5G Mobix EU Project

5G Mobix. Apoyando el Congreso Europeo ITS 2025

5GMOBIX

ABOUT

- EU funded Innovation action (H2020-ICT-18-2018)
- November 2018 – July 2022
- 50 partners from 11 countries in Europe
- 10 non-EU funded partners from China and South Korea

OBJECTIVES

Accelerate deployment of 5G at cross-border areas

- Carry out trials along X-border corridors to assess 5G capabilities for CAM
- Qualify the 5G-infrastructure and evaluate the benefits of 5G within the CAM context
- Identify spectrum allocation gaps, contribute to standardisation and 5G CEF preparatioı

Technical

Business

Define deployment scenarios & recommendations including x-border context

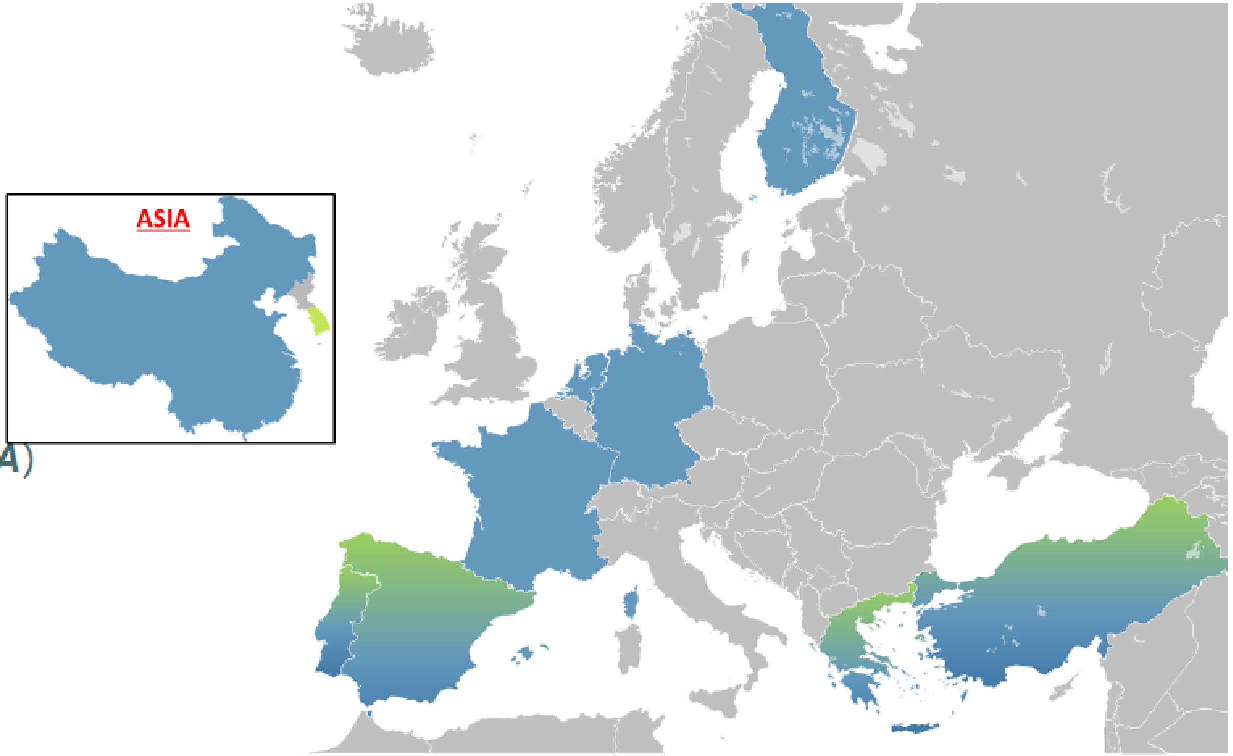
- Perform cost/benefit analysis and impact assessment
- Identify new business opportunities for 5G-enabled CAM
- Investigate legal, regulatory and security issues

5GMOBIX

5G Mobix. Apoyando el Congreso Europeo ITS 2025

LOCATIONS

- **2** Cross-Border Corridors (CBC)
- **4** complementary European Trial Sites (TS)
- **2** complementary Asian Trial Sites (TS)



NETWORK

- **29** 5G gNBs
- ***NSA*** Architecture (potential for evolving to ***SA***)

