

Tackling Edge Orchestration in the Mobile Edge: An Autonomous Vehicle Use Case and other Applications

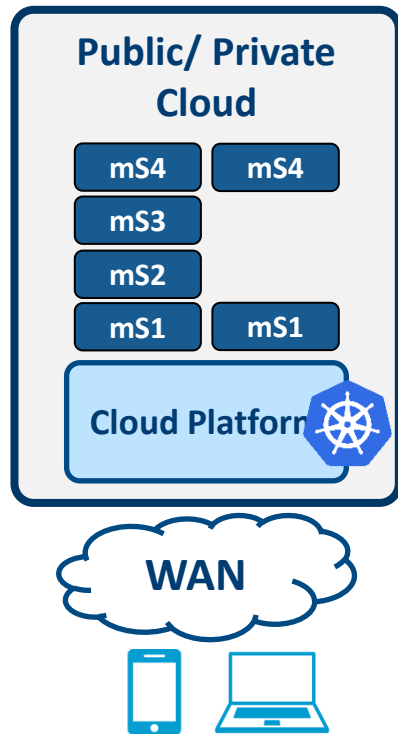
Ritu Sood, Cloud Software Engineer, Intel



Agenda

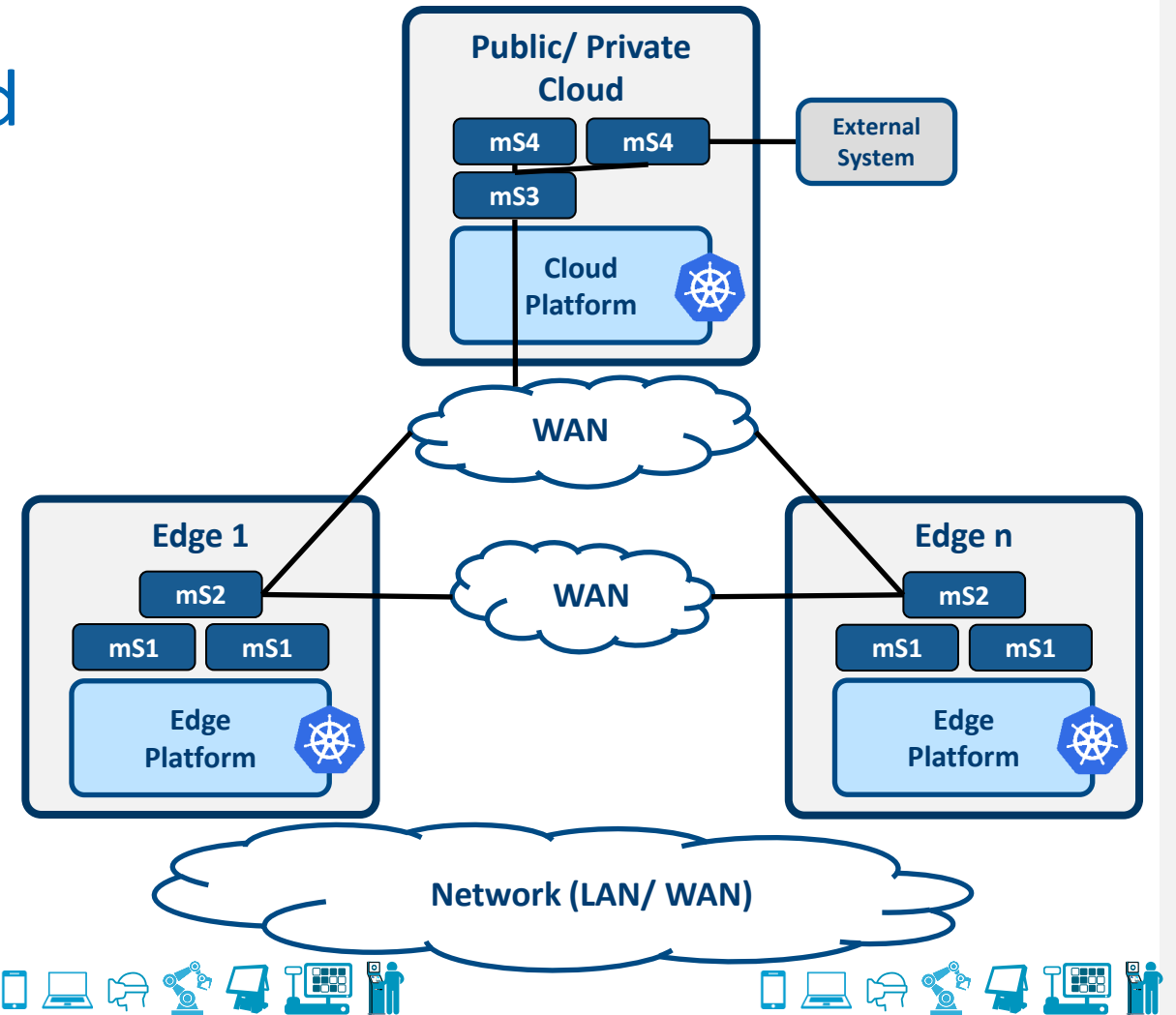
- **Problem Statement**
- **Requirements and Challenges**
- **EMCO**
- **Edge Relocation Use case**
- **Temporal Introduction**
- **EMCO and Temporal**
- **Edge Relocation with EMCO**
- **Call for Action**

Trend : Geo Distributed Computing trend with Edge-computing



Drivers

- Latency/ Physics
- Bandwidth/ Economics
- Context/ Proximity
- Privacy/ Legal

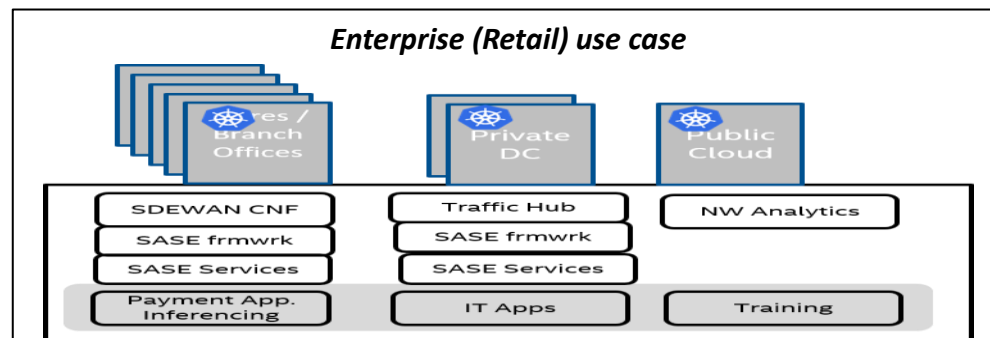
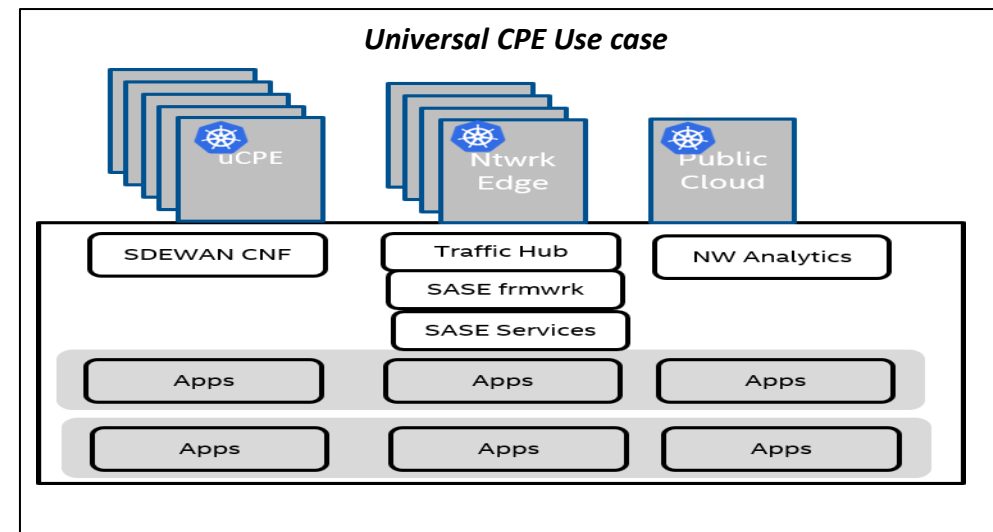
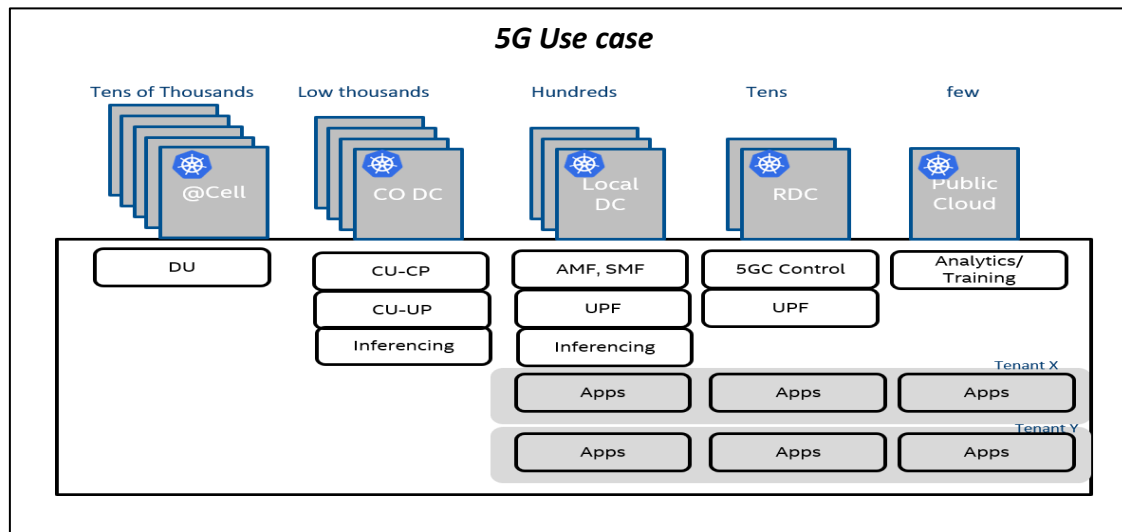


