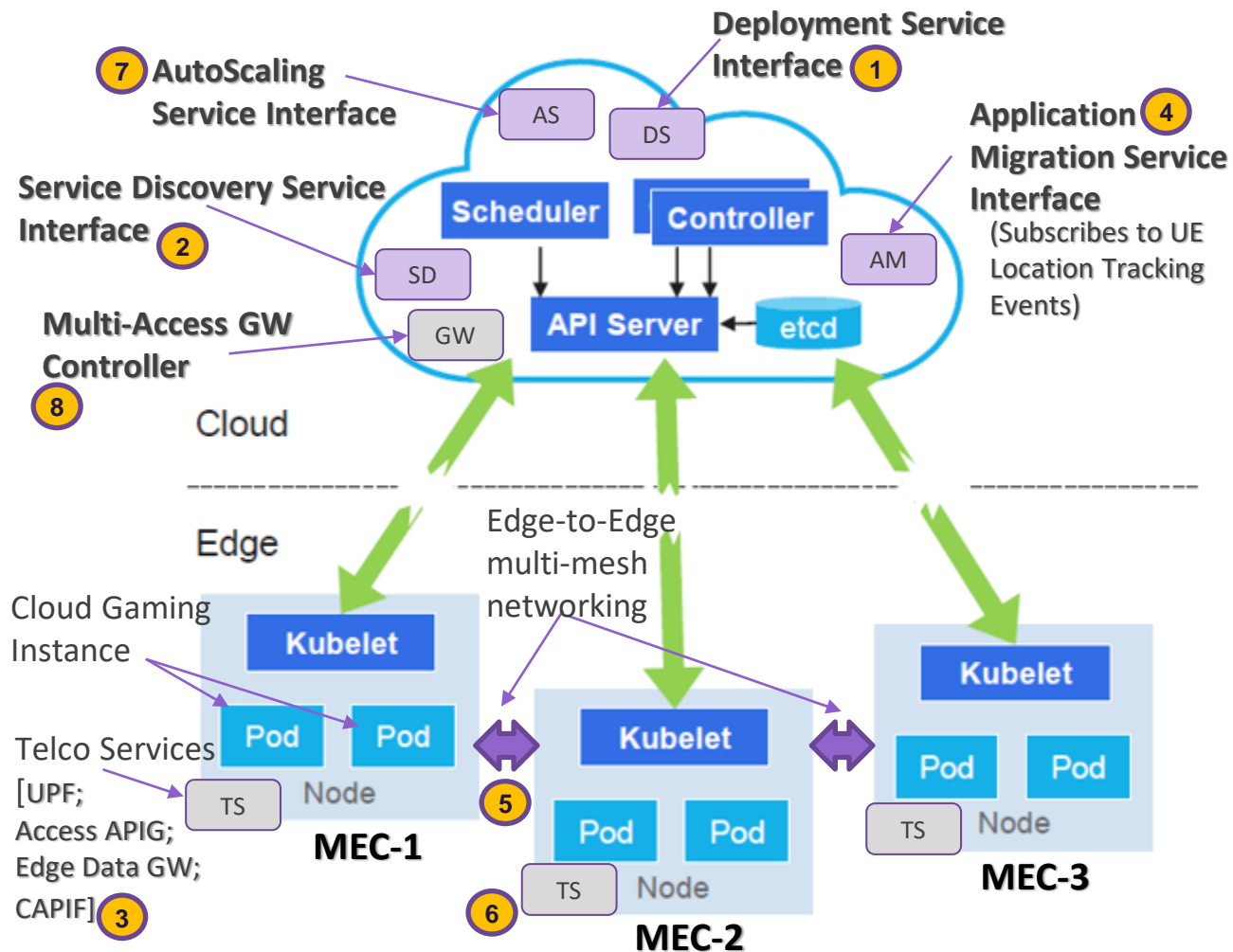- **Local Break-Out (LBO)** – Examples: video traffic offload, low latency services, roaming optimization.

Proposed Blueprint Introduction

❖ Type II of PCEI family focuses on solution with a mobile game deployed across multiple heterogenous edge nodes using various network access modes including mobile and Wifi.