VEHICLES

- ***20*** SAE L4 automated vehicles

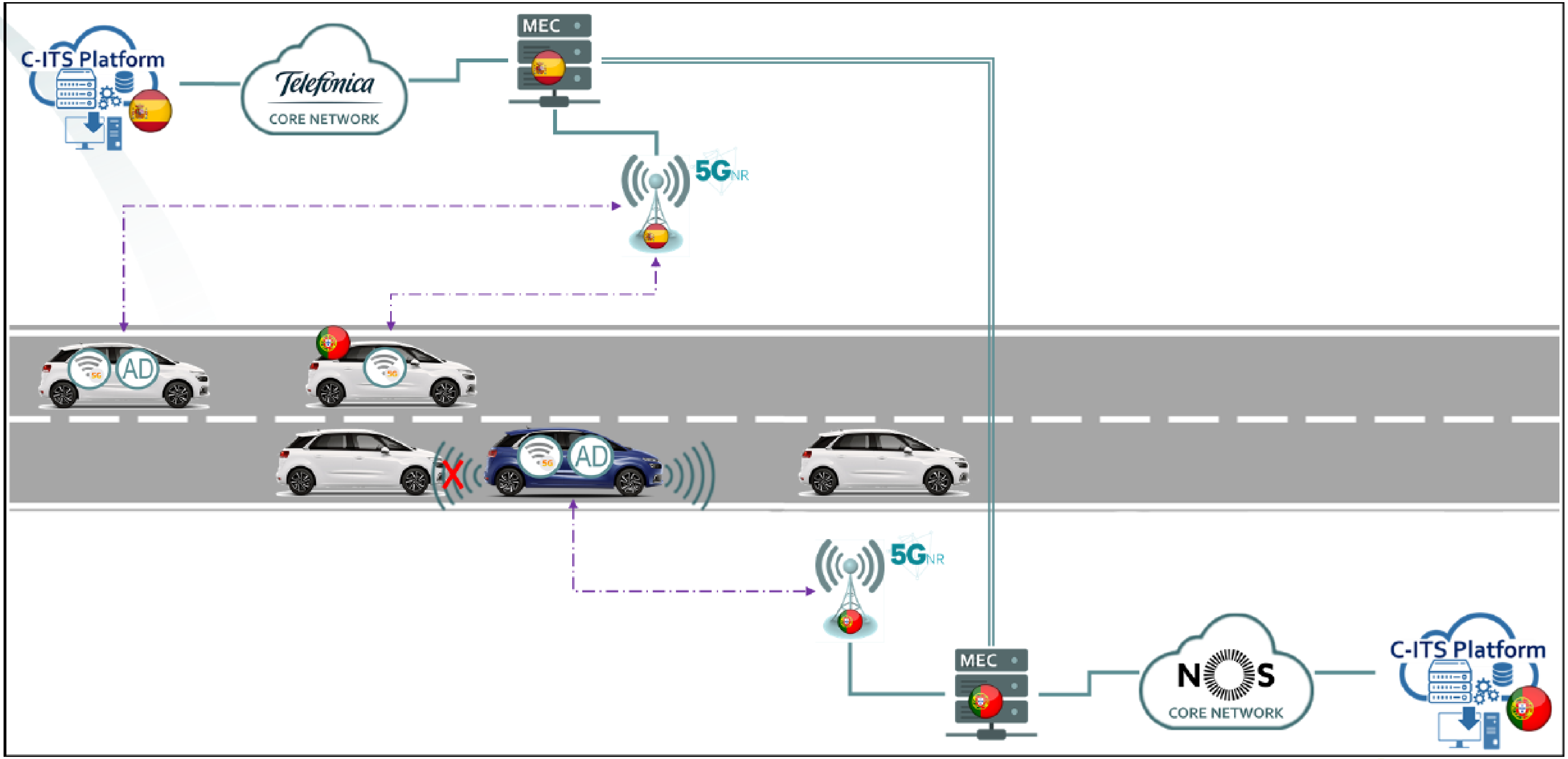
USE CASES

- **5** use case categories based on 3GPP TS 22.186, focusing on x-border operation