On Demand

Geo-Distributed

App Centric infra Config

Geo-Distributed Computing - few use cases

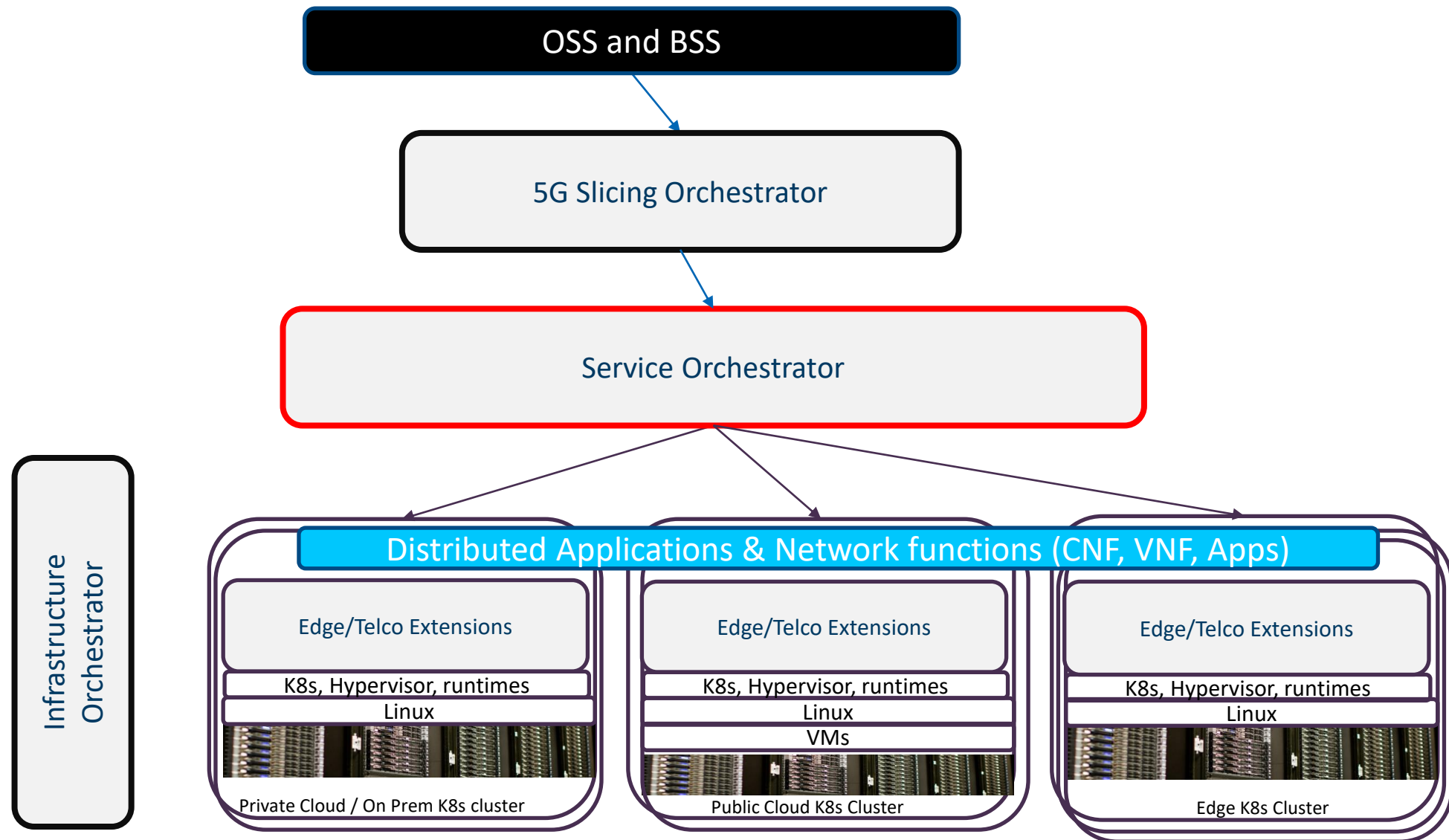


- Large Number of sites
- Computing (Apps across sites) – MEC
- Multiple tenant applications along with operator CNFs.
- Workload types - VMs, VNFs, CNFs, CNAs and Functions (FaaS)
- K8s is becoming choice of workload orchestrator in each cluster

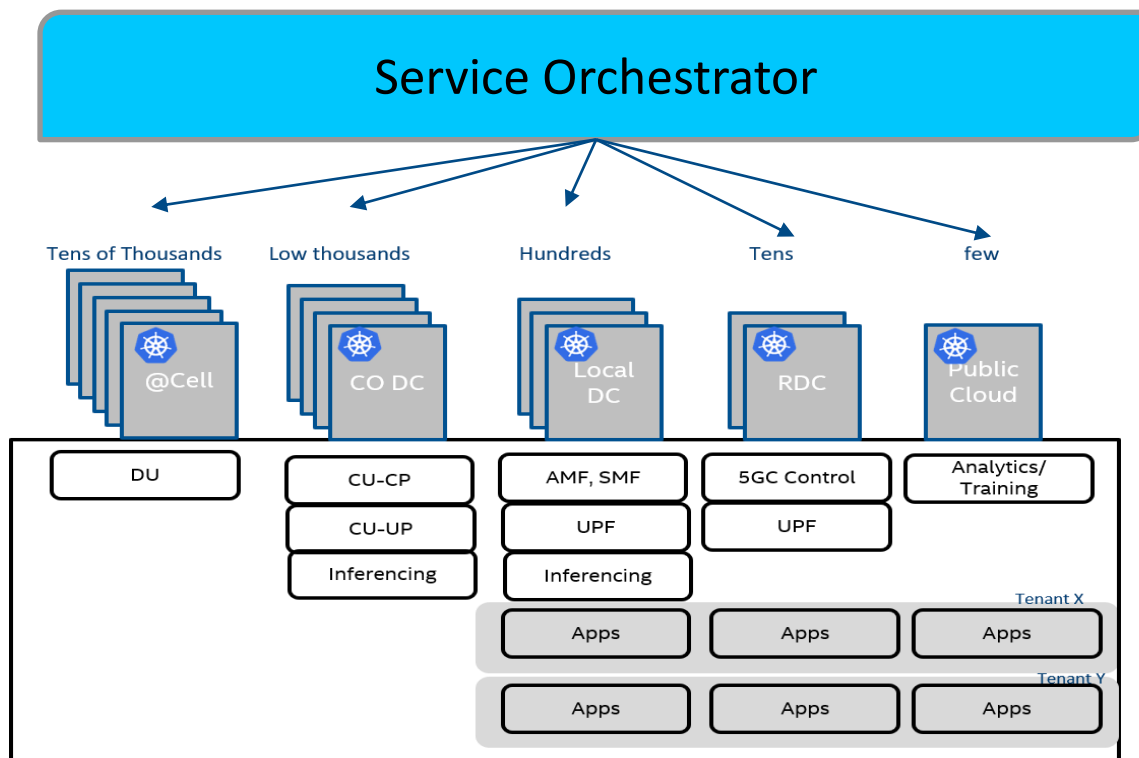
Multi Edge/Cloud computing scale is similar (or even higher) to Hyper-scalers' scale

