

H2020-ICT-2018-2

5G-CARMEN Connected and Automated Road Mobility in the European union

Webinar of the 5G-CARMEN project on System Architecture and Interfaces

Presenter: Dr. Andreas Georgakopoulos, WINGS ICT Solutions

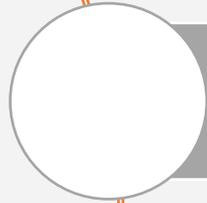
8 October 2021



Outline



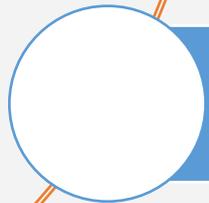
Use Cases



5G-CARMEN System Architecture



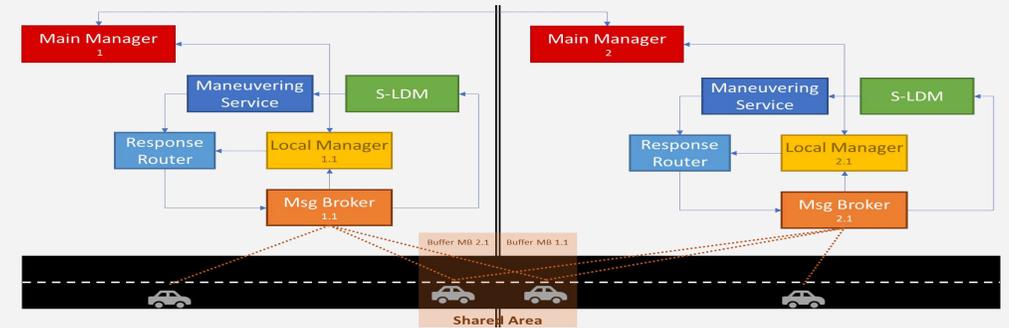
High-level Functional Architecture of the Orchestrated Edge Platform for CCAM



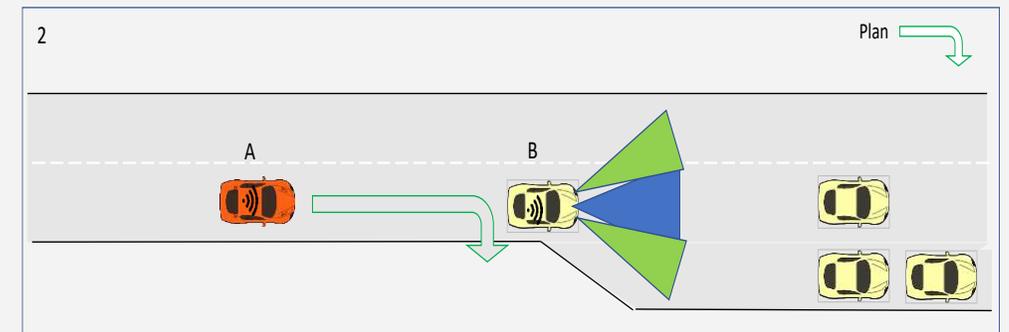
Key Highlights

Use cases

Use case 1: Cooperative and automated lane-change manoeuvres



Use case 2: Cooperative and automated in-lane manoeuvres



Use case 1: Cooperative and automated lane-change manoeuvres – Overview

Lane change manoeuvres are a critical point in traffic oscillation with big impact on:

- Safety
- Stability
- Traffic efficiency



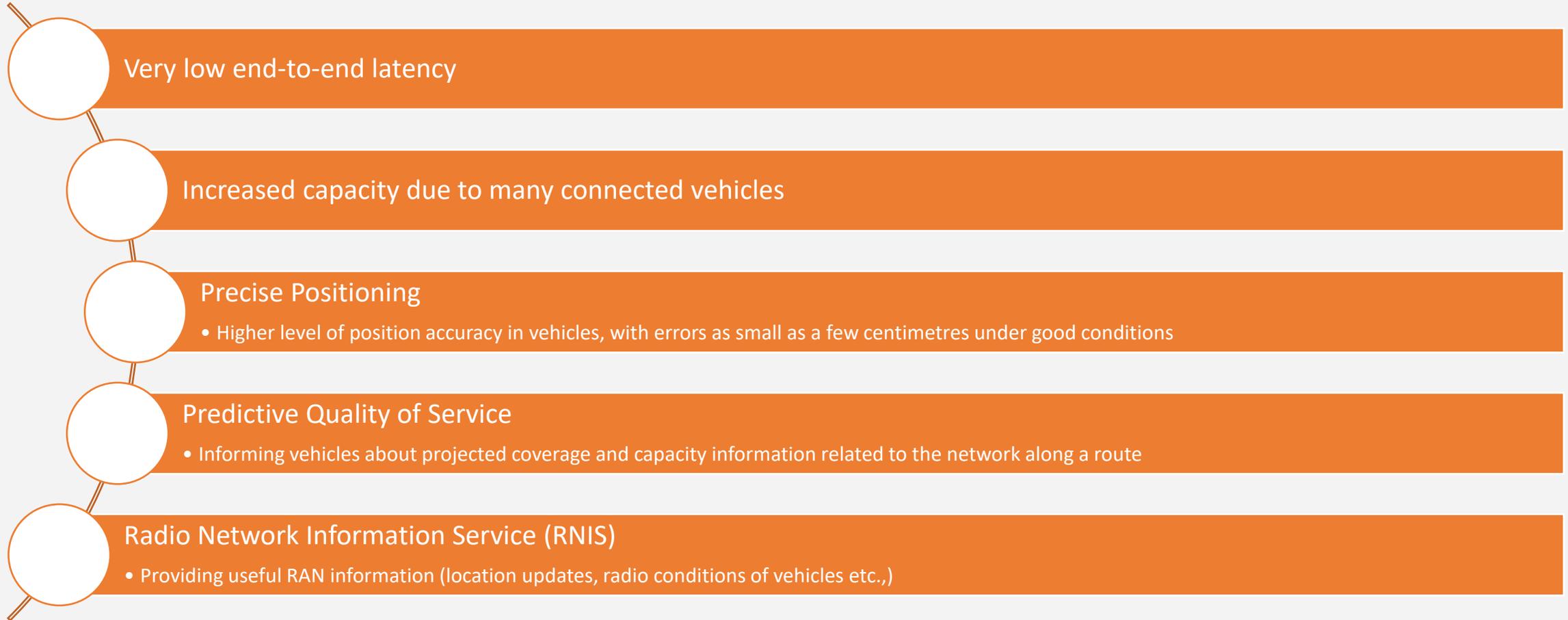
By performing these manoeuvres in a cooperative and automated way and leveraging on 5G's low-latency communication, these aspects could be highly improved.