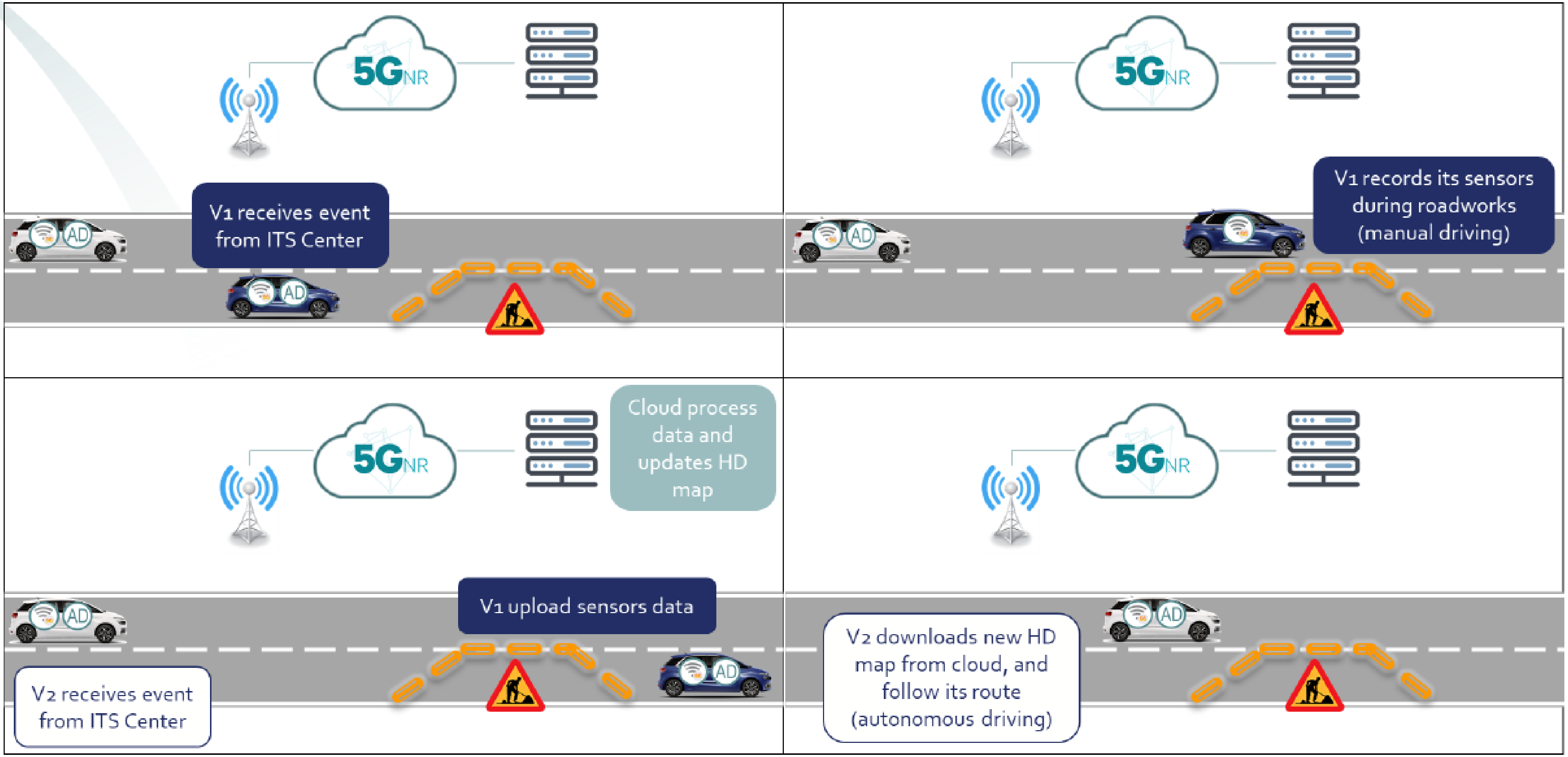
Advanced Driving	Vehicles Platooning	Extended Sensors	Remote Driving	Vehicle QoS Support

