5GCroCo Overview

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26th of May 2020, 5G PPP

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825050-5GCroCo

5G Cross Border Control

Innovation Action H2020-ICT-18-2018
Contract 825050

Cooperative, Connected and Autonomous Mobility (CCAM)

a 5G-PPP Phase III Project

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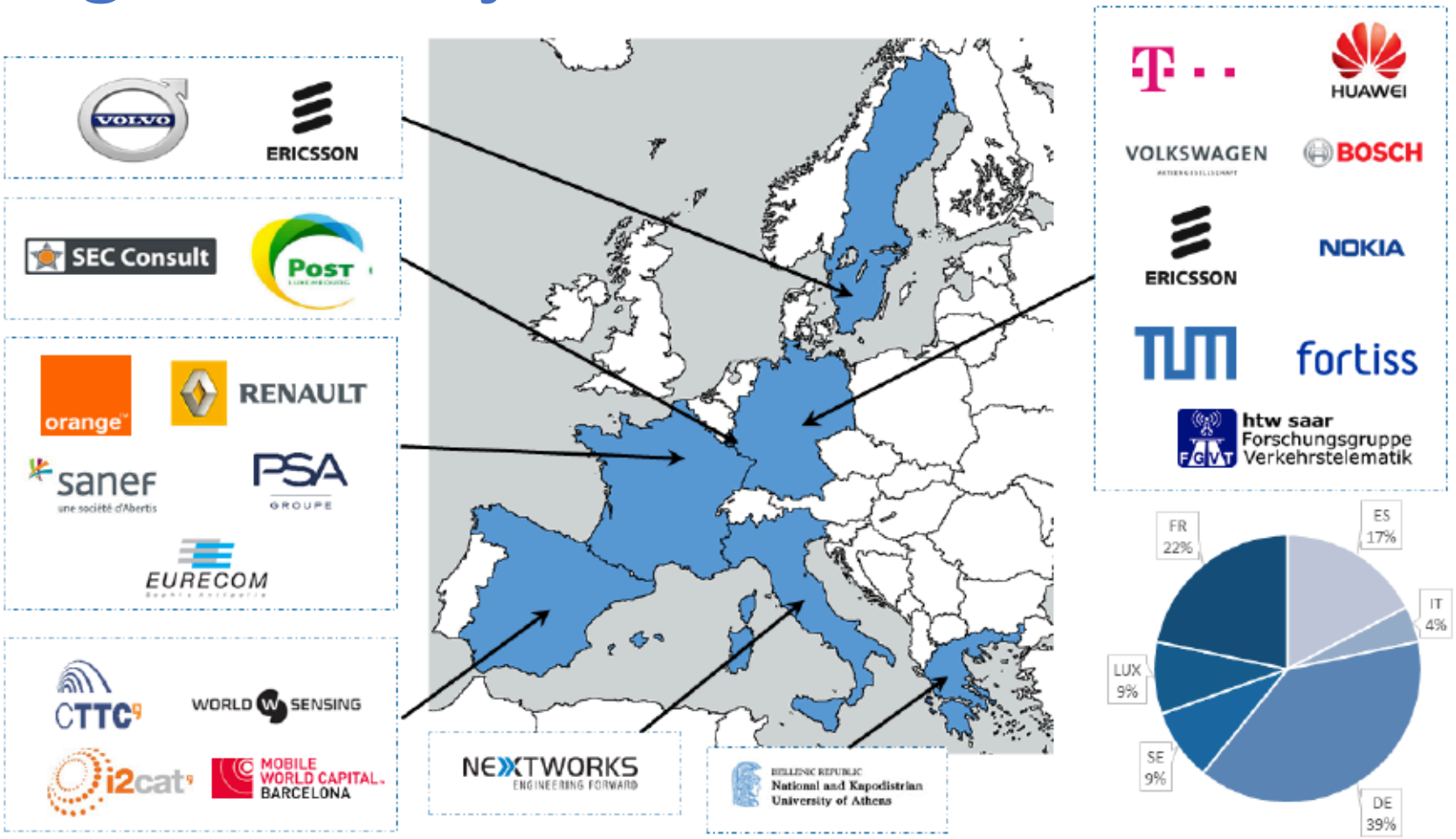
Outline

- General Overview
- Use Cases
- Trials
- How, where, and when we trial the solutions

