Dutch Living Lab Overview

Lead: TNO

HORIZON JU Innovation Actions | 101139048 |
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Dutch Living Lab

- Living Lab is located at the automotive campus in Helmond
- Three UCs are / will be implemented
  - Periodic vehicle data collection for improving digital twin
  - Vehicle testing with mixed reality
  - Tele-operated driving aided by digital twin
- Technical focus on
  - Dynamic reconfiguration of the network exploiting ENVELOPE APIs according to trigger conditions from digital twins and V2X service provider

5G and edge/cloud infrastructure

- 5G NR gNodeB available in the testbed
  - N77 spectrum range from 3800 – 4200MHz
  - 4T4R: 20W / TRX (80W total)
  - 2x radio cells
- Frequency license
  - N77 spectrum range from 3800 – 4200MHz
  - 100MHz → both cells now configured with 40Mhz
  - Power: 4x20W, 33dBW EIRP per cell
- Edge infrastructure:
  - 1x edge server infra OpenNebula
  - 1x central cloud server infra with Amazon AWS

B5G Core

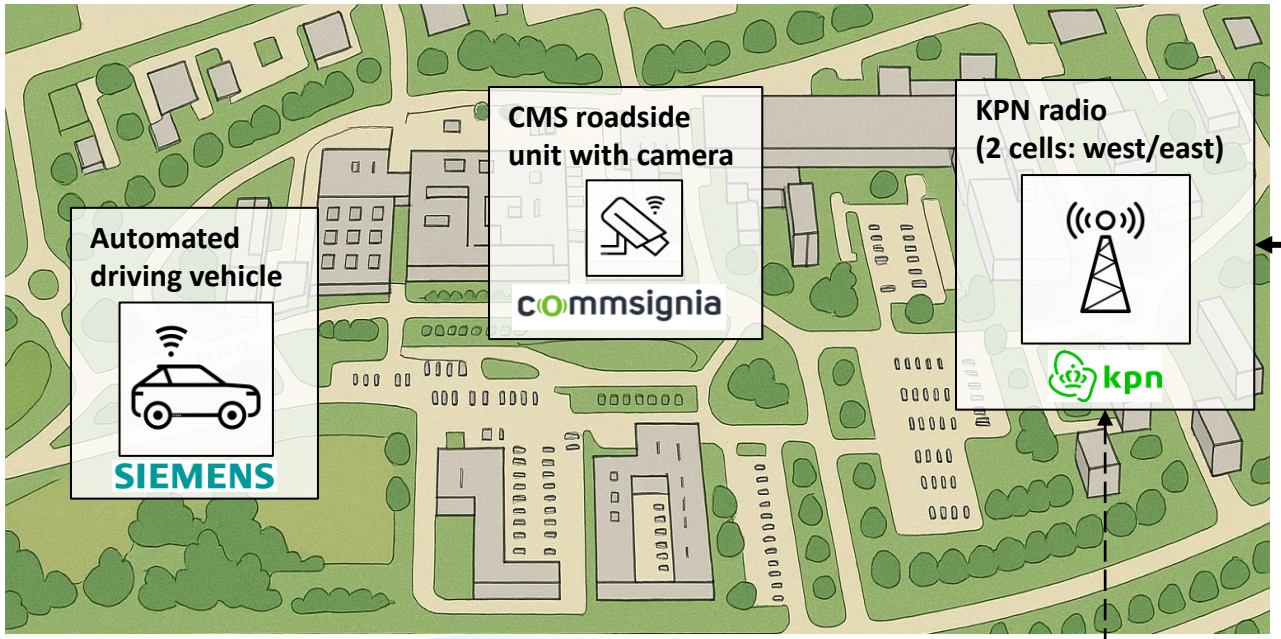
- TNO B5G core based on Open5GS
- 3GPP release 17 compliant
- Includes the following additional features (Network Functions (NFs)):
  - Network Exposure Function (NEF)
  - Network Data Analytics Function (NWDAF)
  - Extension to AMF to support NGAP Location Reporting
  - Extension to PCF and other NFs to support UE Route Selection Policy (URSP)

RSU + MQTT broker

- 1 RSU
  - Embedded system, technical specs: https://www.commsignia.com/products/rsu/
  - Connectivity: ETH, cellular (4G/5G)
  - Smart camera integration --> support non-connected VRU detection
  - Commsignia developed ITS protocol stack running on RSU platform

- MQTT broker (V2X server) providing access to APIs and RSU/camera data

Dutch Site – Integrated System



Automotive campus (Helmond)

Experimentation-as-a-Service
- Open callers / UC providers

Siemens Digital Twin service
- Supporting DT use cases

SIEMENS

CMS V2X application server
- MQTT broker
- Camera pedestrian detections

commsignia

TNO Open 5GS core TNO
- QoD API
- Device location API
- Performance metrics API
- Predictive QoS API
- Edge cloud API

kpn
Helmond edge (K8s cluster 1)

TNO Open 5GS core (UPF)
- Edge cloud API (Traffic Influence)