5GMOBIX

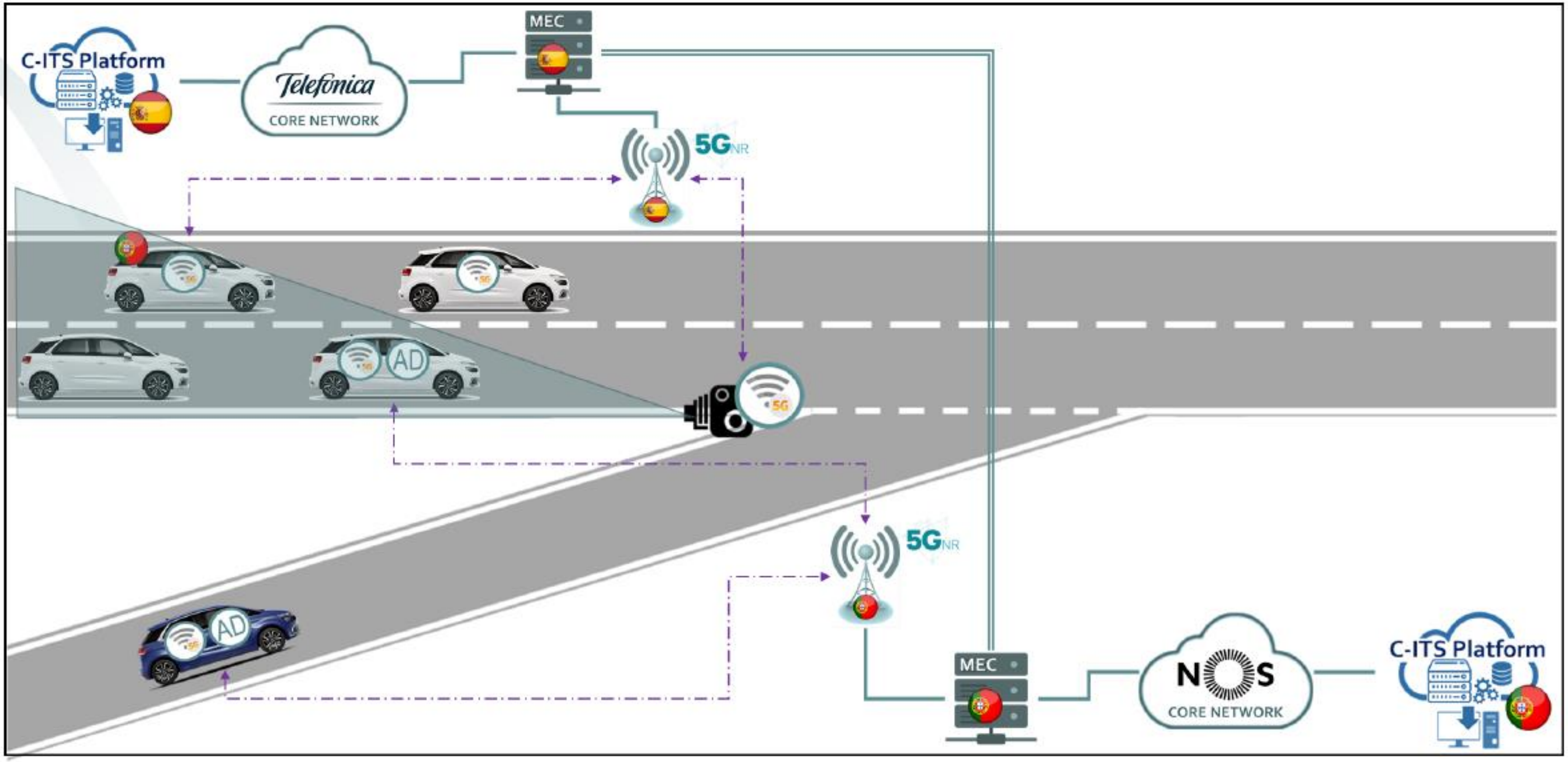
5G Mobix. Cooperative automated overtaking