5gCroCo Project Partner



Focus of the innovation

- **5G Technology** features
  - Cross-border/MNO/vendor/generation Operation
  - Distributed Computing enabled by Mobile Edge Computing (MEC)
  - New Radio
  - Network Slicing
  - Predictive QoS
  - Improved Positioning
- Recommendations for **Regulation** and **Spectrum**
- Identification of **new business model** opportunities
- Impact on **standardization** (3GPP, ISO, ETSI, SAE, …)

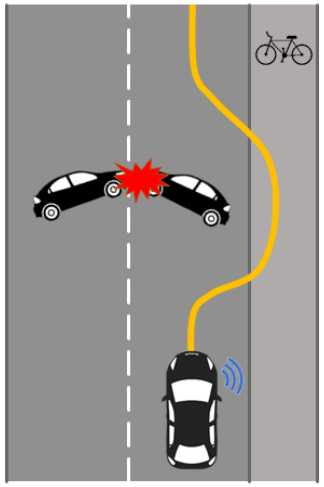
Main 5G Needs of Use Cases

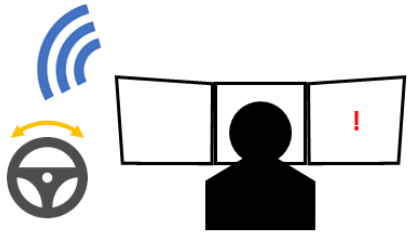
5G Feature	ToD	HD mapping	ACCA
High data rate	X	X	
Functional safety	X		
High reliability	X		X
Low latency	X		X
Seamless availability		X	
QoS prediction	X	X	
Mobile Edge Computing			X

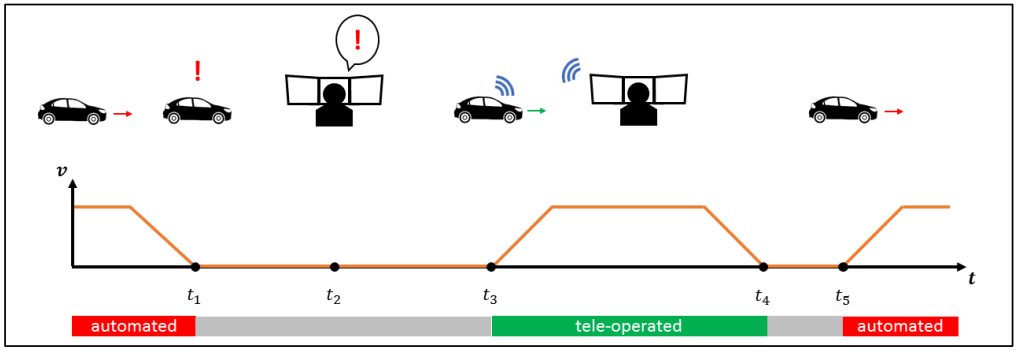
Use Case 1(3) Tele-operated driving

Different situations:

- Remotely initiated lane change or speed adaptation on highway (L3 - L4)
- Transfer from urban to highway (L4)
- Not responding driver (L4)
- Undefined traffic situations (L4 – L5)



