MEC Service Federation for Location-aware IoT with DevOps MEC Infra Orchestration

ETSI – LF Edge Hackathon 2022

Team DOMINO solution submission
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DevOps MEC INfra Orchestration
Introduction

In our solution we use Akraino Public Cloud Edge Interface (PCEI) blueprint and MEC Location API service to demonstrate orchestration of federated MEC infrastructure and services, including:

• Bare metal, interconnection, virtual routing for MEC and Public Cloud IaaS/SaaS, across two operators/providers (a 5G operator and a MEC provider)

• 5G Control and User Plane Functions

• Deployment and operation of end-to-end cloud native IoT application making use of 5G access and distributed both across geographic locations and across hybrid MEC (edge cloud) and Public Cloud (SaaS) infrastructure

• By orchestrating, bare metal servers and their software stack, 5G control plane and user plane functions, interconnection between the 5G provider and MEC provider, connectivity to a public cloud as well as the IoT application and the MEC Location API service, we show how it is possible for providers to enable sharing of their services in a MEC Federation environment.
Use Case Description

- **Bare Metal/K8s**
- **MEC/IoT Edge (Azure)**
- **Fabric**
- **Public Cloud Core (PCC)**
- **5G Core Control Plane**
- **IaaS/SaaS**
- **IoT Hub (Azure)**
- **Operator A Resources (Silicon Valley, CA)**
- **Operator/Provider B Resources (Dallas, TX)**
- **PCEI Enabler (MEC Federation Broker/Orchestrator)**
- **MEC Federation Interconnection Provider Resources**
- **MEC Federation Data Plane (Fabric)**
- **IP/Network**
- **UPF**
- **gNB**
- **UE**
- **5G Network Slice and Location Service**
- **Location request/response**
- **Encoded IoT data**
- **Decoded IoT and Location data**

**5G Network Slice and Location Service**

**IoT App (Azure IoT Edge and Azure Cloud)**

**ETSI MEC**

**Free5GC**

**Equinix**

**Aarna**

**Vrtr**

**Public Cloud Edge (PCE)**

**Public Cloud Core (PCC)**

**BGP**

**L2**

**Port**
What does the use case do?

**Infrastructure Orchestration Stage**

**5G Operator**
- Orchestrate Bare Metal
- Orchestrate K8s Install

**MEC Fed Interconnect Provider**
- Create Private MEC Federation Data Plane Connection

**MEC Provider**
- Orchestrate Bare Metal
- Orchestrate K8s Install
- Orchestrate virtual router
- Orchestrate ExpressRoute to Azure

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**5G Network Functions and MEC Services/Applications Deployment Stage**

**5G Operator**
- Create 5G network slice for IoT customer
- Orchestrate 5G Control Plane Functions
- Orchestrate 5G User Plane Functions
- Orchestrate MEC Location API Server

**MEC Provider**
- Orchestrate hybrid MEC IoT Application
- Orchestrate Azure IoT Edge GW on MEC Server
- Orchestrate Azure IaaS and IoT SaaS (IoT Hub)

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**End-to-end Application Operation Stage**

**5G UE**
- Register with 5G Network
- Establish PDN Connection

**IoT Client**
- Send Encoded IoT Sensor data
  - (Temp, Humid, Pressure)

**IoT Edge Gateway**
- Receive encoded data
- Decode sensor data
- Obtain location data
- Send sensor and loc data to cloud

**Cloud IoT Hub**
- Receive IoT data
  - (Temp, Humid, Pressure, Lat, Lon, Alt)
5G cloud native Control and User Plane Functions deployment (with simulated UE/gNB)
MEC Service Federation Call Flow: Location aware Low Power IoT

IoT Client/UE → 5G Operator UPF → MEC Location API Server → MEC Fed Data Plane → MEC App IoT Edge → Virtual Router VNF → Cloud Interconnect ExpressRoute → Public Cloud IoT Hub SaaS

- Send sensor data in Low Power Encoding: Temp, Humidity, Pressure, UE ID
- Decode sensor data and Convert to JSON
- GET UE Location, UE ID
- Add UE Location Info to decoded IoT message
- Post decoded and enriched IoT message to IoT Hub
- Temp, Humidity, Pressure, Coordinates
- Display location aware IoT Data on map
Architecture of the Orchestrator
Summary of contributions and innovations

• A practical use case showing a realization of ETSI MEC Federation architecture
• An introduction and a functioning demonstration of MEC Federation Data Plane
• Implementation of the GSMA OPG Edge Node sharing scenario using MEC Federation
• Implementation of ETSI MEC Location API Service and its integration with a MEC application
• Implementation of a combined MEC Federation Broker and MEC Orchestrator with unique capabilities for infrastructure orchestration in multiple domains such as public cloud, edge/MEC cloud, network operator, 5G control plane and user plane cloud native function deployment as well as cloud native service and application deployment
• Implementation of integrated Terraform Infrastructure-as-Code module into the orchestrator enabling DevOps infrastructure orchestration
Summary of software contributions

• **Terraform plans**

• **Ansible playbooks**

• **Helm3 charts**

• **Camunda workflows**
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For more details, please follow the links:

Detailed solution document
Demonstration video
This presentation