Italian trial site Overview

Lead: LINKS

HORIZON JU Innovation Actions | 101139048 |
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Trial Site Overview

- Living Lab will be based on a joint 5G/6G testbed of LINKS and Politecnico di Torino
  - This will enable the use of two base stations for the experimentation

- Two UCs to be demonstrated
  - **IT-UC1:** Advanced In-Service Reporting for Automated Driving Vehicles (MEC federation)
  - **IT-UC2**: Dynamic Collaborative Mapping for Automated Driving (MEC handover)

Technical focus on
  - Dynamic network reconfiguration (uplink and downlink) leveraging ENVELOPE APIs to optimize conditions based on triggers from CAM vertical applications
  - Seamless information exchange between CAM vertical applications and the 5G network
  - MEC federation and MEC handover scenarios

Hardware Components

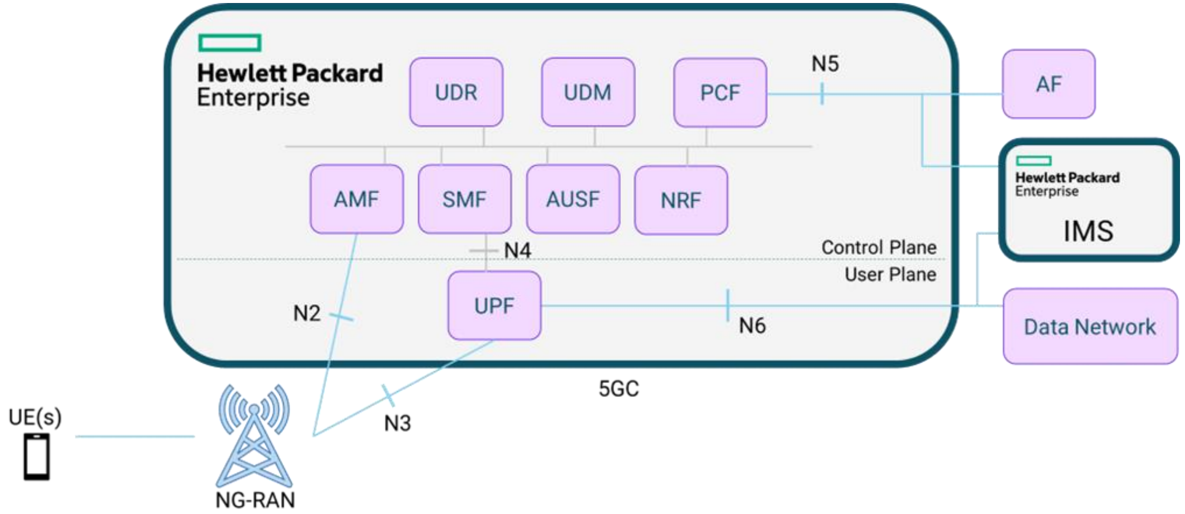
- Network Infrastructure
  - 5G-CN by HPE
  - 2 gNBs
    - 5G in Frequency Range 1 (FR1), n77 band (4045 MHz) and 30 MHz of bandwidth, 4 layers MIMO (4x4

- Specialized Equipment:
  - 2 GPU-enabled edge servers
  - End-devices are TEO's vehicles with sensors using LINKS OBUs as Ues

Software Stack

- Core Network software from HPE
- Management and orchestration stack from NXW
  - **Service Orchestrator**
  - **Network Orchestrator**
  - **Closed Loop Platform**
  - **Resource Orchestrator**