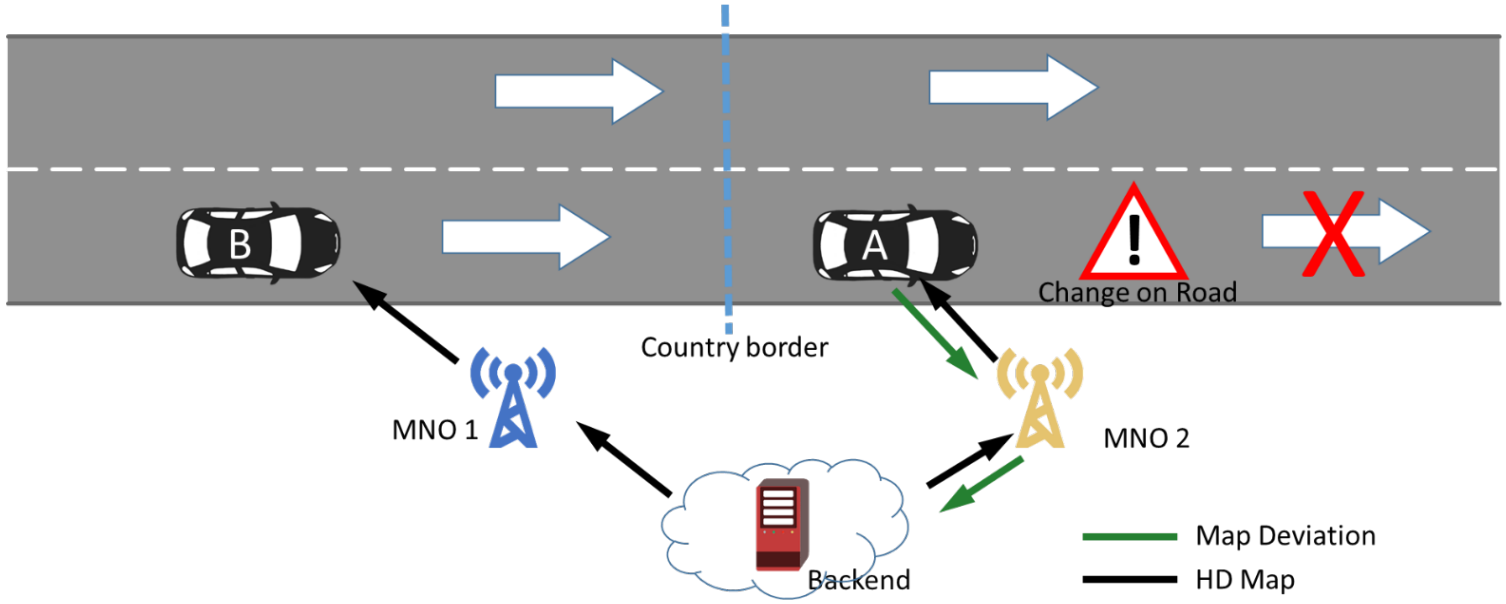




Use Case 2(3) High Definition Maps for Enabling Autonomous Driving

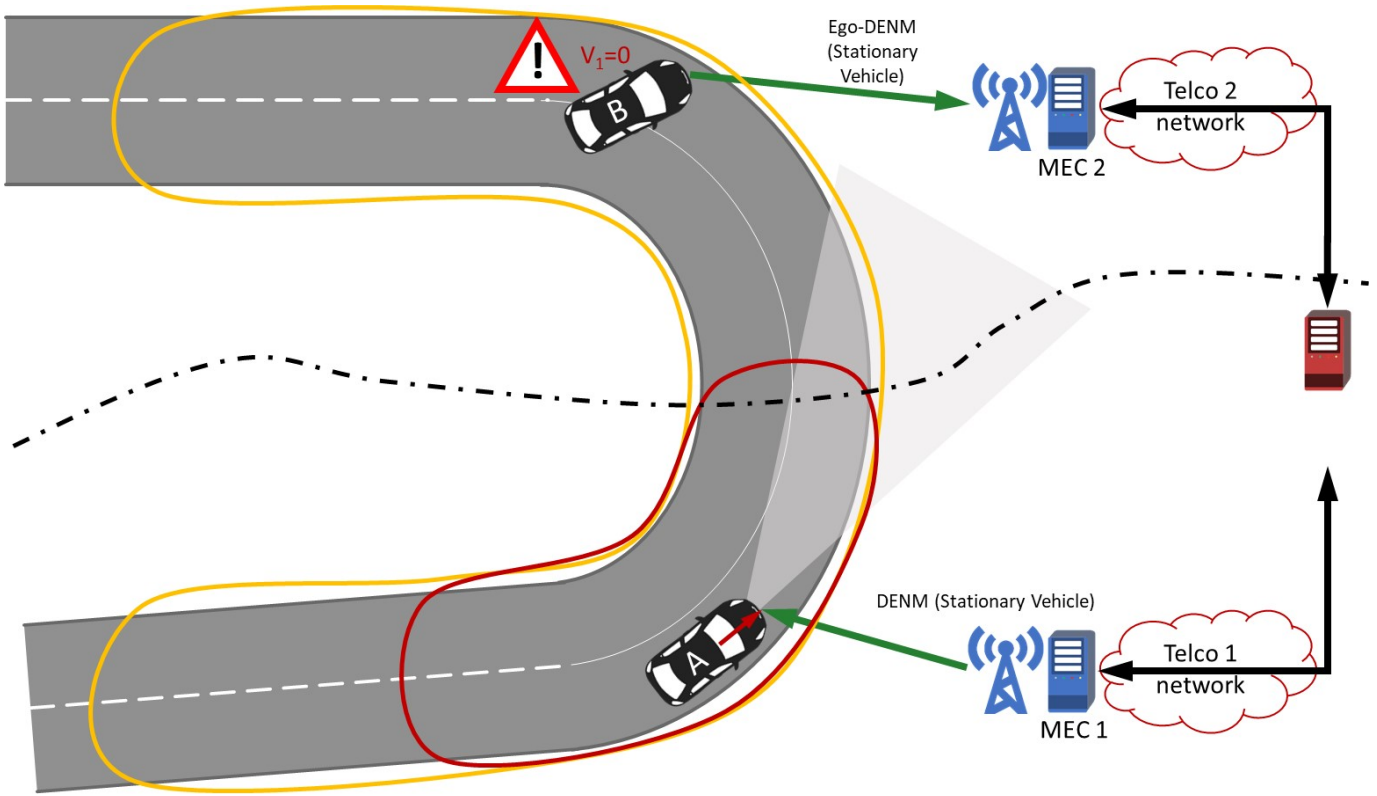
Permanently updated (crowd sourcing) and e.g. used for:

- Optimal route selection
- Updating route in hazardous situations



Use Case 3(3) Anticipated Cooperative Collision Avoidance (ACCA)

- Anticipate dangerous events
- Facilitate smoother and more homogeneous vehicle reaction



Requirements (extract)

UC name	Network Latency	Data Rates Uplink	Data Rates Downlink	Reliability Uplink	Reliability Downlink
ToD	< 40 ms	50 Mb/s	500 Kb/s	> 99%	> 99,9%
HD Mapping	1000 ms maximum “age” of information	[Hundreds of kB to hundreds of MB]/s, depending on the tile size, number of roads in tile and tile content.		> 99.9%	> 99.9%
ACCA	< 1000 ms	4 Kb/s (for 1 hazard)	4 Kb/s/vehicle	> 99%	> 99%

5GCroCo – Pilots & Testing

The 5G Croco Project has identified 3 use cases

- Tele-Operated Driving (ToD)
- High Definition Map Generation and Distribution for Autonomous Driving (HD Maps)
- Anticipated Cooperative Collision Avoidance (ACCA)

5G CroCo will implement, roll-out and showcase these Use Cases.

- First on small scale Pilot sites in Barcelona, UTAC-Monthléry, Munich, A9 Germany, AstaZero
- And finally on a Large Scale Cross-Border Corridor between Germany, France and Luxemburg