Now Telcos, MSPs and Enterprises need @scale Orchestration and Automation solutions

E2E Edge Stack



Service Orchestrator – Big Picture



One Click deployment of complex applications & network services across multiple K8s clusters

Comprehensive Status monitoring of deployed complex applications

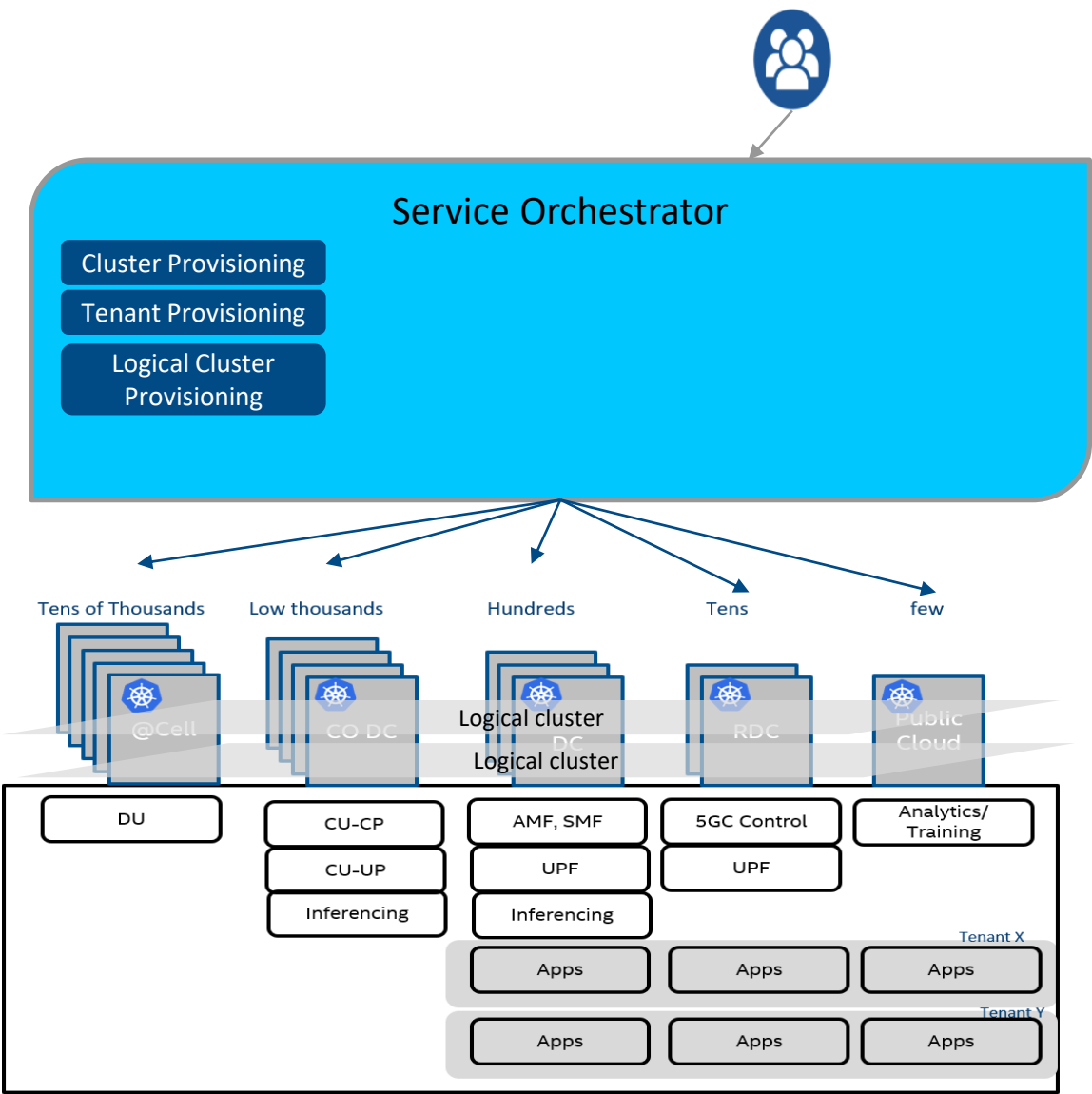
Automation of compute resources

Configuration of CNF's (may require Restful API's or workflows)

App Centric infrastructure configuration (Service Mesh, SDWAN, L2/L3 switches)

Self Service Portal for multiple tenants

Needs/Requirements – Preparation



Registration of Clusters

Cluster labels

*(Example: Cell tower Edge, CO Edge etc..)
Needed for identifying multiple clusters*

Cluster specific configuration

*(Few: ISTIO CA provisioning;
Virtual/Provider network preparation)*

Tenant registration

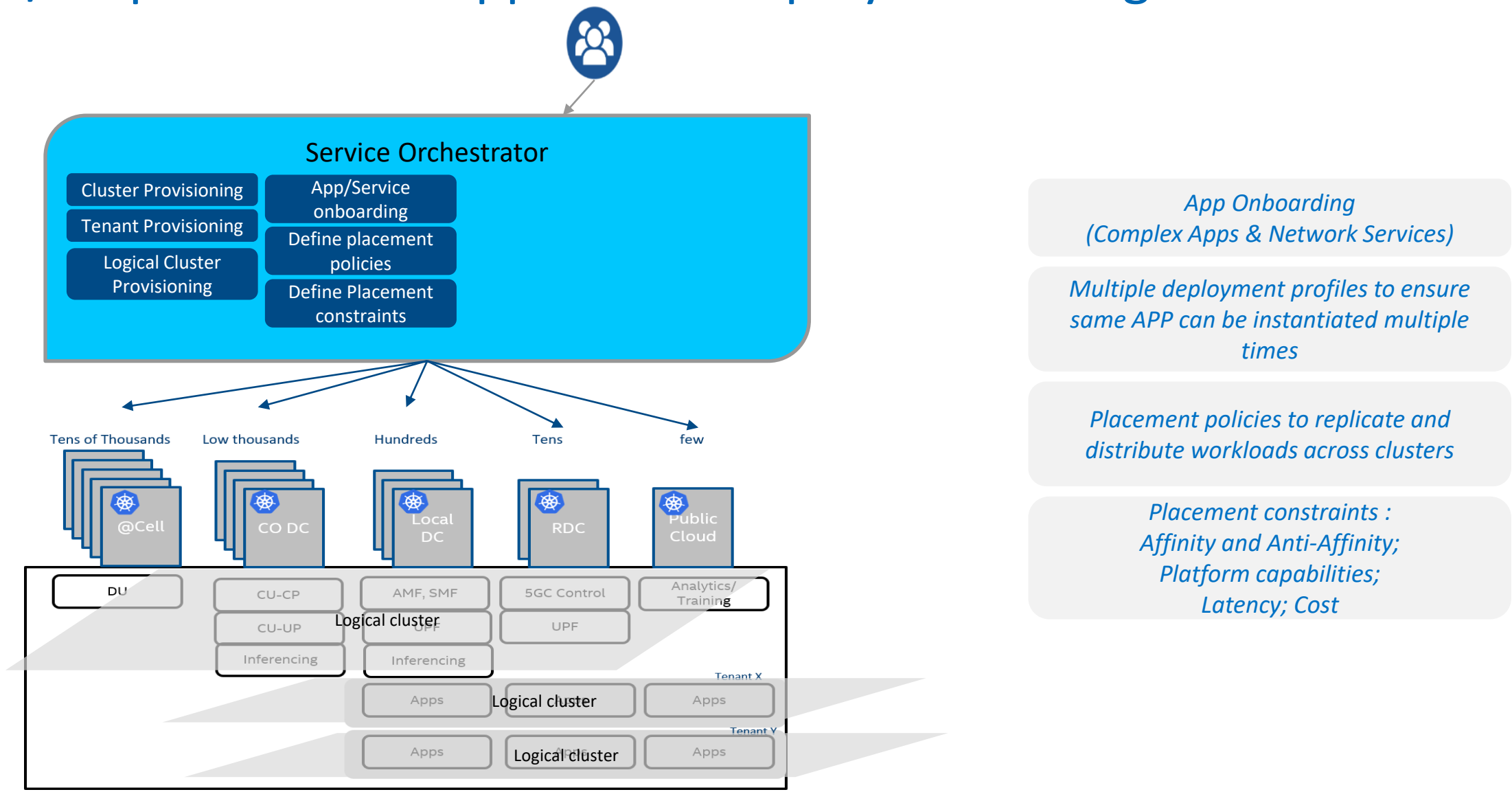
*Ability to use tenant specific OAUTH2
servers for authenticating tenant admins*