TNO

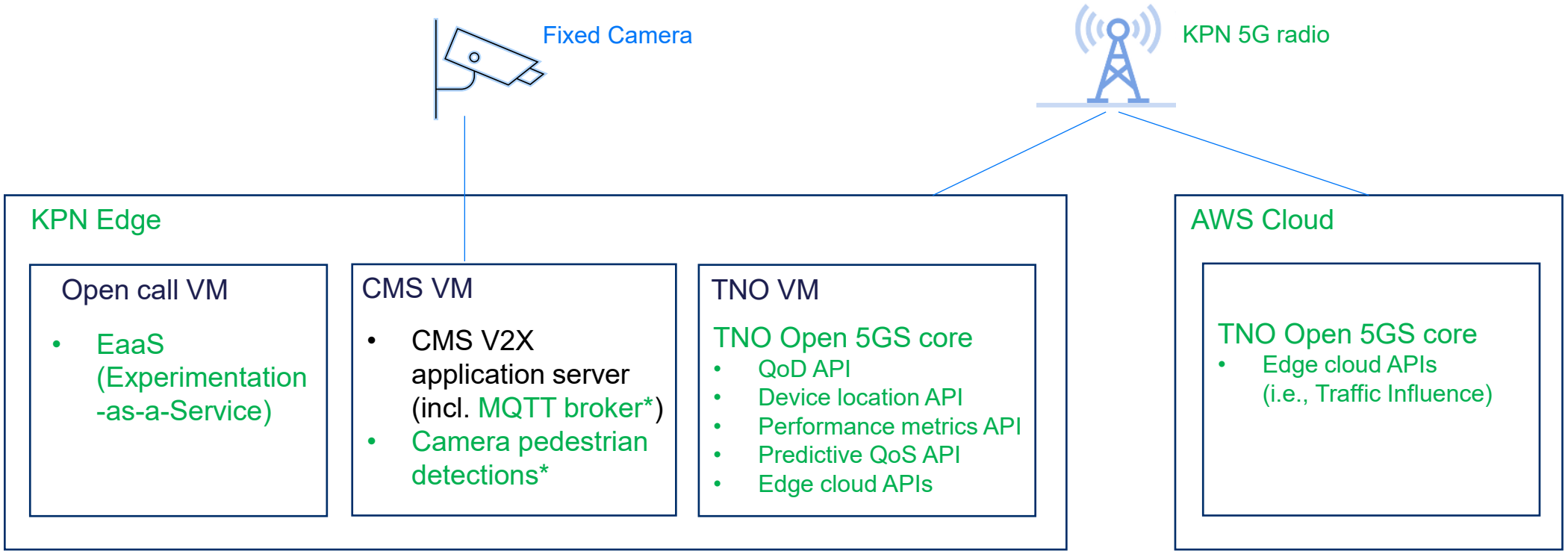
aws
Central cloud (K8s cluster 2)

List of exposed APIs

API	Description
CAMARA Quality on Demand (QoD)	Dynamic change of QoS profile for QoS flows of specified devices (based on port range, IP range)
CAMARA Device Location (Geofencing Subscriptions)	Geofenced event-based notification for mobility of specified devices (location reporting of cell-level events)
New ENVELOPE Performance Metrics API	Subscription of periodic performance metrics (throughput for uplink/downlink)
CAMARA Predictive Connectivity Data	Prediction of throughput performance for specified devices on cell-level
CAMARA Edge Cloud (Edge Application Management)	Edge server discovery and instantiation of application in selected edge zones
CAMARA Edge Cloud (Traffic Influence)	Traffic re-routing (traffic influence) to the new edge using 3GPP URSP (UE Route Selection Policy)

Infrastructure

in green what will be available for open call



*ETSI V2X messages and camera detections will be available for open callers via specific topics on the MQTT broker

Boundary conditions

- Extension of trial site infrastructure with new hardware (GPU, new 5G base station, new 5G core, etc.) is NOT supported in the site;
- Open Callers are required to bring their own testing devices: e.g., vehicles, UEs (phones, etc.). Suggested/tested devices are: Nighthawk M6 Pro 5G (MR6450), Quectel RM520N-GL.
  - **Note**: for the Traffic Influence API, the UE must support the URSP feature. Dutch site partners have validated this API with Quectel RM520N-GL (revision >= RM520NGLAAR03A04M4G).
- Permanent site-to-site VPN connection to participants' labs is NOT possible. A VPN client will be offered to open callers to connect to the Dutch site server infrastructure with access restricted to the Experimentation-as-as Service (EaaS) platform only where experiments can be defined.

Use Case Examples

- Dt-UC3: Periodic vehicle data collection for improving digital twin.
- Dt-UC4: Vehicle testing with mixed reality
- Dt-UC5: Tele-operated driving aided by digital twin

With these use cases the living lab enables

- Dynamic QoS flow adaptation of UEs; data traffic requested on demand by services based on triggers such as geofenced location and performance
- Dynamic edge discovery, service instantiation and traffic influence (UE data traffic re-routing to new PDU session to selected edge's local UPF)
- Predictive QoS to enable a more timely QoS adaptation of UE's data traffic

Thank you