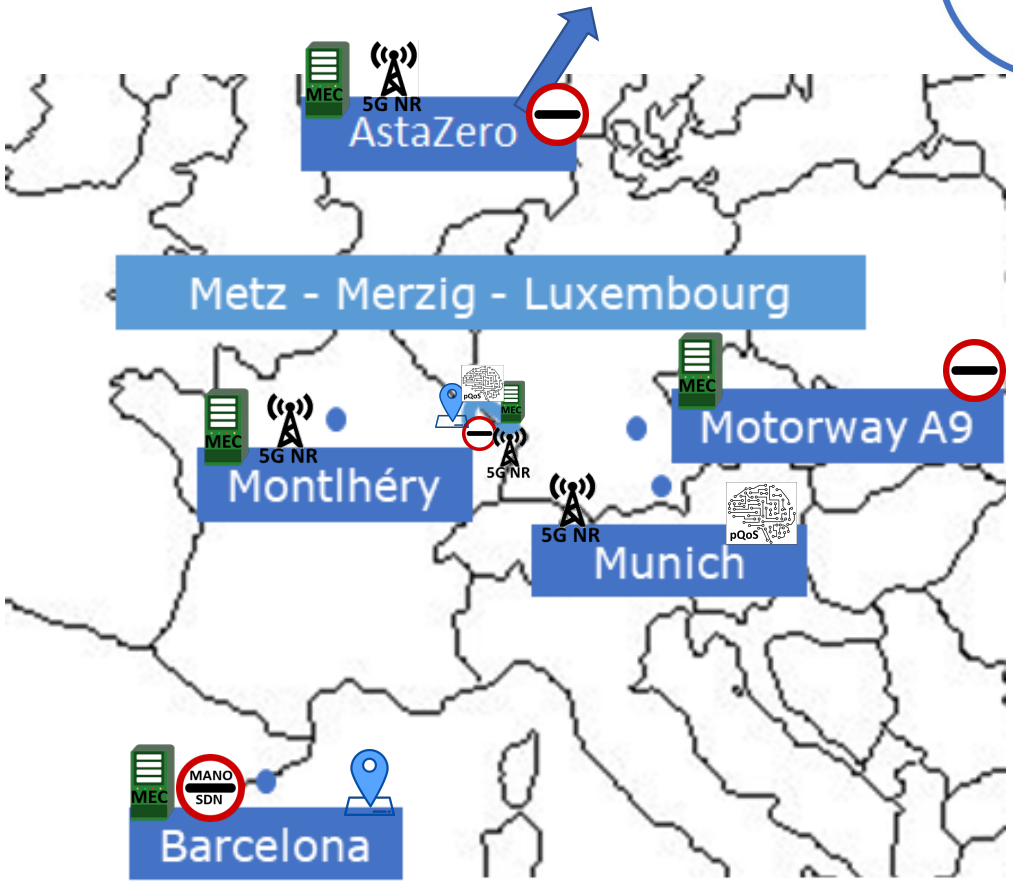
Technical 5G Solutions for CCAM

- 5G New Radio
- Cross-border/-MNO handover
- Quality of Service (QoS)
  - End-to-end with Dedicated Bearers*)
  - QoS prediction
- Mobile Edge Computing/Cloud (MEC)
  - Alternative/complement to public Internet hosting
  - 3GPP network service/session continuity
  - Inter-MEC communication across borders / MNOs1)
- Management and Orchestration & SDN2) *)
  - Single country /-MNO
  - Cross-border/-MNO
- Precise positioning

*) Incl. Network Slicing 1) MNO: Mobile Network Operator 2) SDN: Software Defined Networking

5G Trials 5GCroCo

- Tests/trials started at small-scale
- Aug./Sep. 2020 & Jun. – Aug. 2021 @ large-scale
- Each small-scale trial site
  - Supports one use case
  - Has some 5G solutions
- Large-scale trial site supports all use cases and 5G solutions
  - In 2020 we test the solutions one-by-one
  - In 2021 we combine, e.g. “Cross-border handover with Local Breakout Roaming for MEC”



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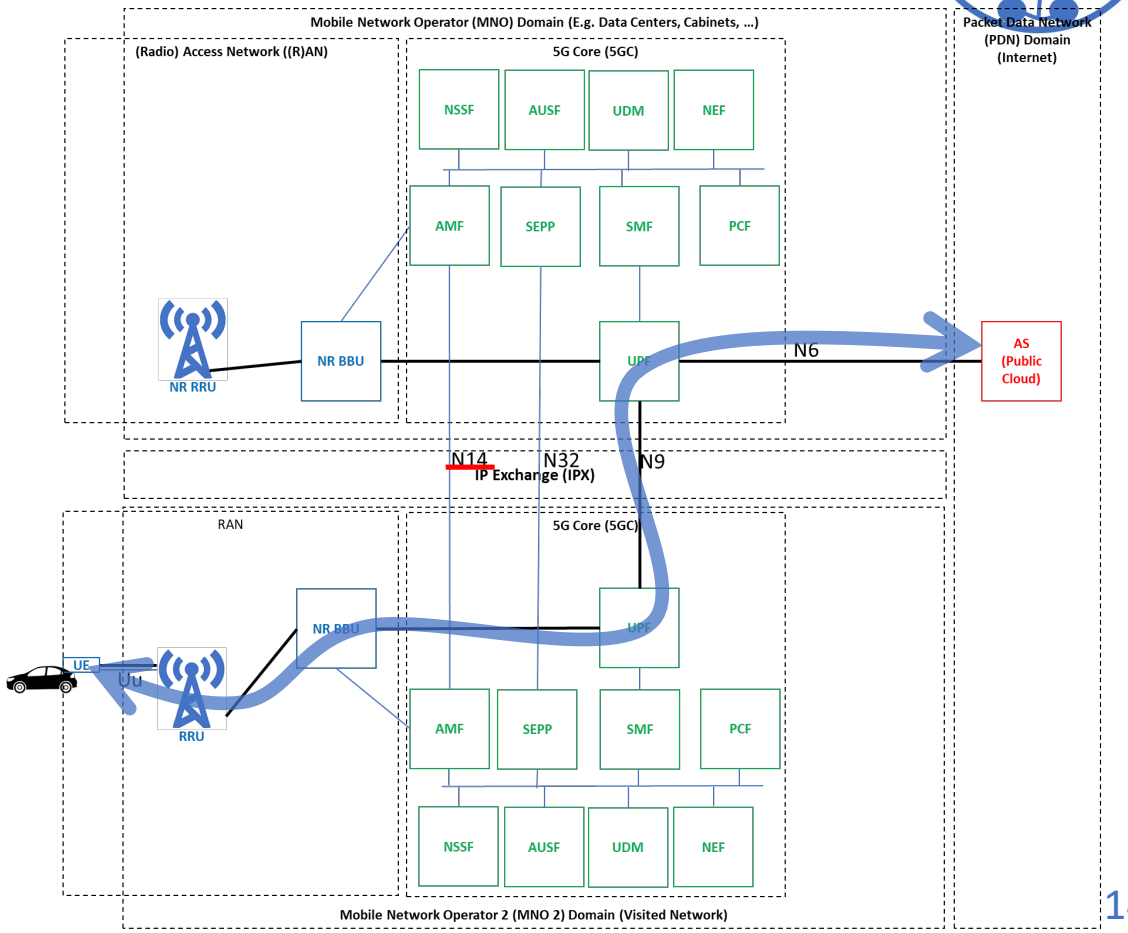
➔ **Also possible with 4G Evolved Packet Core (non-standalone 5G New Radio)**