❖ A simulated mobile access environment is used to mimic a real time device access condition changes.

❖ The key component is a federated multi-access edge cloud platform – it features several key components.

❖ The platform sits between applications and underlying heterogeneous edge infrastructure and also abstracts the multi-access interface and exposes application developer friendly APIs.

❖ This blueprint leverages upstream project KubeEdge as baseline platform – this includes the enhanced KubeFed compatible federation function.

Use Case Scenario

Cloud Game Service Key Enablers

- Service Discovery Service
- Service Catalog
- Multi-mesh
- Service Migration Service
- Federated Edge Cloud Scheduler
- Cluster Registry
- AutoScaling
- Deployment Service

Device

Location X

① Service Discovery Flow

② Game Service Flow

Multi-Access, Multi-Operator Network

Edge (MEC A)

Edge (MEC B)

From location X to Y

③ Session Migration Flow

Edge (Wifi EC C)

Edge (Wifi EC D)

④ Game Service Flow

Location Y

Game App

Multi-Access GW Service

Federated Edge Service

Game Edge Service

Cloud Gaming Detail Flow using KubeEdge

- ❖ 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 application migration service subscribes to UE location tracking events or resource rebalancing scenario. **4**
- ❖ Upon UE mobility or resource rebalancing scenario, application migration service uses Cloud core side Service Discovery service interface to retrieve the address of new appropriate location-aware edge node. **2**
- ❖ Cloud Core side application migration 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.

Disparate Multi-Access Protocols Migration Challenges

❖ Challenges due to <mark>Intra</mark> & <mark>Inter</mark> Operator Roaming

    ❖ WIFI ⬄ WIFI transition

    ❖ 5G ⬄ 5G transition

    ❖ WIFI ⬄ 5G transition

KubeEdge Project Overview

- Built upon Kubernetes, 100% compatible with Kubernetes APIs

- Optimized node components and runtimes for edge

- Bidirectional multiplexing message channel

- Metadata persistence at the edge, local autonomy

- Support for extensive edge applications and protocols

- Simplified access and control of edge devices

- Unified management of cloud and edge applications and resources

KubeEdge
https://kubeedge.io
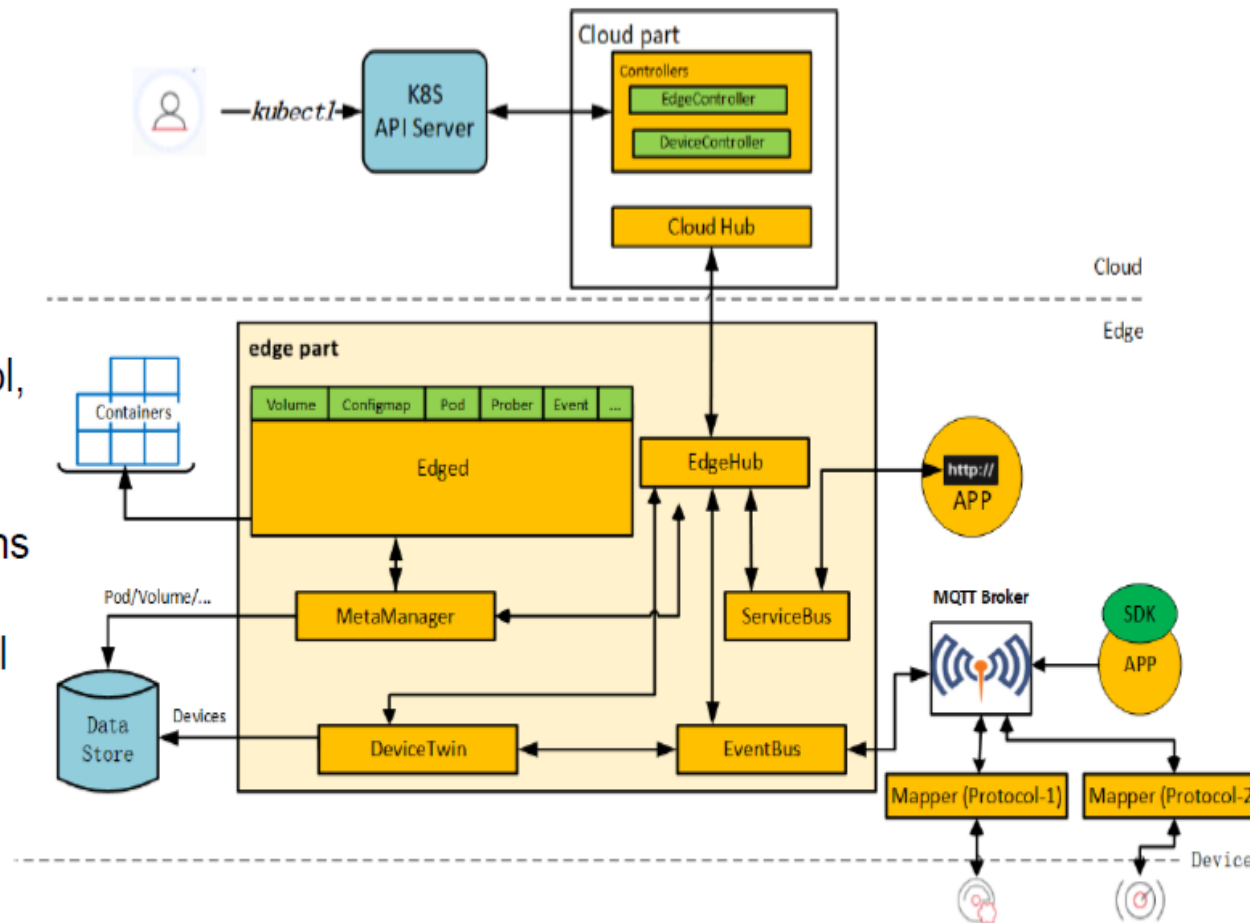
KubeEdge Architecture