Tenant level isolation via RBAC rules

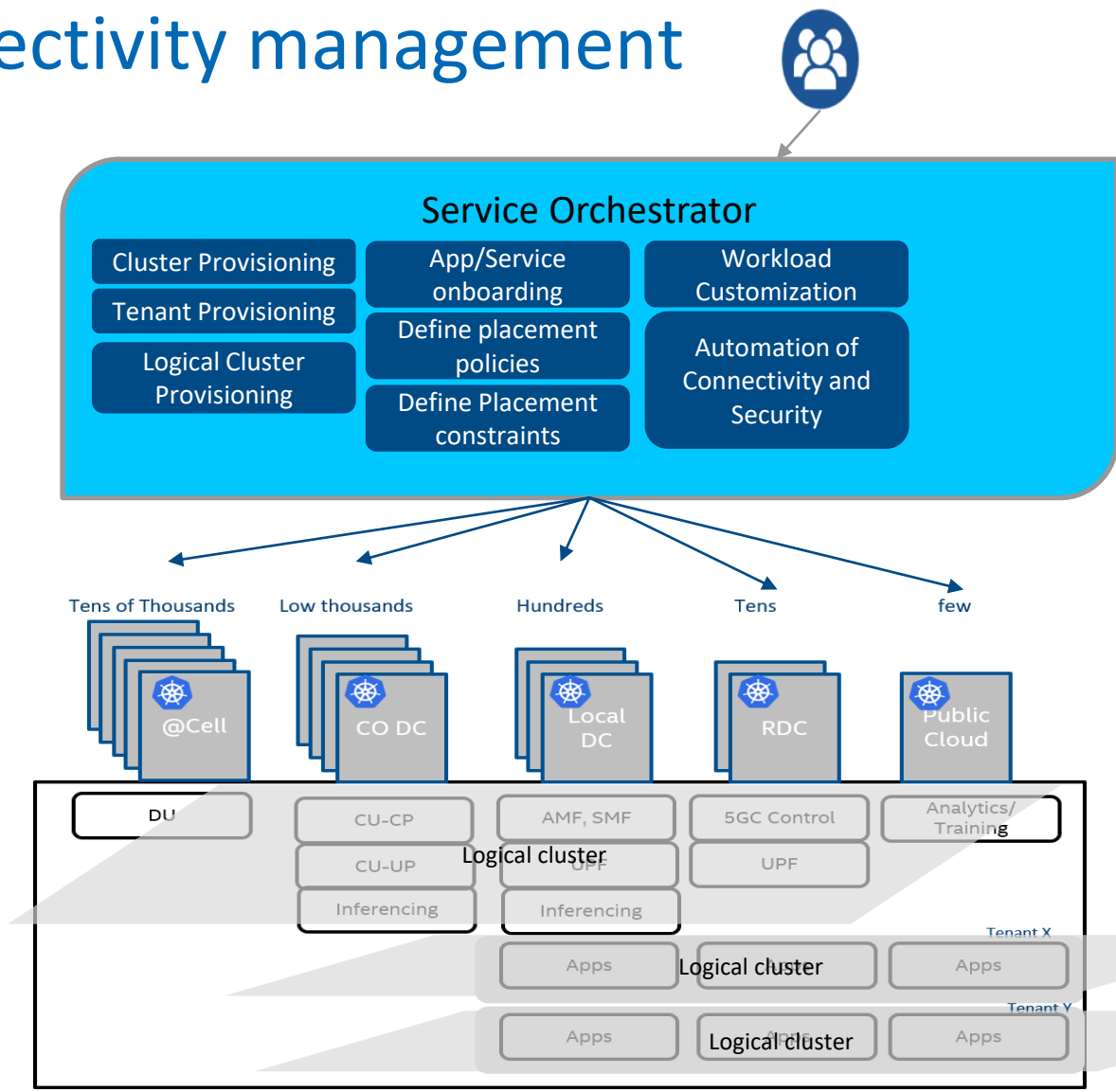
*Logical Cluster provisioning across
multiple selected clusters*

*Logical Cluster user and permission
provisioning*

Needs/Requirements – Application deployment design



Requirements – Workload Customization & Connectivity management



No changes to helm charts/K8s description of applications

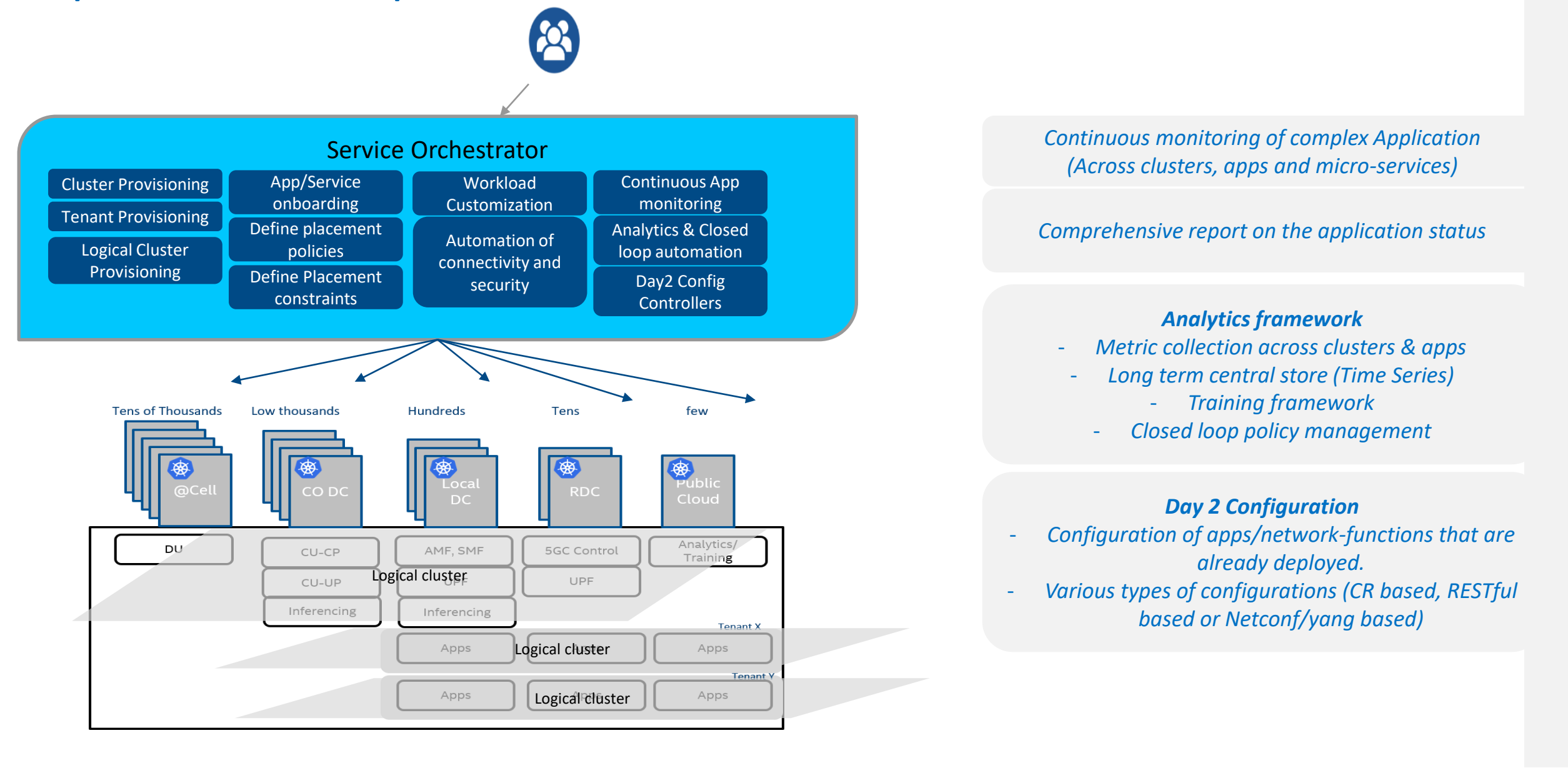
Each deployment may have its own customization