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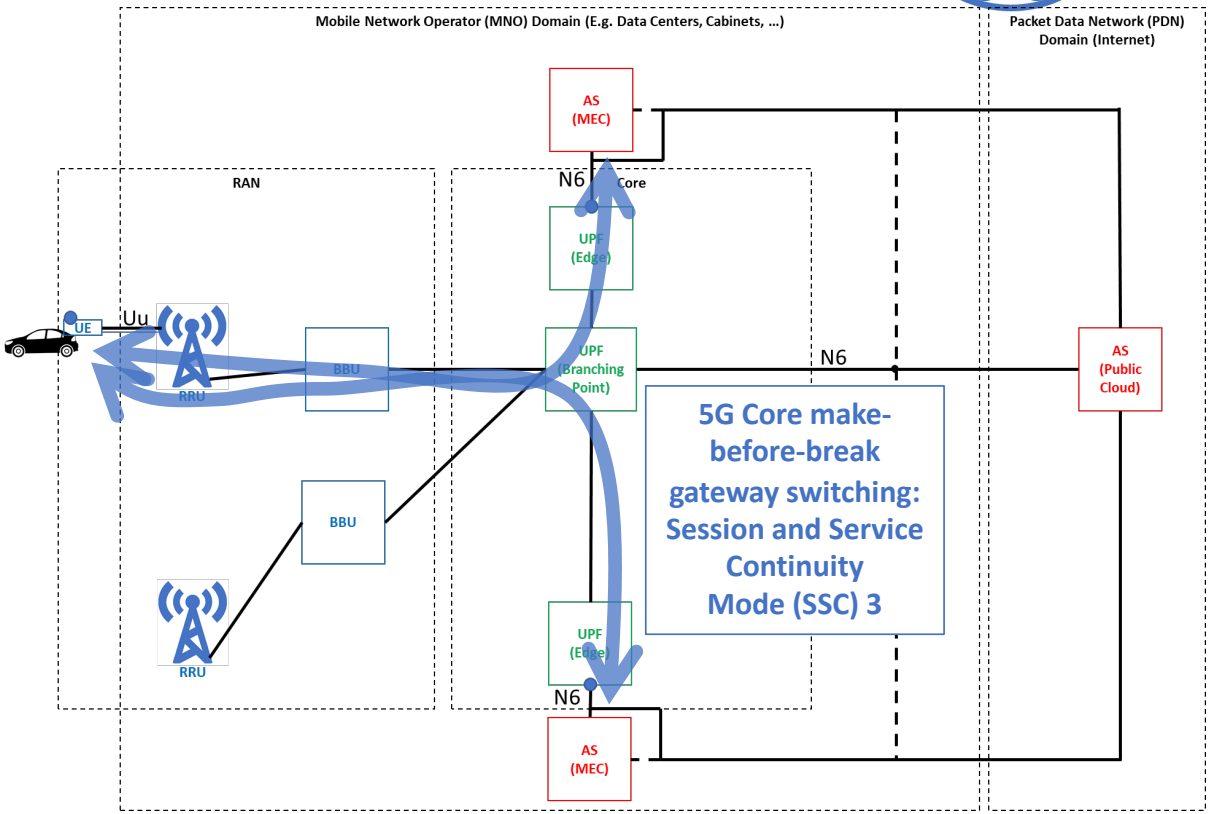
➔ **Also possible with 4G Evolved Packet Core (non-standalone 5G New Radio) but with "break-before-make" gateway switching 8service interruption)**