Here we focus on:

- **Centralized** lane change, with V2V and low-latency V2N2V communication, with network recommendation
- **Decentralized** lane change with V2V and low-latency V2N2V communication, without network recommendation
- Lane change needed due to **emergency** vehicle approach: lane change or lane-keeping based on estimated time of arrival of the emergency vehicle (EmV).

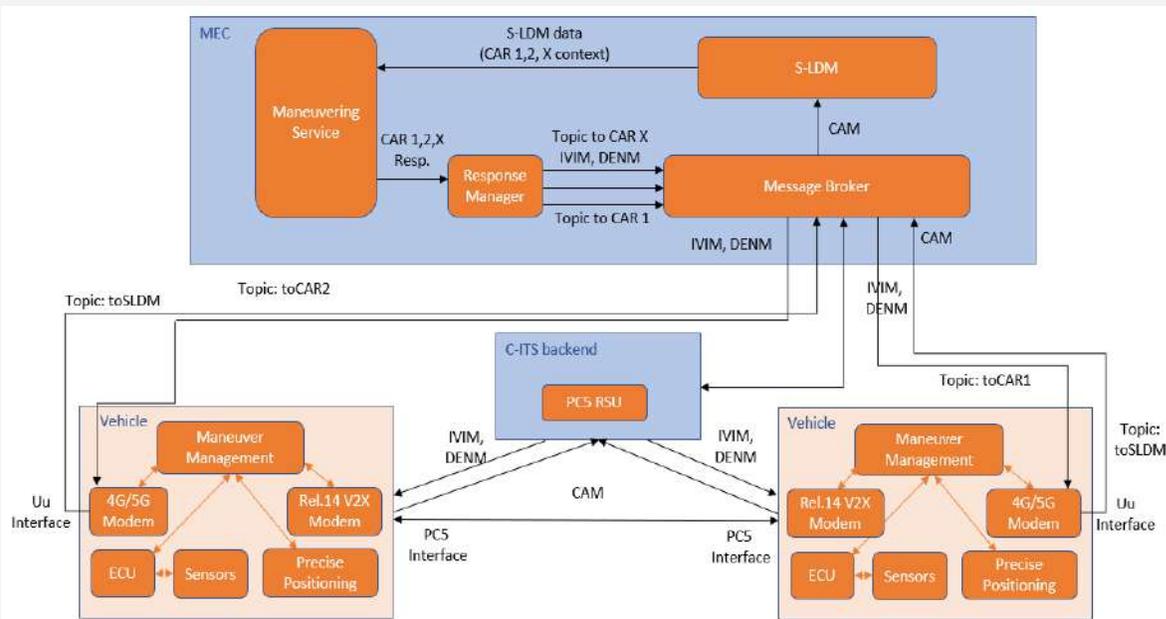


Use case 1: Cooperative and automated lane-change manoeuvres – Why is 5G needed?