- Connectivity intent provisioning**
- Enabling inter-micro service communication within or across clusters
 - Enabling communication to external entitles
 - With/Without Mutual TLS
 - Multi Cluster DNS management

Dynamic provisioning with LCM of Applications

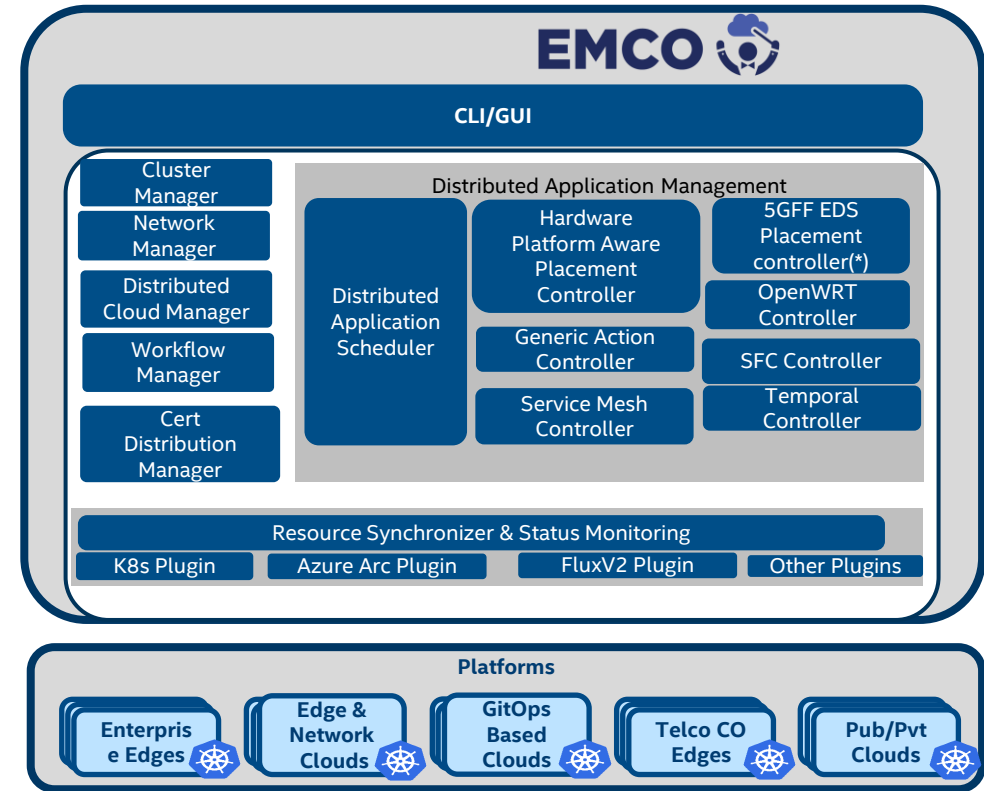
Extensible framework to add new capability controllers

Requirements – Operations



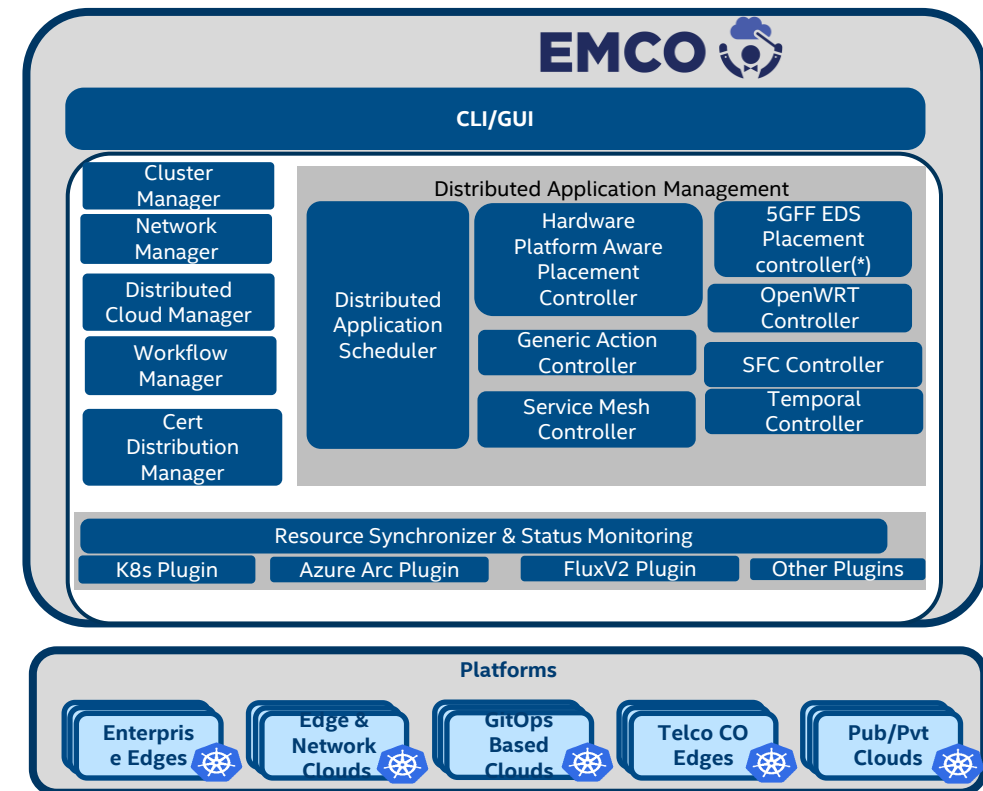
Edge Multi Cluster Orchestrator (EMCO)

- Linux Foundation's project-emco.io
- Intent-based Lifecycle management of apps and network functions
- Various edge locations, cloud/on-prem DCs
- Highly extensible with in-tree or 3rd party controllers
- Intent based architecture
- Intelligent selection of clusters to place the workloads
- Tenant Isolation using logical clouds
- Customization of resources in the applications based on clusters