5G Mobix. Real time HD Map service in road works



5G Mobix. Cooperative lane merge



5G Mobix. Apoyando el Congreso Europeo ITS 2025

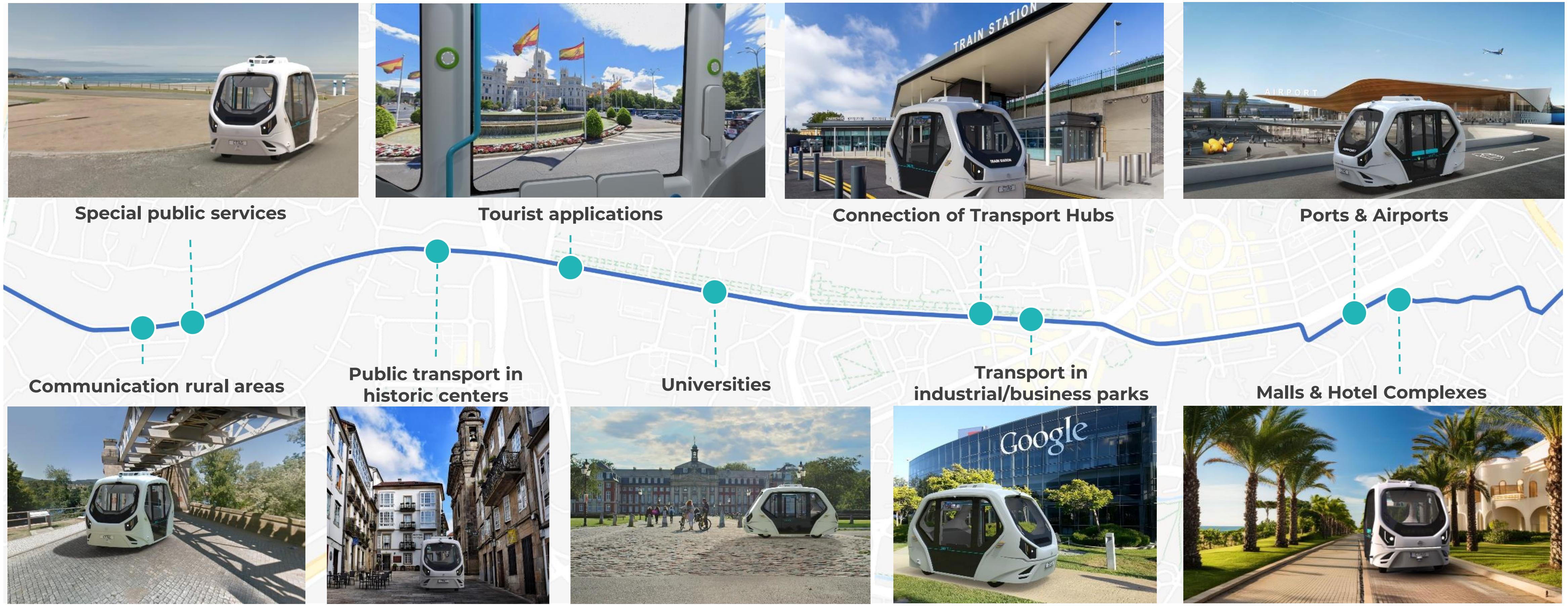
Shuttle by CTAG

New transport opportunities and solutions

- The **increasing** concentration of **population in urban areas** creates new challenges to adequately manage **mobility needs** from the point of view of people and goods.
- **Advances in digitization and connectivity technologies** promote **new opportunities** to transform cities into smart sustainable environments.
- **Connected and autonomous last-mile Shuttles** are a mode of transport that add value to the portfolio of **next-generation multimodal, sustainable and intelligent mobility solutions**.

Multiple operating environments

It allows to **meet the needs of transporting people safely and sustainably** in multiple environments, whether in **cities or rural areas**:



Shuttle by CTAG

L0	L1	L2	L3	L4	L5
Sin automatización	Asistencia a la conducción	Automatizaciones Parciales	Automatización Condicional	Alta Automatización	Automatización Total

Historia

- **Vehículo aprobado por la DGT** — 2024
- **+12 pilotos realizados** — 2023
- **1st Unidad de Mercado** — 2022
- **1st Prototipo** — 2019

Valores

- **A la Vanguardia de la innovación**
- **Experiencia de movilidad única**
- **Eléctrico, Autónomo y Conectado**
- **Diseño Atractivo y Ergonómico**

Shuttle by CTAG

Un vehículo de **transporte de personas de última milla** que satisface las necesidades de movilidad tanto en entornos **urbanos, interurbanos como rurales**.