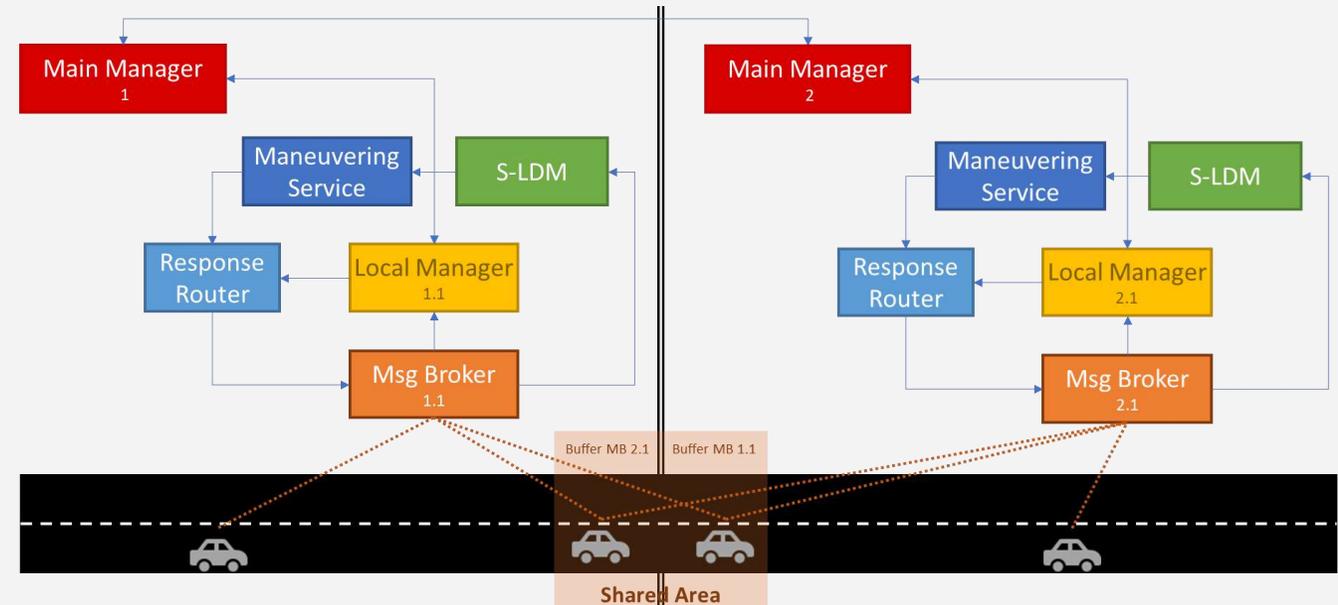


Use case 1: Cooperative and automated lane-change manoeuvres

Centralized Cooperative Lane Change (In-Country)



Centralized Cooperative Lane Change (Cross-Border)



Legend

LDM: Local Dynamic Map

S-LDM: Server LDM

V-LDM: Vehicle LDM

IVIM: In-Vehicle Information Message

CAM: Cooperative Awareness Message

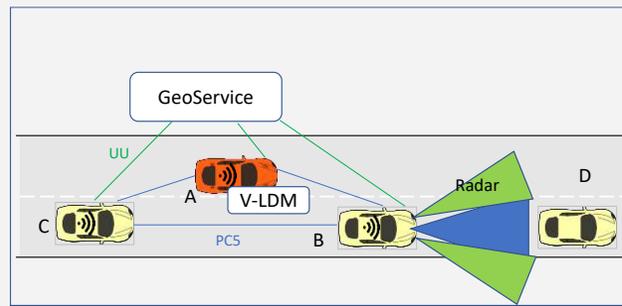
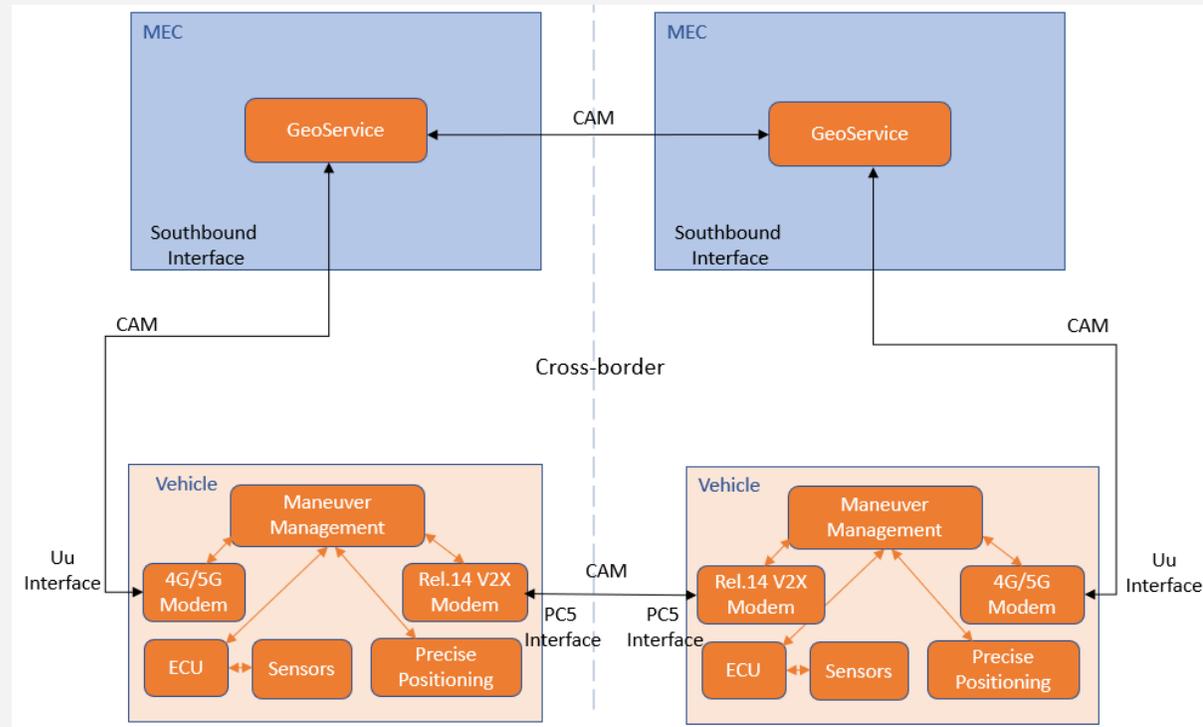
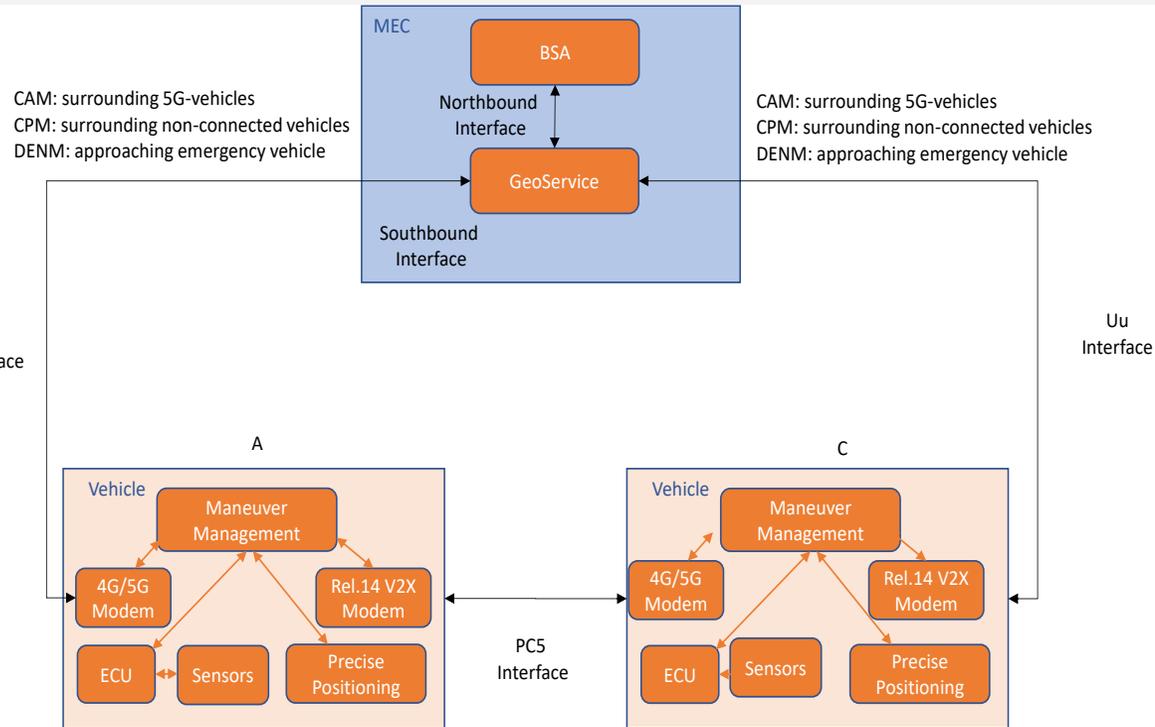
CPM: Cooperative Perception Message