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- Management and Orchestration & SDN
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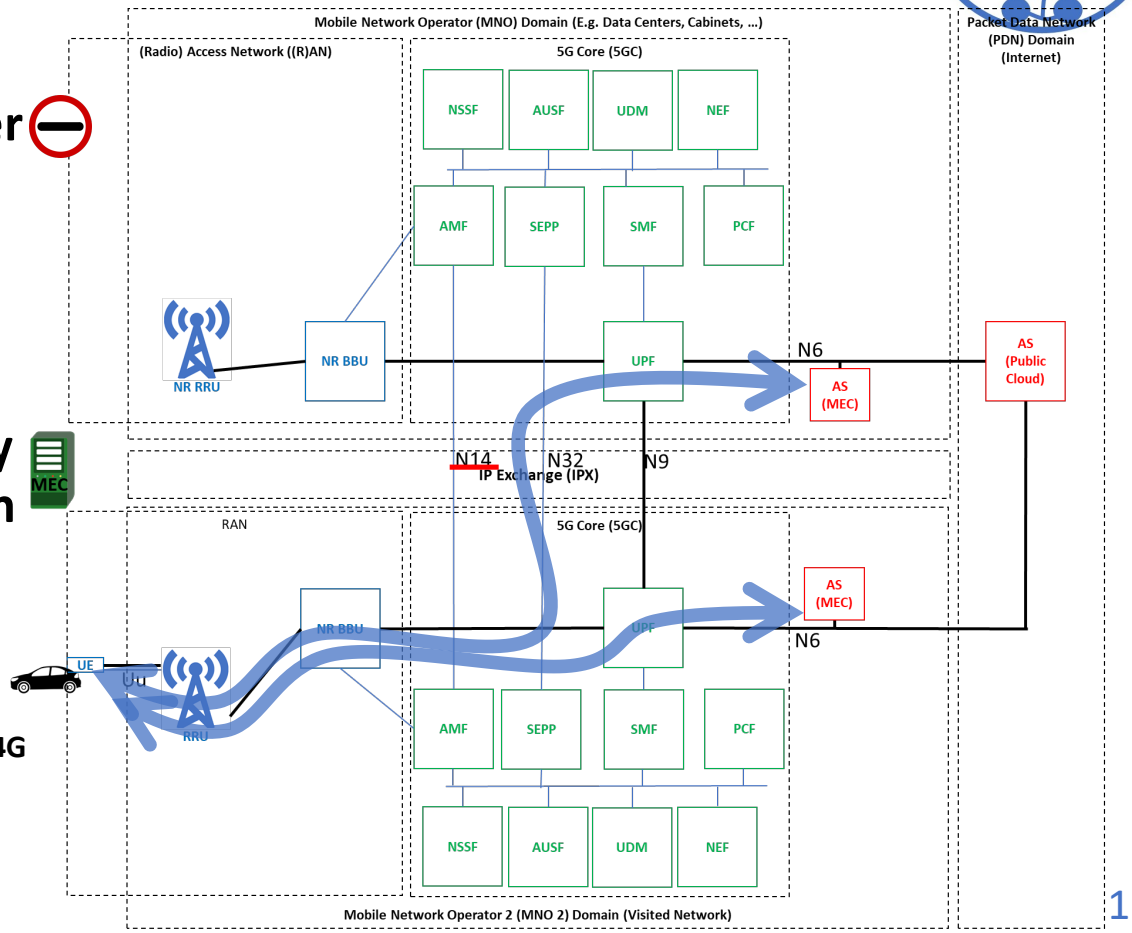
- Precise positioning

➔ **Cross-border/-MNO handover also possible with 4G Evolved Packet Core (non-standalone 5G New Radio) but change of gateway results in service interruption**



THANKS!!

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To know more:

http://5gcroco.eu

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Backup

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Test sites

Large scale

Small scale:

- Barcelona (Spain): cross-border city
- Montlhéry (France): test track
- AstaZero (Sweden): test track
- Munich (Germany): dense urban area; transition from city to motorway; sophisticated 4G & 5G test network
- A9 (Germany): motorway; resembling major part of large scale cross-border test site

Goals and partners per domain

- Goal: harmonized solutions for CCAM along Europe supporting **cross-border traffic**
- Challenge: the multi-country, multi-operator, multi-telco-vendor, and multi-car-manufacturer scenario of any cross-border layout

Automotive:

HD Mapping

— Volvo Cars:

Tele-Operated Driving:

— Volkswagen

— Bosch

Anticipated Coop. Collision Avoidance (ACCA).