An extensible framework to maximize the compute power at edge

Local persistent metadata management

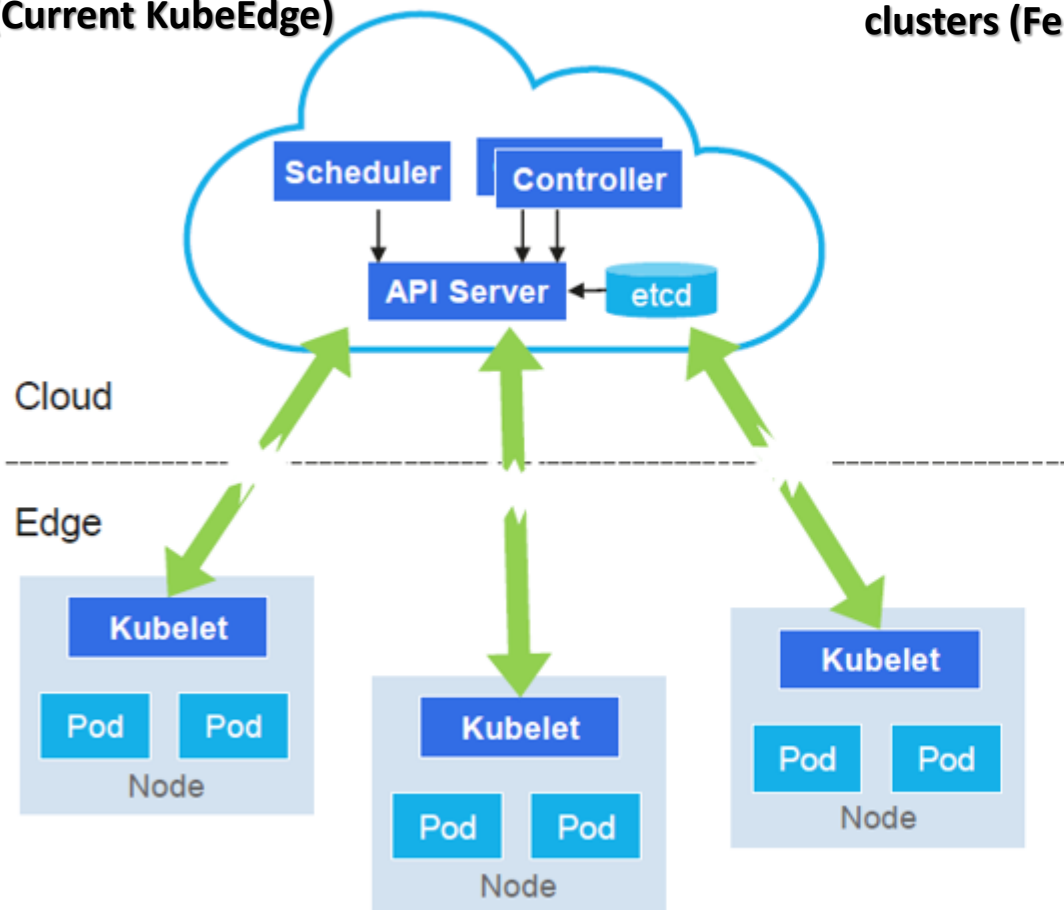An Edge-Cloud channel not just for node control, but also for application