DENM: Decentralized Environmental Notification Message

Use case 1: Cooperative and automated lane-change manoeuvres

Cooperative messages over Uu and PC5 interface, in lane clearance for emergency vehicle

Decentralized Cooperative and Automated Lane Change Manoeuvre (Cross-border)



Legend

LDM: Local Dynamic Map

S-LDM: Server LDM

V-LDM: Vehicle LDM

IVIM: In-Vehicle Information Message

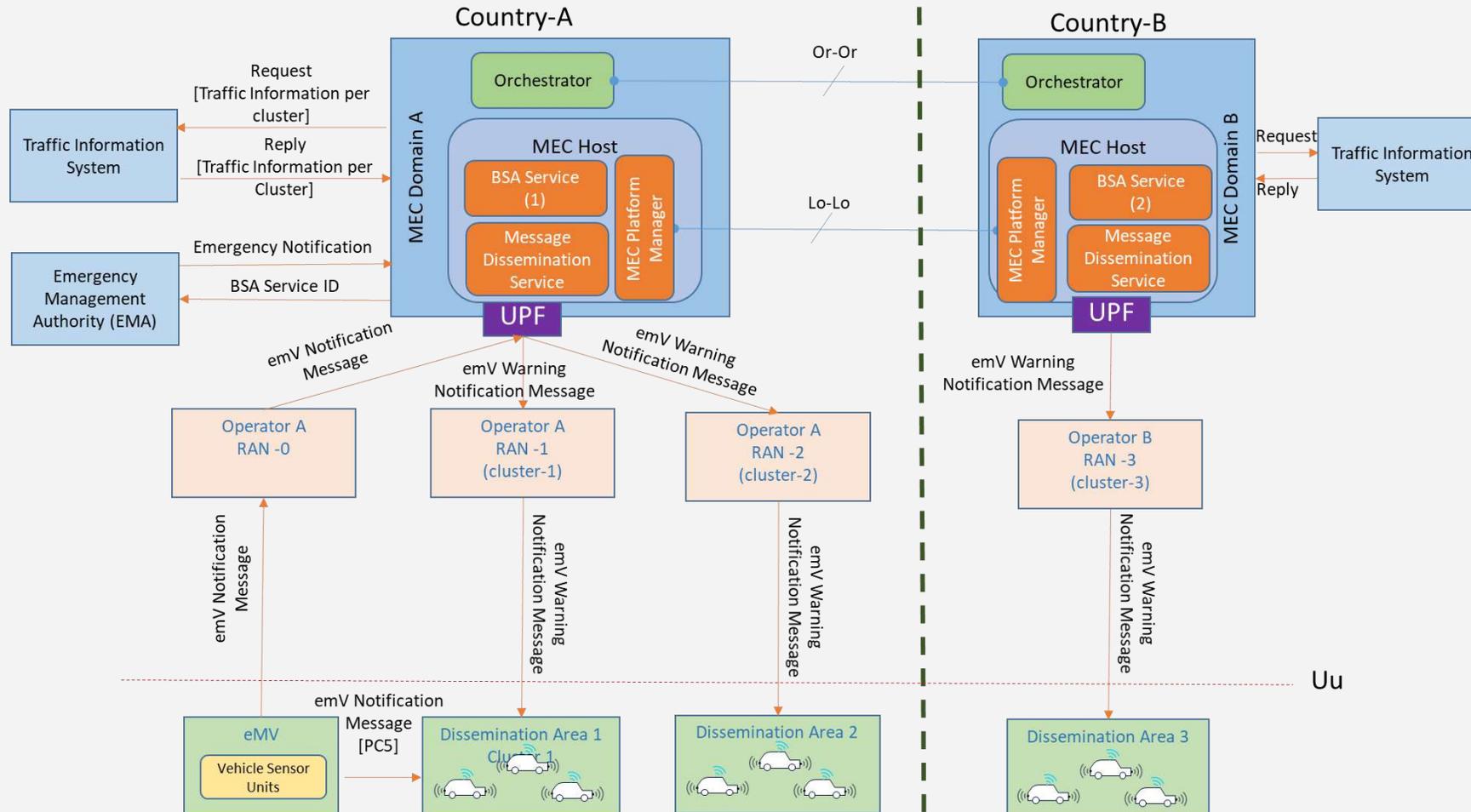
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Use case 1: Cooperative and automated lane-change manoeuvres