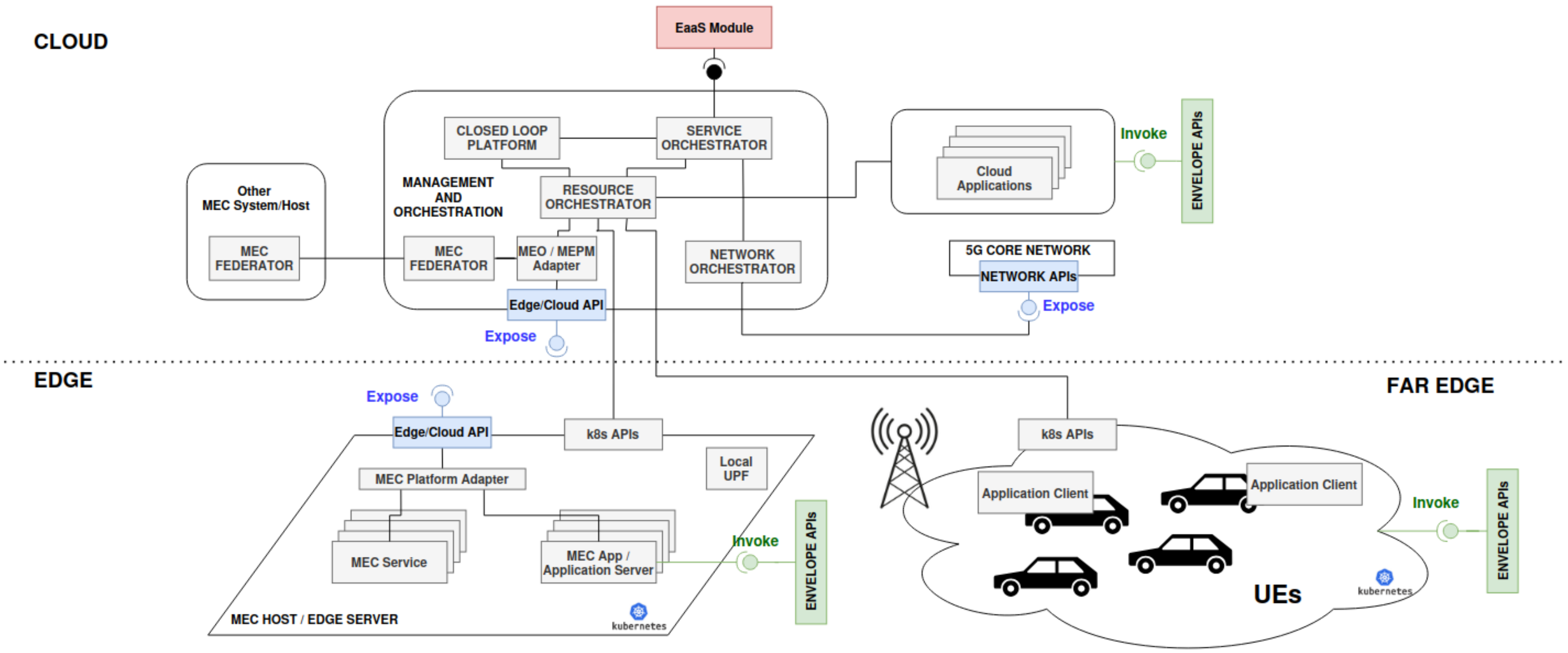
HPE 5G Core



- Control/user-plane **separation**
- **Containerized** 3GPP-standard NFs
- Support of **network slicing**
- Deployable over common-off-the-shelf HW
- Compatible with any 3GPP RAN

- **Exposed** N1, N2, N3, N5, N6 interfaces
- **Distributed** deployments
- **QoS management/control** via AFs
- **APIs** for metric collection and remote control/configuration

NXW Stack



CLOUD
EaaS Module
CLOSED LOOP PLATFORM
SERVICE ORCHESTRATOR
MANAGEMENT AND ORCHESTRATION
RESOURCE ORCHESTRATOR
Other MEC System/Host
MEC FEDERATOR
MEC FEDERATOR
MEO / MEPM Adapter
NETWORK ORCHESTRATOR
Edge/Cloud API
Expose
Cloud Applications
Invoke
ENVELOPE APIs
5G CORE NETWORK
NETWORK APIs
Expose
EDGE
FAR EDGE
Expose
Edge/Cloud API
k8s APIs
Local UPF
MEC Platform Adapter
MEC Service
MEC App / Application Server
Invoke
ENVELOPE APIs
MEC HOST / EDGE SERVER
kubernetes
k8s APIs
Application Client
Application Client
Invoke
ENVELOPE APIs
UEs
kubernetes