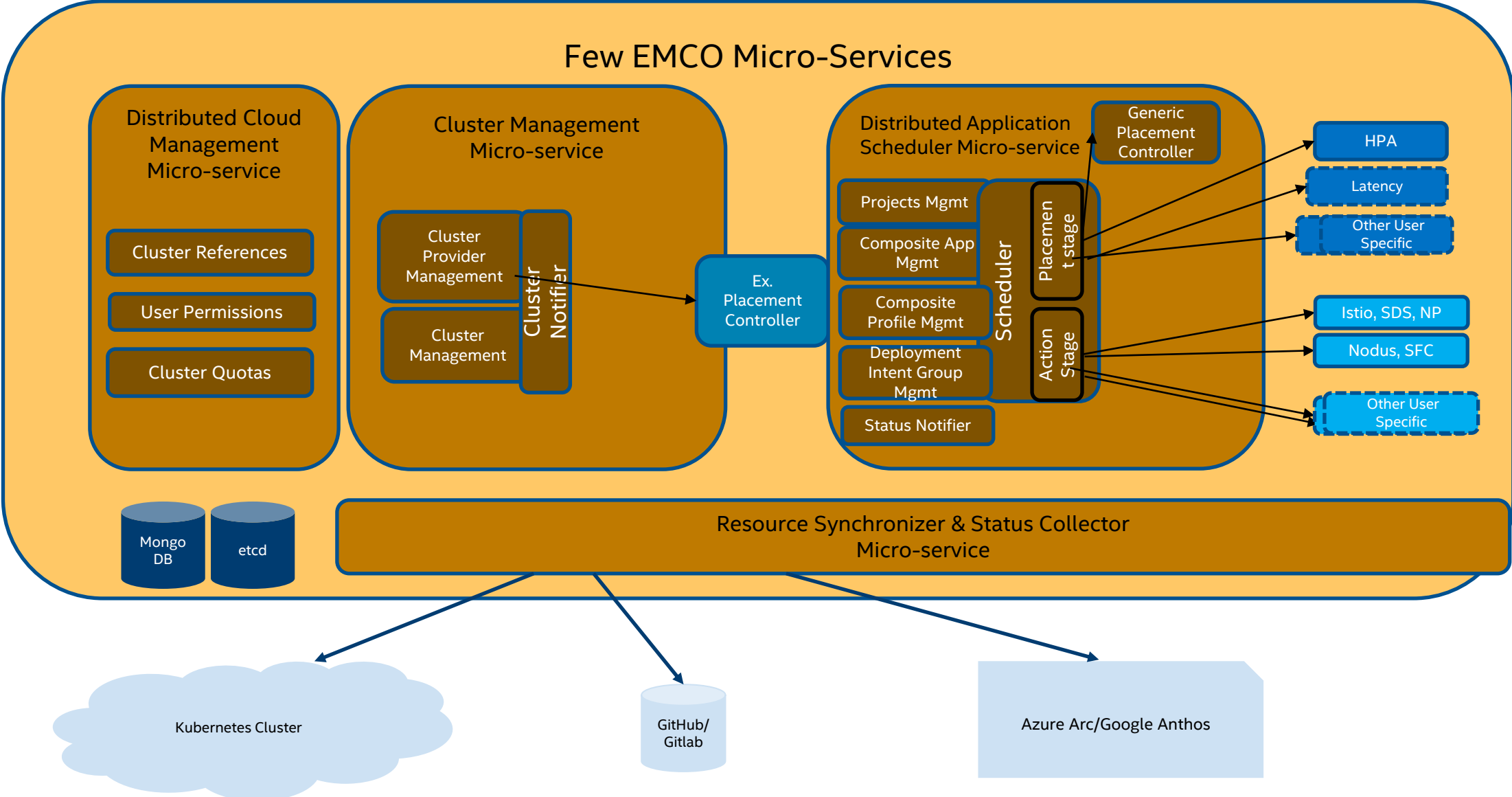


Edge Multi Cluster Orchestrator

- Automation of service mesh and other connectivity & security infrastructure
- Dependency and order of priority of application deployments between clusters
- Update and Rollbacks
- GitOps based cluster support
- Temporal Support



EMCO Architecture



Edge Relocation Use case (Intel & Orange collaboration)

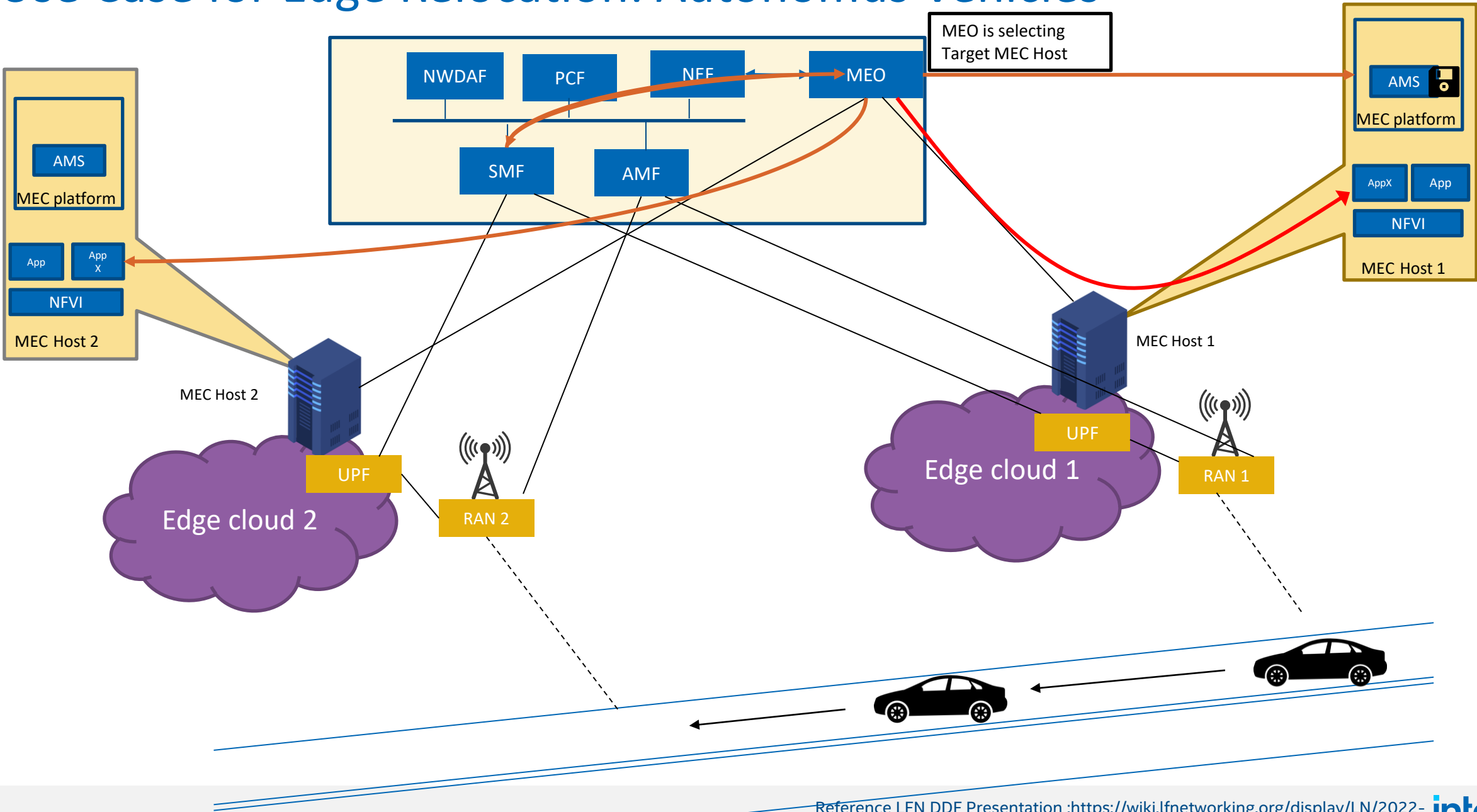
Problem statement according to ETSI standards

The user (UE) is consuming a service, while moving out of the coverage area of Source MEC Host (Cluster A). Later he/she enters the coverage area of Target MEC Host (cluster B) and expects to resume the same service. This requires a relocation of a service instance from cluster A to cluster B.