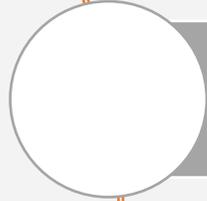
Situation awareness - Back-situation Awareness



Outline



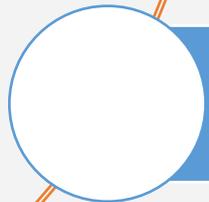
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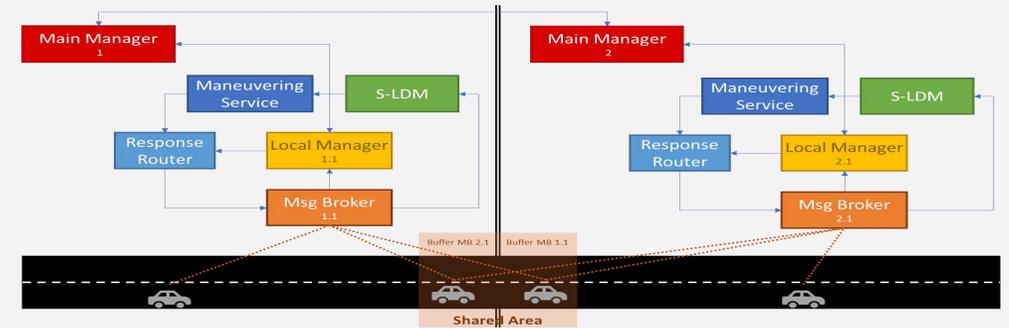
High-level Functional Architecture of the Orchestrated Edge Platform for CCAM



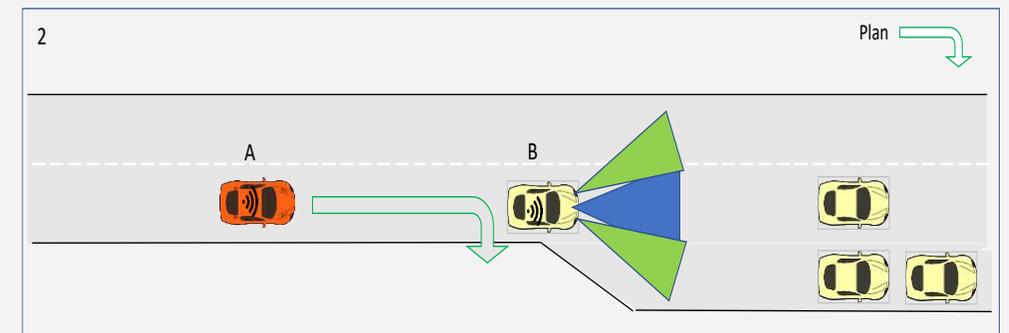
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Use case 1: Cooperative and automated lane-change manoeuvres