— Renault

— PSA

Telco:

Vendors:

— Ericsson

— Huawei

— Nokia

Operators:

— Dt. Telekom

— Orange

— POST Luxembourg

Research/SME:

— CTTC (ES)

— Barcelona Mobile World Capital (ES)

— I2CAT (ES)

— Nextworks (ES)

— Worldsensing (ES)

— Fortiss (DE)

— TU Munich (DE)

— htw saar (DE)

— Eurecom (FR)

— NKUA (GR)

— SEC Consult (LUX)

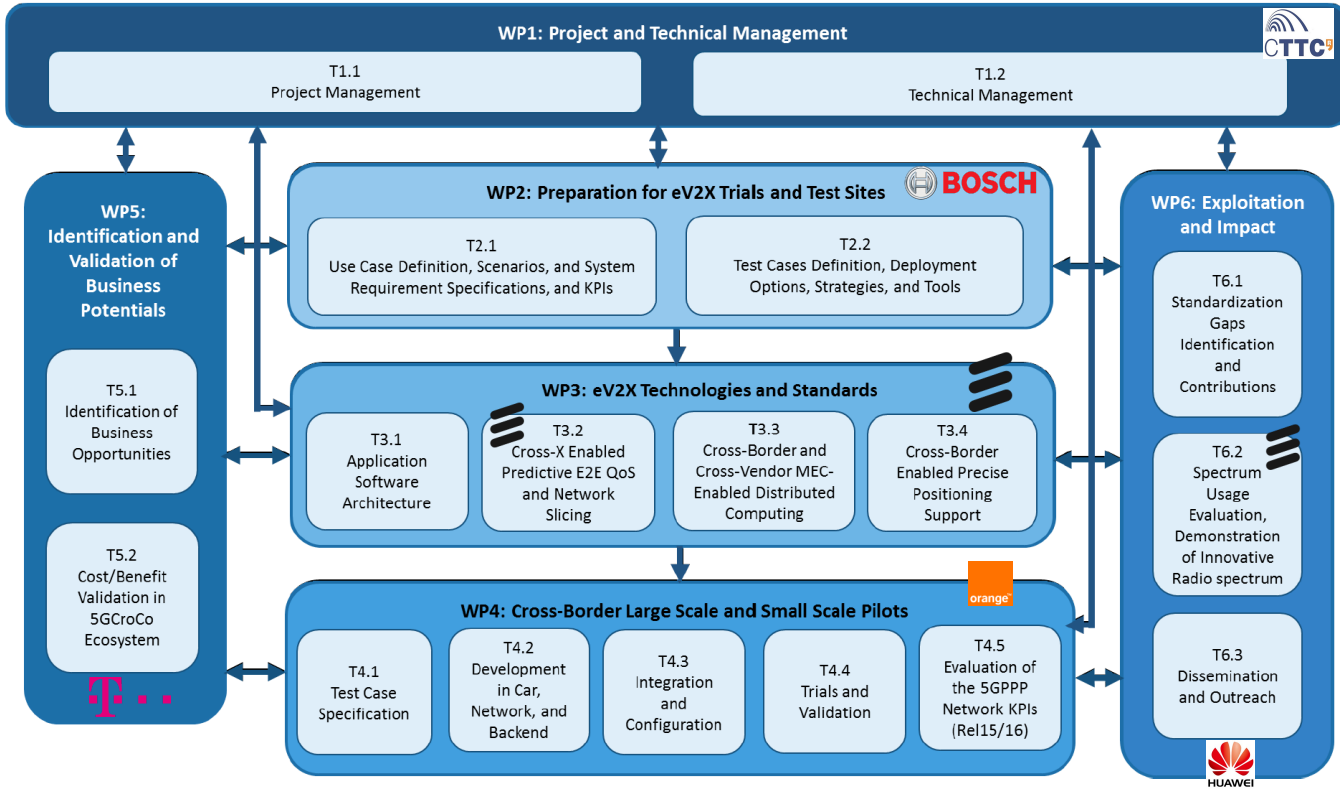
Public sector:

— SANEF (FR)

— htw saar (DE)

— POST Luxembourg

WPs and WP-leaders



Technologies and expected progress

- Definition “Technology Readiness Level (TRL) 4”: shown in lab / test site (including closed test-tracks) but not on public road
- Underlying baseline technology might be more mature but not in in **cross-X context**
- 3GPP long-range cellular communication technology (LTE & NR)

Technical element	**Project start**	**Project end**
Cross-Border/-MNO 5G Network Service Continuity	TRL 4	TRL 6
Cross-Border/-MNO/-Vendor/-OEM Mobile Edge Computing	TRL 3	TRL 5
Predictive QoS	TRL 4	TRL 6
Cross-Border/-MNO Mobile Radio Network Supported Precise Localization	TRL 4	TRL 5
E2E QoS with Network Slicing	TRL 4	TRL 6
Cellular-V2X Security Architecture	TRL 5	TRL 6
Trial Execution and Result Quality Assurance Methods **for Safety Critical Services**	TRL 4	TRL 6