Requirements for application relocation (identified by ER WG):

- Service continuity must be assured to the UE;
- The new instance of the application must be declared to be 'ready' before we can steer the traffic to the new app instance;
- If there are several candidates for the target MEC cluster, the final choice should be made by MEC Orchestrator

Use Case for Edge Relocation: Autonomus Vehicles



Intro to Temporal

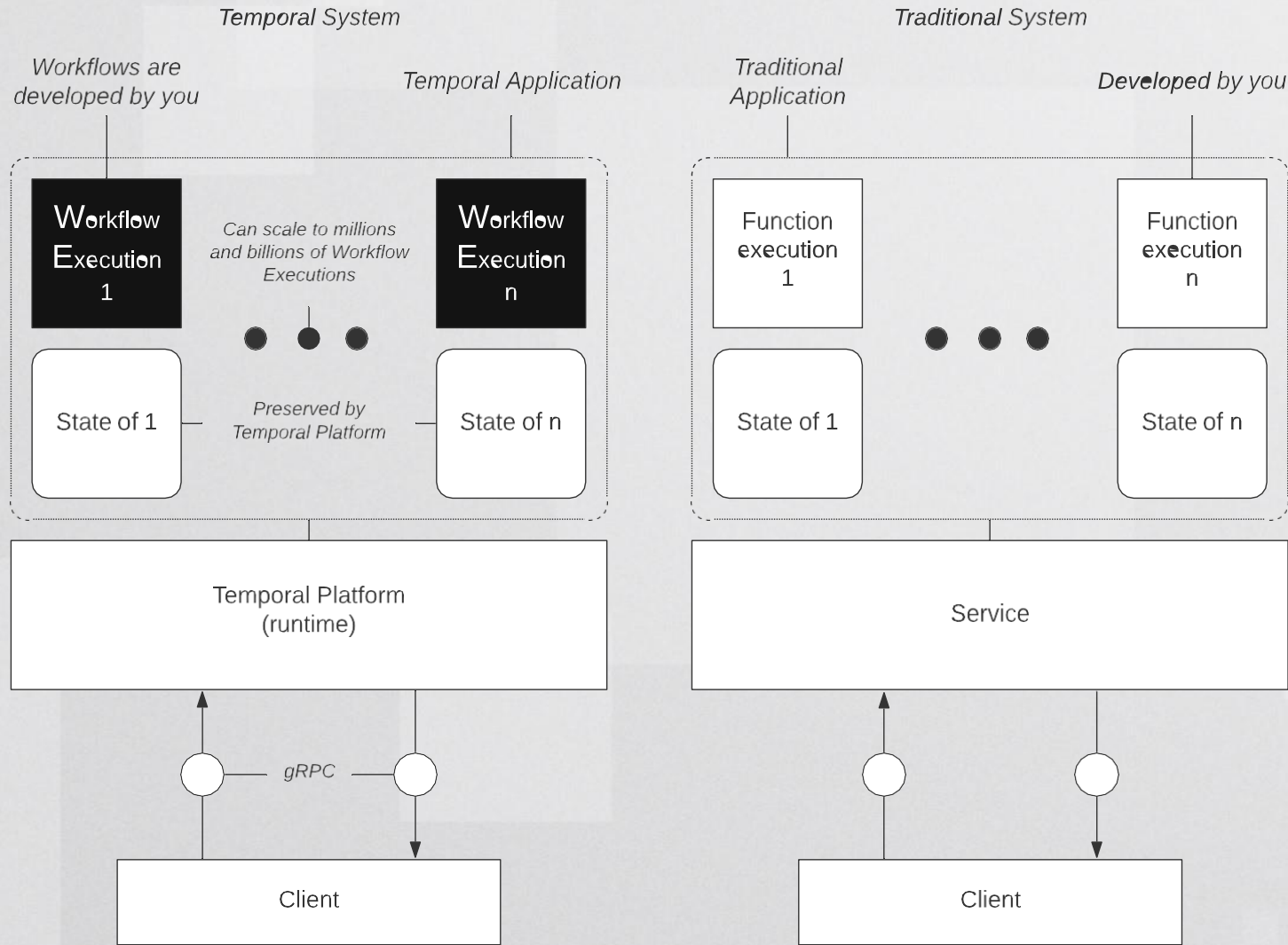
What – Platform to build reliable and scalable applications. It provides Resilience, Configurability and Scale (billions)

Why - The most valuable, mission-critical workloads in any software company are long-running and tie together multiple services.

Two types of special purpose functions:

- Workflows: Stateful functions that are used to orchestrate the application. The state of the workflow is saved in Temporal and Temporal can restart a workflow exactly where it stopped. Multi-step, stateful, long-running.
- Activity: Functions used to interact with unreliable entities. They are not stateful, but come with retries, timeouts etc. Distributed processes that can interact via messages.

Temporal Overview



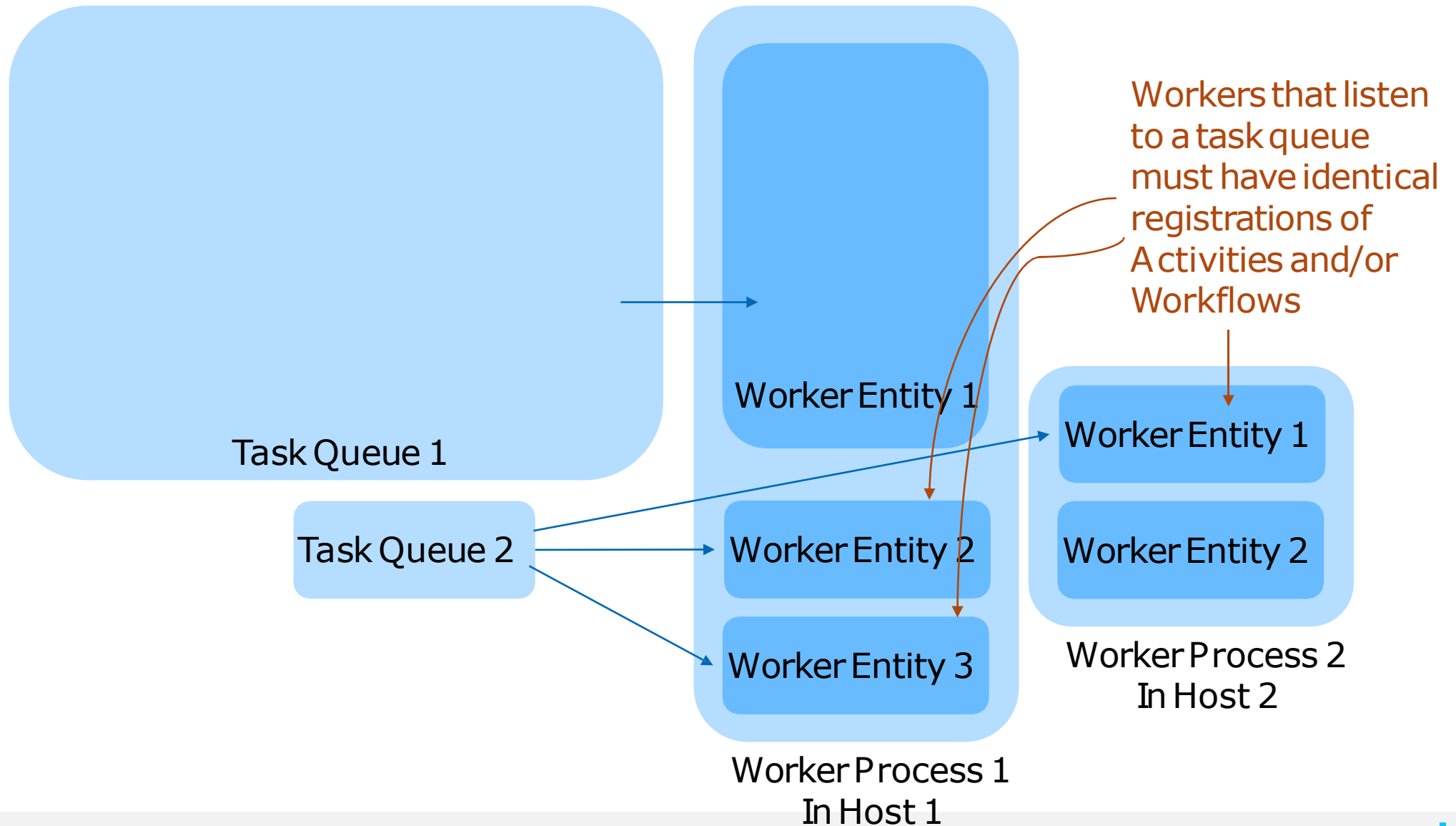
Components:

- Temporal server
- User code in Workers
 - Workflows (deterministic)
 - Activities (arbitrary code)
- User-provided Workflow Client

Temporal server and workflows/activities communicate via task queues.

<https://docs.temporal.io/docs/temporal-explained/introduction>

Temporal Concepts



EMCO + Temporal Benefits

For Temporal users:

- EMCO can deploy workers + workflow clients together as a composite app.
 - Workflows become multi-cluster: geo-distributed, replicated, versioned.
 - Workflow deployment gets more flexibility: multiple DIGs/profiles, intent-based LCM
 - Shared parameters between wf clients and workflows are easily encapsulated.
- Temporal workflows can leverage EMCO's knowledge/access of clusters and apps.
- Workflow author and admin roles are unaffected.
 - Workflow author develops code and packages them as worker/client Helm charts.
 - Workflow admin deploys them, monitors status, and cancels them [via EMCO](#).