Use case 2: Cooperative and automated in-lane manoeuvres



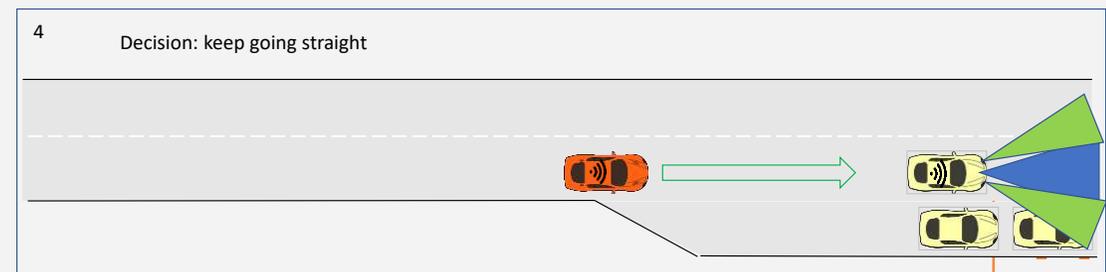
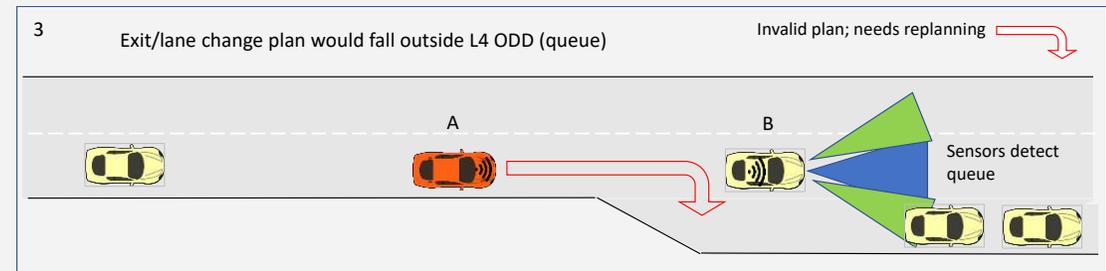
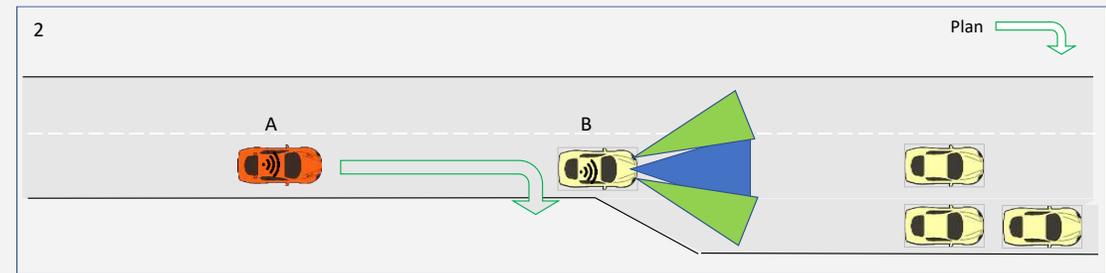
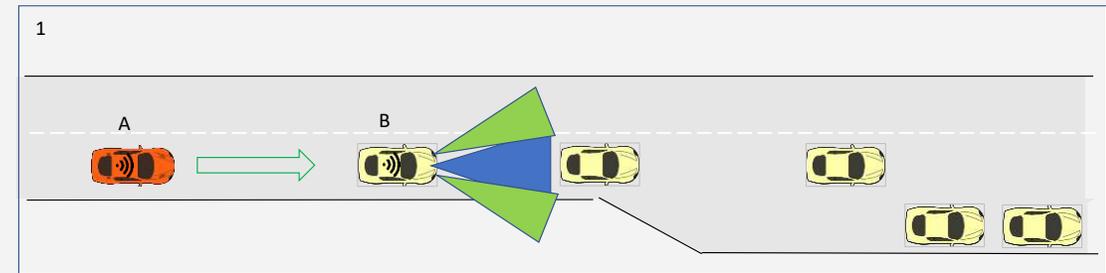
Use case 2: Cooperative and automated in-lane manoeuvres – Overview

In Cooperative and Automated in-lane manoeuvres the vehicle performs longitudinal control and keeps the in-lane lateral control (lane centering). 5G-CARMEN addresses:

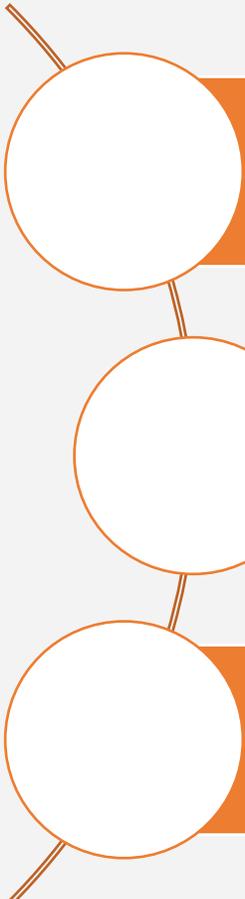
- In-lane manoeuvres based on forward detection (cruise control)
- In-lane manoeuvres based on lateral detection (prevented lane change)
- In-lane manoeuvres based on backward detection
- In-lane manoeuvres based on emergency vehicle approach

The focus is on unexpected events, as required by L4 driving. An example is scenario b.

- The L4 vehicle on the first lane and plans to exit the motorway in moderate-high traffic situation, with vehicles in front obstructing the view.
- A queue or obstacle on the exit lane would require the driver to take over.



Use case 2: Cooperative and automated in-lane manoeuvres – Why is 5G needed?