NXW Stack

- **Service Orchestrator:** Entry point for EaaS Platform
  - Manages Vertical Services
  - Delegates Network Orchestrator to manage Network Resources (network slices)
  - Delegates Resource Orchestrator to manage computing resources
  - Delegates the Closed Loop Platform to manage closed loops
  - Exposes (through an adapter) ETSI MEC 10-2 APIs for MEC app lifecycle management, which are invoked by the Transformation Function in the Exposure Framework
  - Supports MEC Federation (MEC 040) to enable MEC app lifcycle management among different MEC systems (e.g. owned by different operators)

NXW Stack

- **Network Orchestrator:** Manage Network Resources on top of Network APIs exposed by HPE's 5G Core Network
- **Closed Loop Platform:** Instantiate and Manage ETSI-ZSM based closed loops
- **Resource Orchestrator:** Manages multi-cluster compute continuum resources, abstracting the underlying cloud-native infrastructure through unified APIs in support of vertical applications deployment and operation

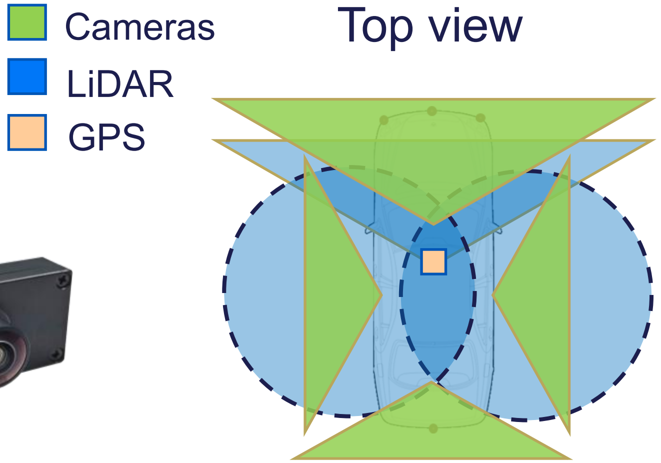
TEO Automated Vehicles

- Cameras
  - Stereocamera Leopard LI-AR0234CS-STEREO-GMSL2-30
  - 3 x Monocamera Leopard AR0234CS-OWL-GMSL2
- LiDARs
  - 1 x 120 deg Solid State Lidar Robosense M1
  - 2 x 360 deg Rotating Lidar Robosense 32 channels
- GPS
  - Xsense MTI680G
  - Foreseen to use in ENVELOPE the information from the GNSS receiver of the OBU
- Vehicle actuation (drive-by-wire) not available for safety reason