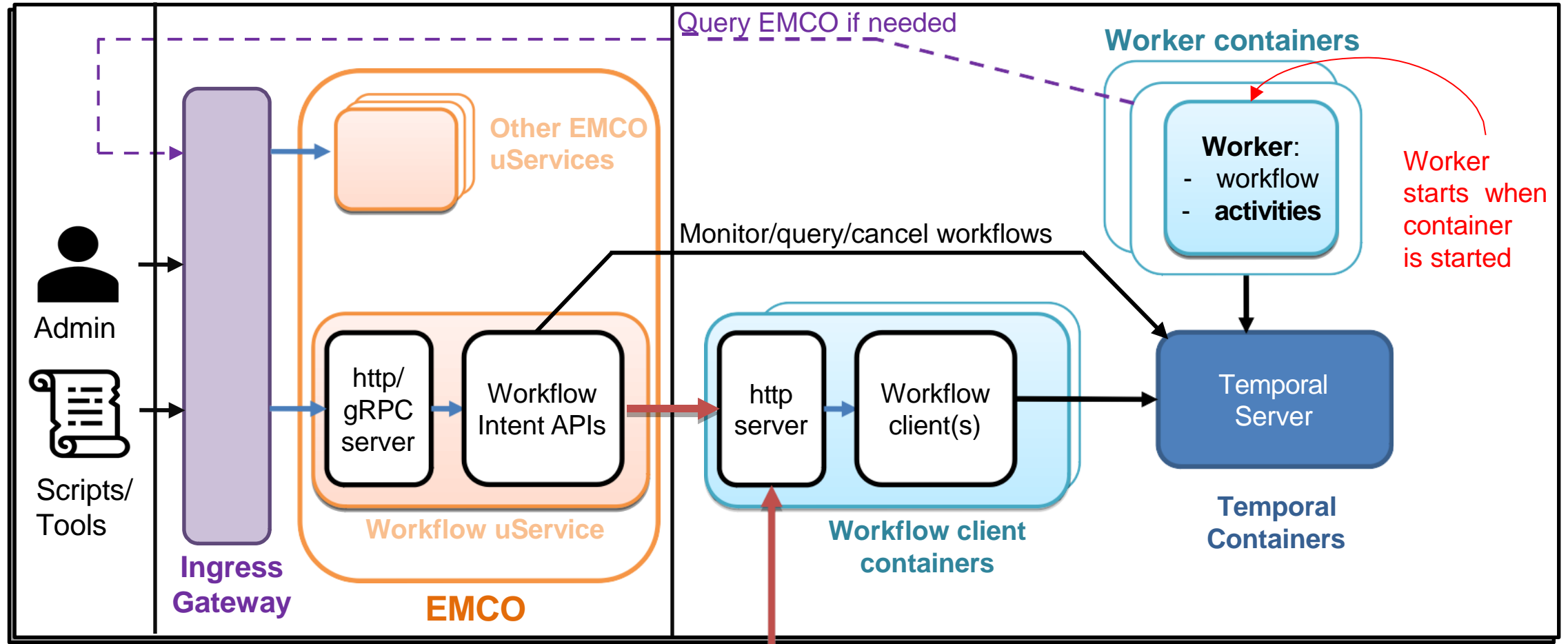
For EMCO users:

- Treat Temporal workflows as composite apps.
- Use workflows as another mechanism to extend EMCO functionality.

Temporal Integration

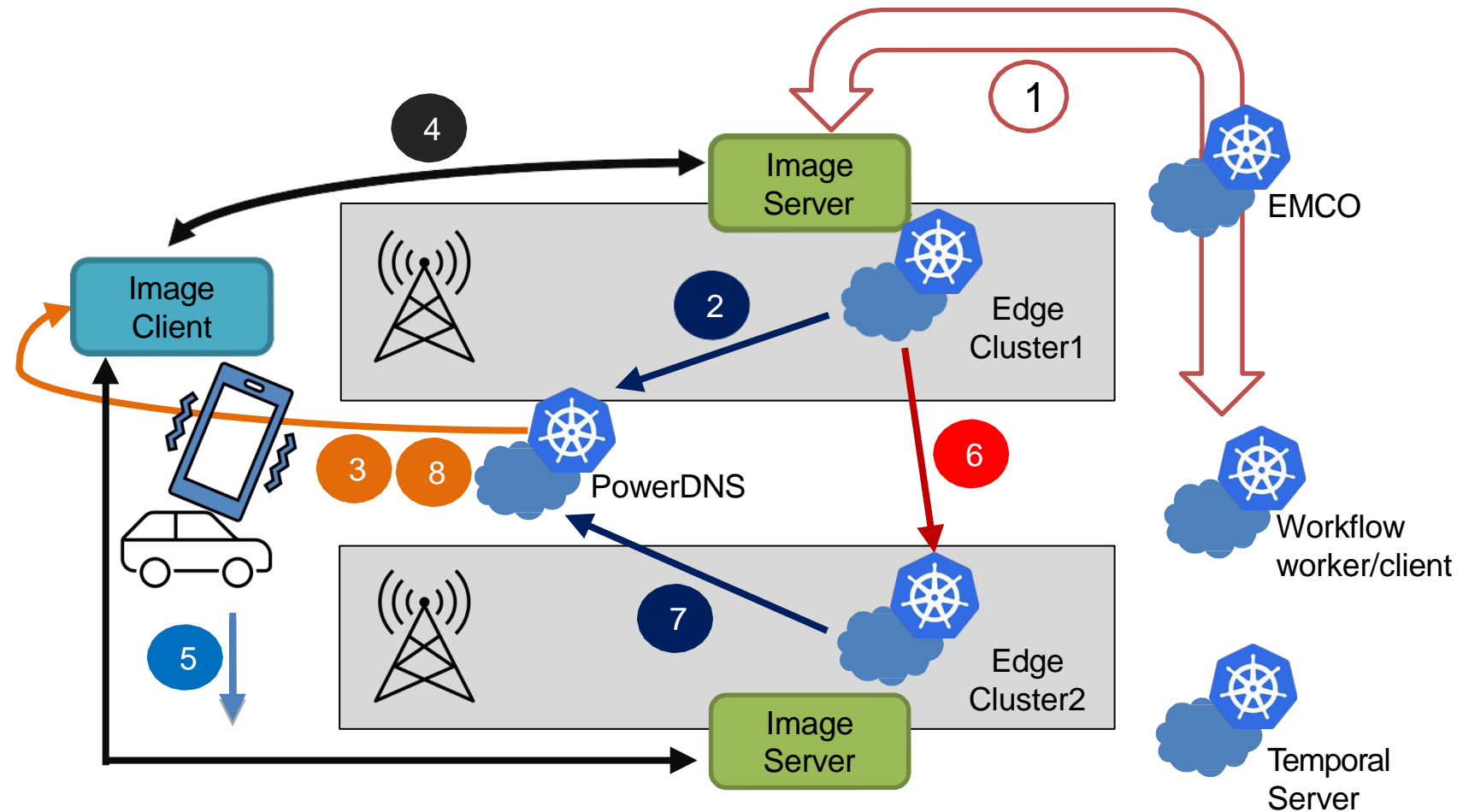
- Temporal can be used with EMCO
 - As a Workflow Manager
 - During LCM Events

EMCO + Temporal



```
curl -X POST http://container-ip:9090/invoke/my-workflowclient
```

Edge Relocation with EMCO and Temporal



- 1 EMCO deploys app
 - 2 App published in DNS
 - 3 Client queries DNS
 - 4 Client traffic to server
 - 5 Client roams to tower 2
 - 6 EMCO starts workflow to migrate app
 - 7 App updated in DNS
 - 8 Client queries DNS
- Client traffic to server
In cluster 2!

Call for action

Links for EMCO

- Website <https://project-emco.io/>
- Wiki <https://wiki.lfnetworking.org/display/EMCO/Welcome+to+the+EMCO+Wiki>
- Code <https://gitlab.com/project-emco>

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