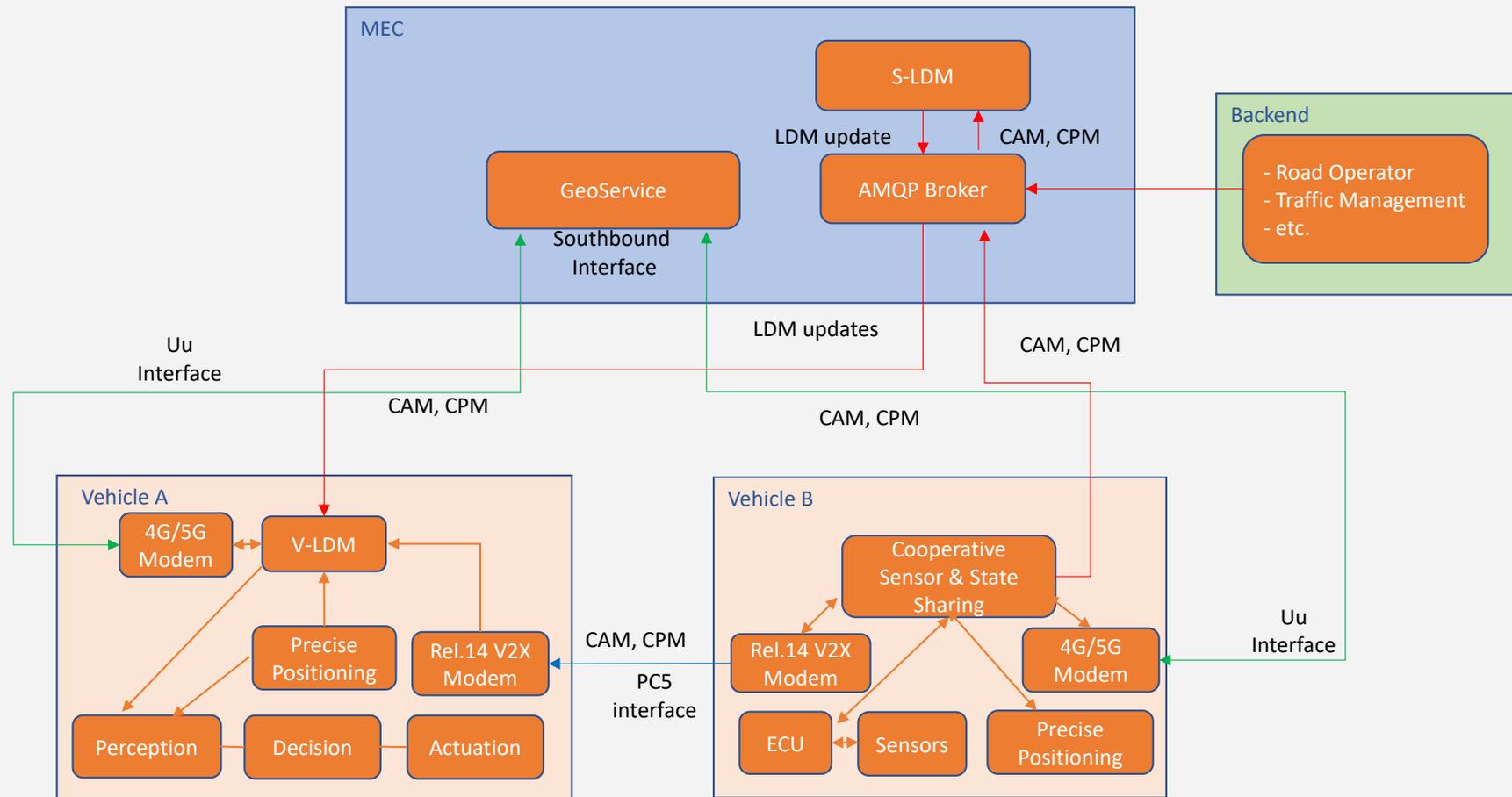
5G allows to exchange such information (CAM, CPM) at the same refresh rate as the vehicle on board sensors (camera, radar) and have the needed responsiveness to emergency situations, which is a key aspect for SAE L4 automation.

Demonstrate how the V-LDM can be dynamically updated from the S-LDM, to augment the on-board perception both with improved information about surrounding vehicles' and with information from other sources (infrastructure, road operator, back-end).

The outlook is that the S-LDM; having the bird-eye view of a local area, could provide the vehicles with all information related to the driving context (including from road operator back-end).

Use case 2: Cooperative and automated in-lane manoeuvres

Cooperative and automated in-lane manoeuvres and for the decentralized lane change manoeuvres, in country



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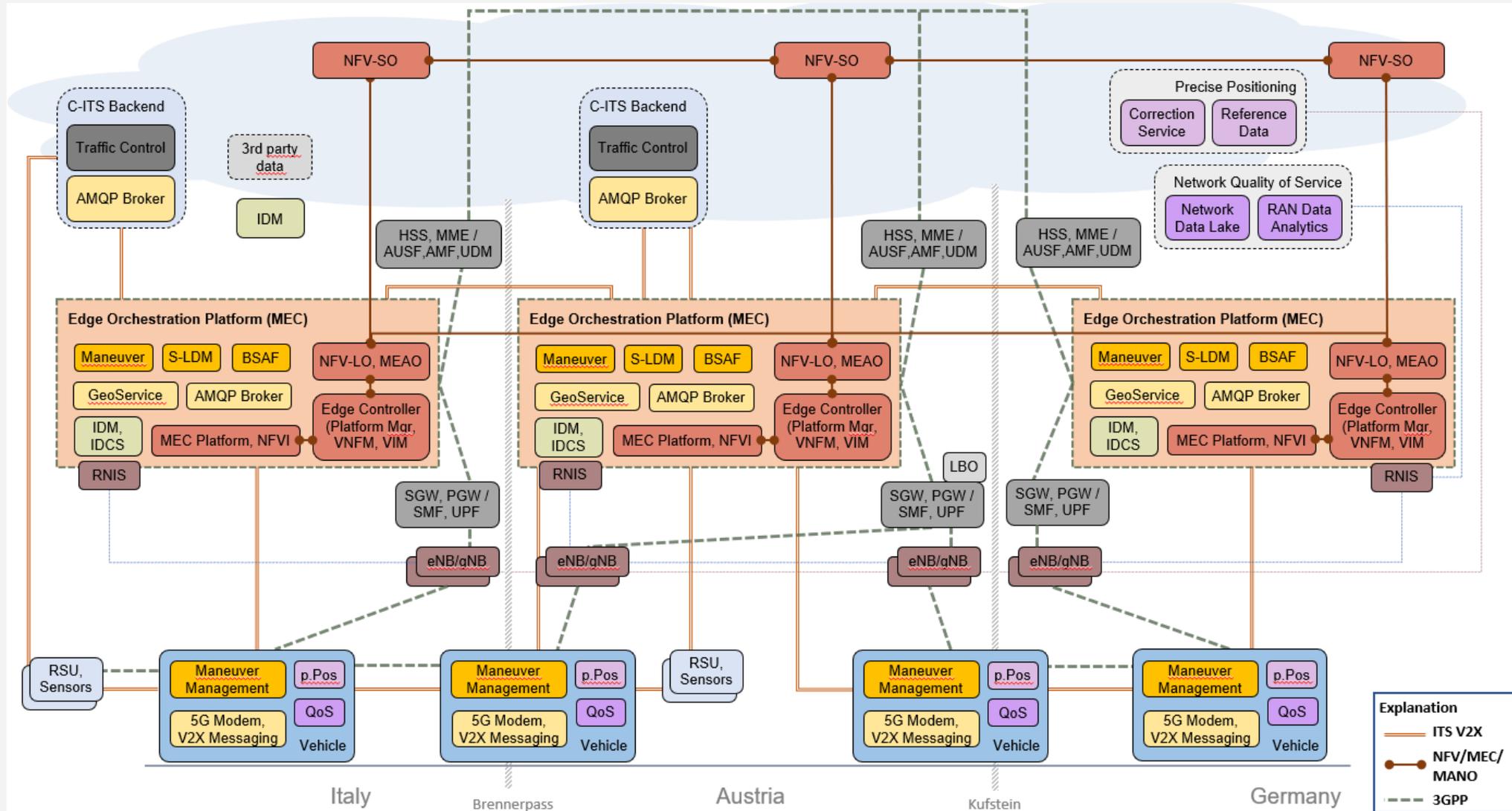