Enables node-cloud, node-node communications

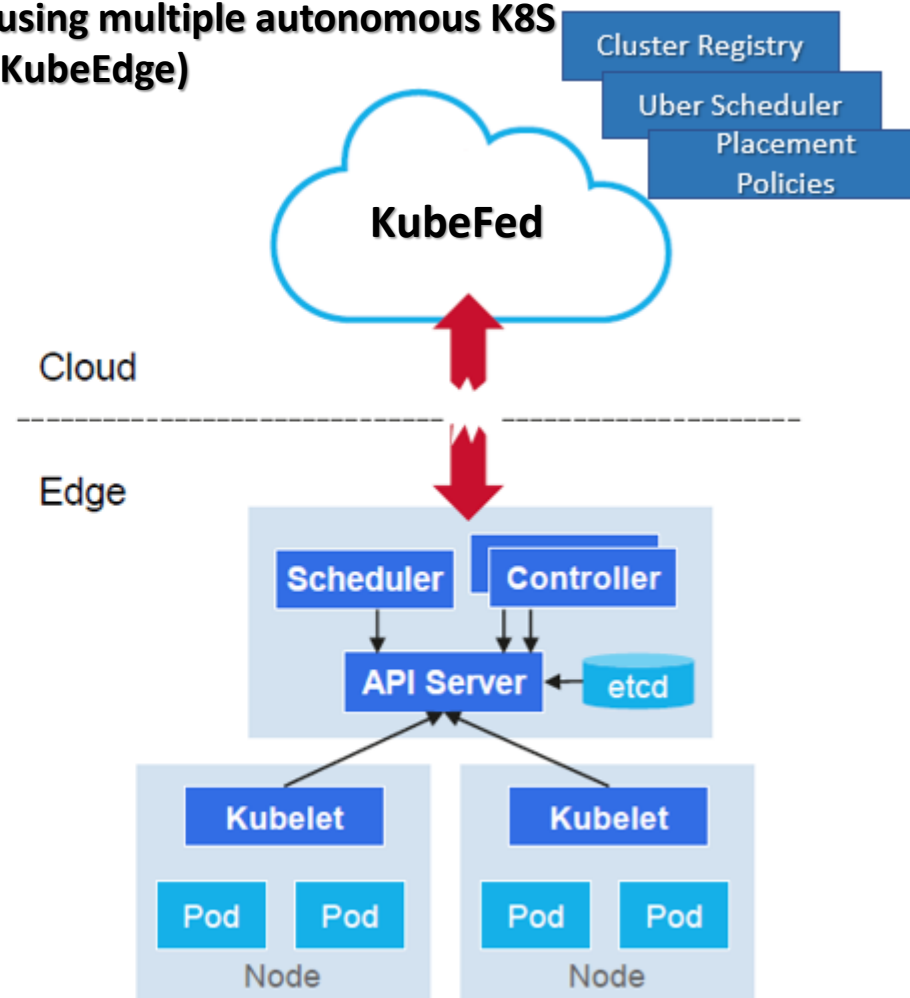Enabler for digital transformation of the physical world

Multi-Operators Deployment Topologies

Soft Multitenancy using one K8S cluster (Current KubeEdge)

Hard Multitenancy using multiple autonomous K8S clusters (Federated KubeEdge)

Thank You!