Autónomo, Conectado y Eléctrico

Flexible

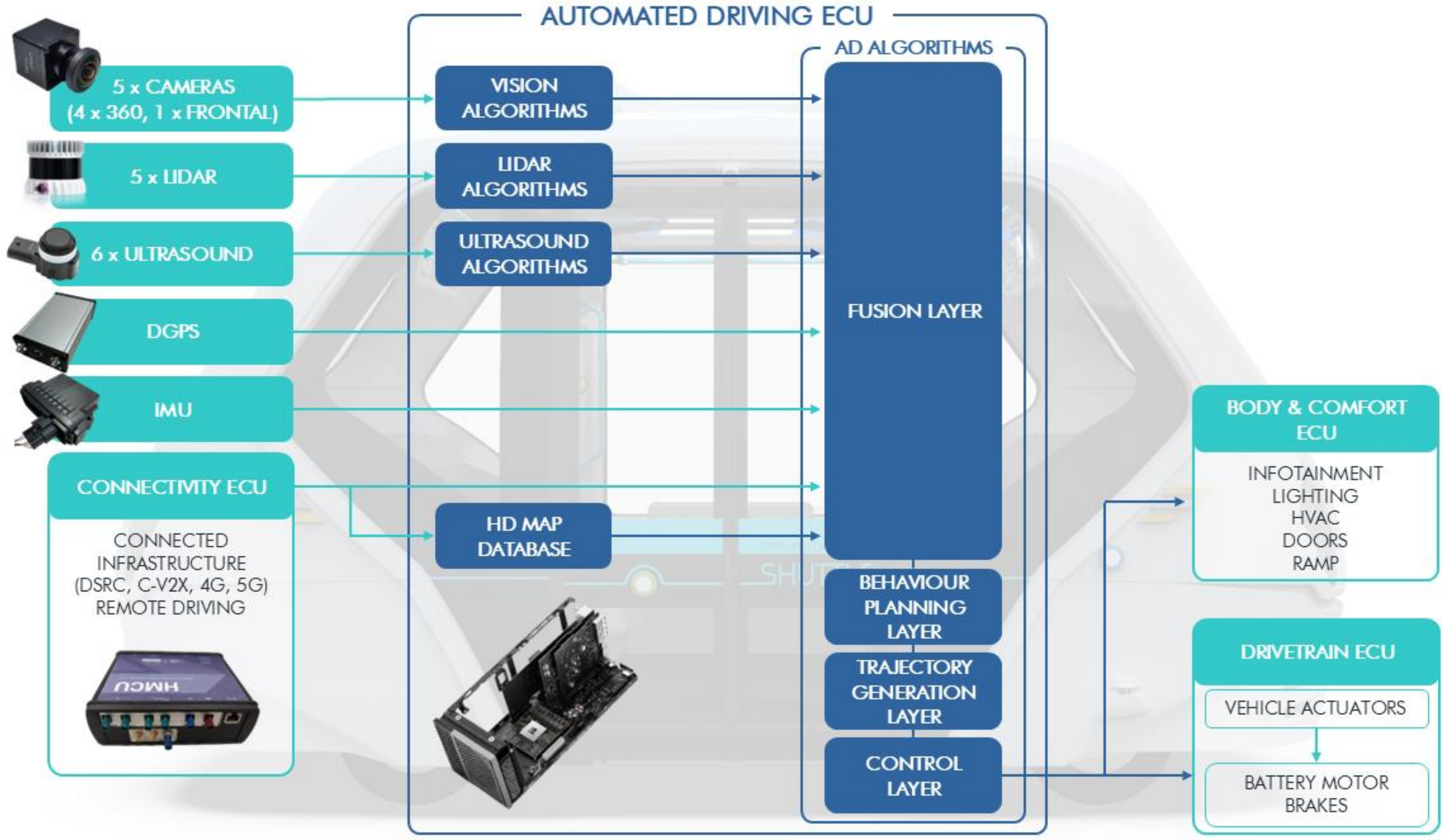
Diseñado, desarrollado y fabricado por CTAG