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High-level Functional Architecture of the Orchestrated Edge Platform for CCAM

Key Highlights

5G-CARMEN System Architecture



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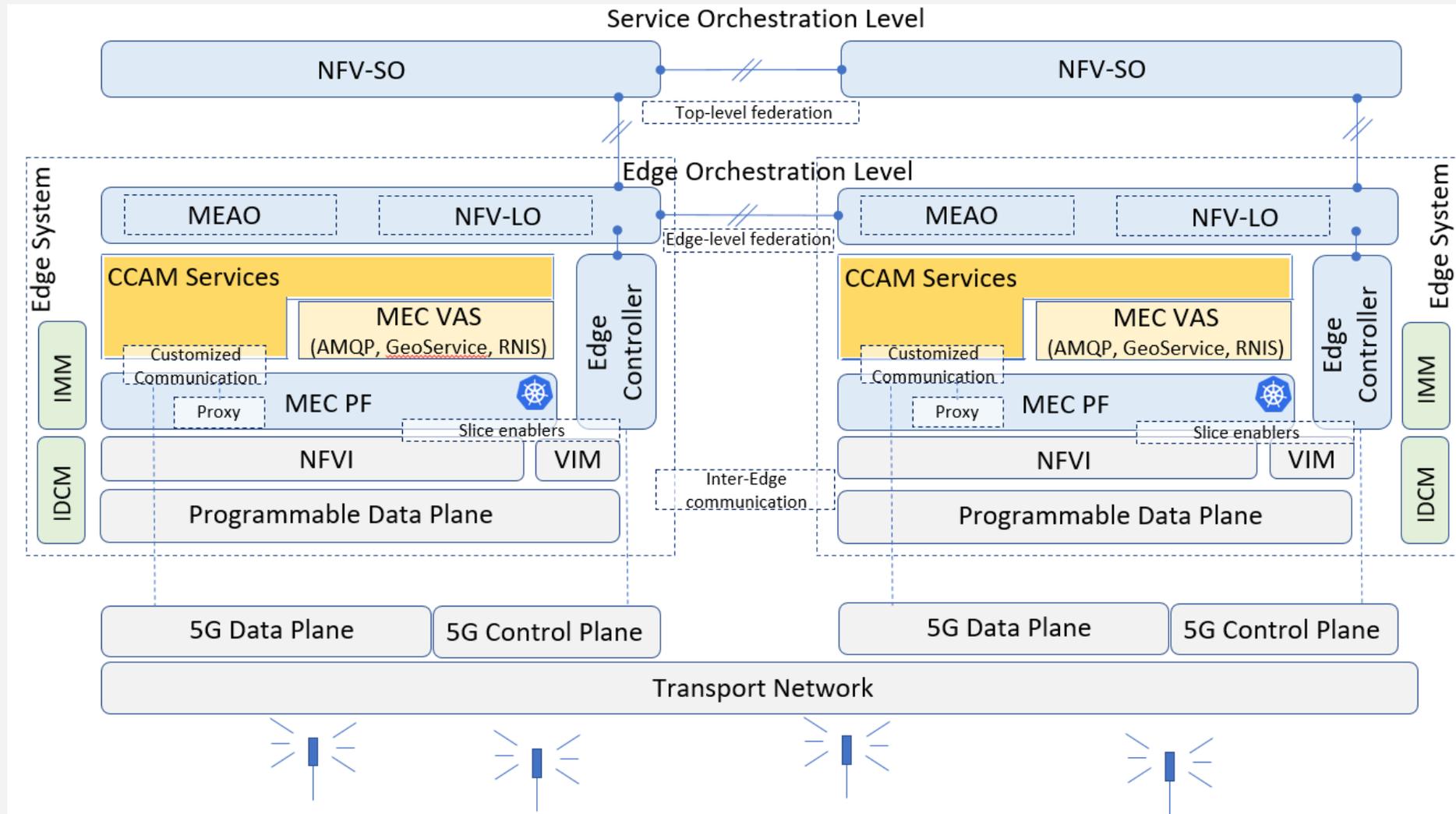
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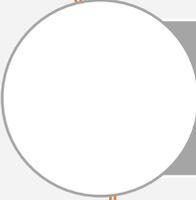
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High-level Functional Architecture of the Orchestrated Edge Platform for CCAM



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- Use Cases
 - Use case 1: Cooperative and automated lane-change manoeuvres
 - Use case 2: Cooperative and automated in-lane manoeuvres
- 5G-CARMEN System Architecture
- Orchestrated Edge Platform for CCAM

Thank You!

 5G