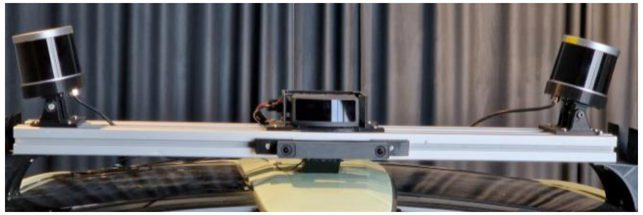
M1

Helios 32P

Top view



Front view



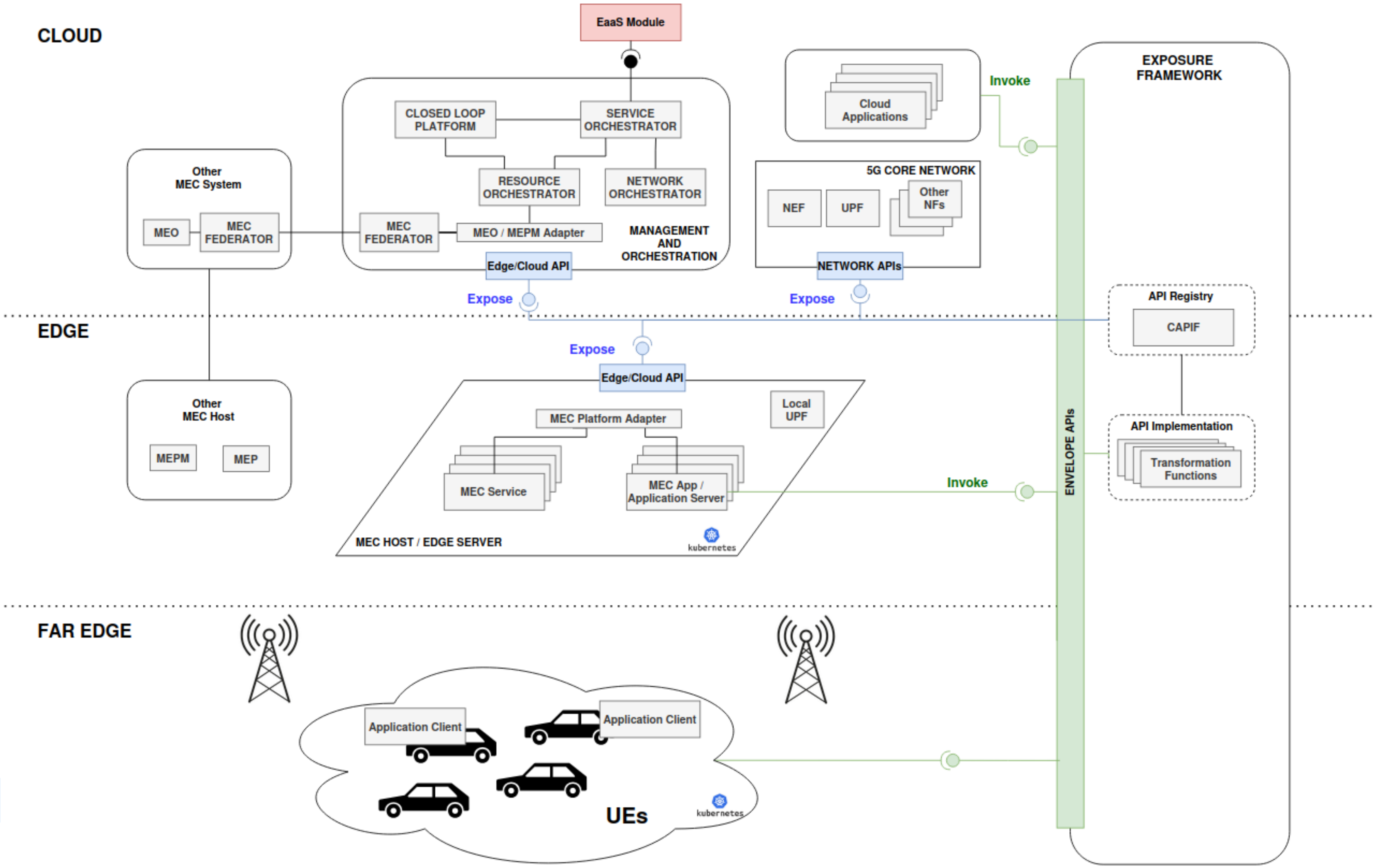
LINKS OBU

- Research-driven Proof of Concept conceived for experimenting with CCAM-related use cases
  - COTS hardware integrated by LINKS
  - Embedded devices based on NVIDIA® Jetson Xavier™ NX board with ARM64 architecture with GPU
- OBU includes
  - 5G Telit FN980 or FN990 modem
  - Ublox F9R GNSS receiver supporting RTK corrections
  - Ethernet interface for connecting to the vehicle network or to external sensors
  - WiFi hotspot for interaction with smartphones or wireless sensors
- OBUs will be available for deploying applications using the EaaS module of ENVELOPE

Available ENVELOPE APIs

API	ENVELOPE API	Description
Quality on Demand (QoD)	CAMARA	Dynamic change of QoS profile for QoS flows of specified devices (based on port range, IP range)
Device Location – Devices in Area	New APIs based on CAMARA approach	Information about devices that are present in a given area
Edge cloud	CAMARA	Discovery and instantiation of services based on requirements for specified devices and traffic re-routing to the new edge

Italian Trial Site Infrastructure



Use Case Examples

- IT-UC1 - Advanced In-Service Reporting for Automated Driving Vehicles
  - 3D accident scene reconstruction exploiting sensor data from vehicles

- IT-UC2 - Dynamic Collaborative Mapping for Automated Driving
  - HD maps update at the edge server upon indications from vehicles

Remarks

- No infrastructure sensors are available
- No traffic light information is provided
- The testbed area is located within a no-flight zone
    - A drone cage outside the testbed may be available for rental
    - Applicants should plan a dedicated budget for this expense, as it is not covered by ENVELOPE

Thank you