Altamente tecnológico

Maximiza el uso de los servicios y tecnologías cooperativas

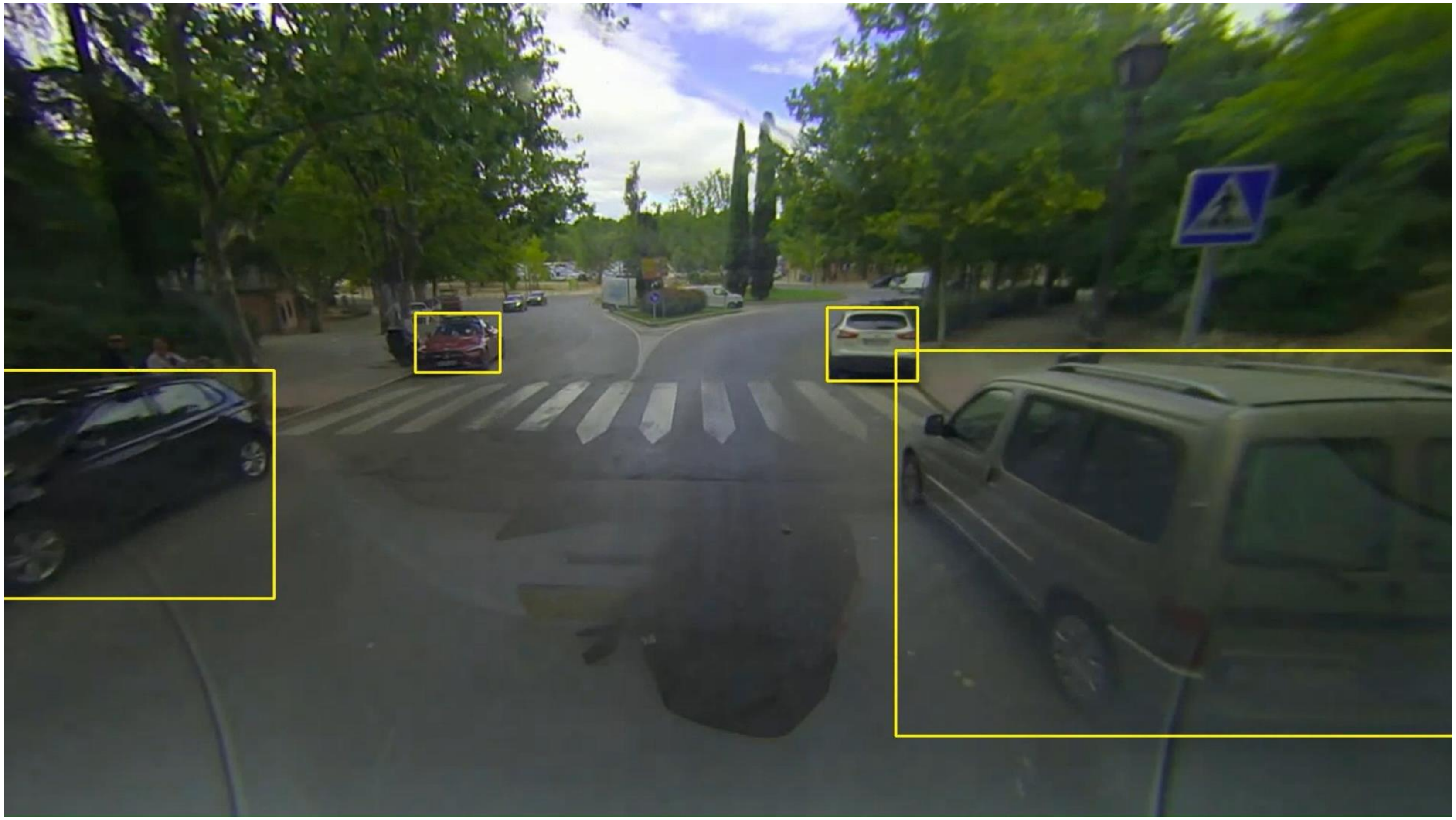
Diseño atractivo, futurista y ergonómico que busca satisfacer la **experiencia del usuario**

Shuttle by CTAG. Arquitectura



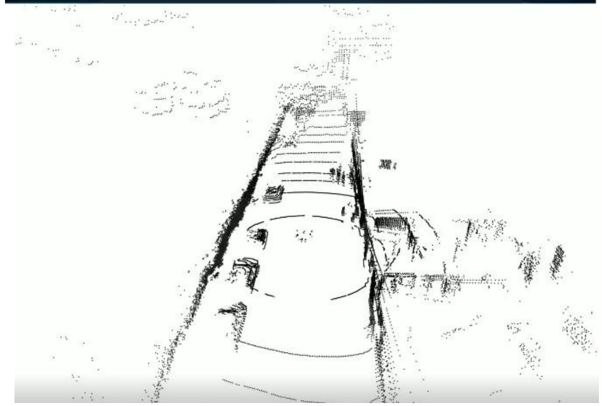
Shuttle by CTAG. Tecnologías clave: aplicaciones de IA

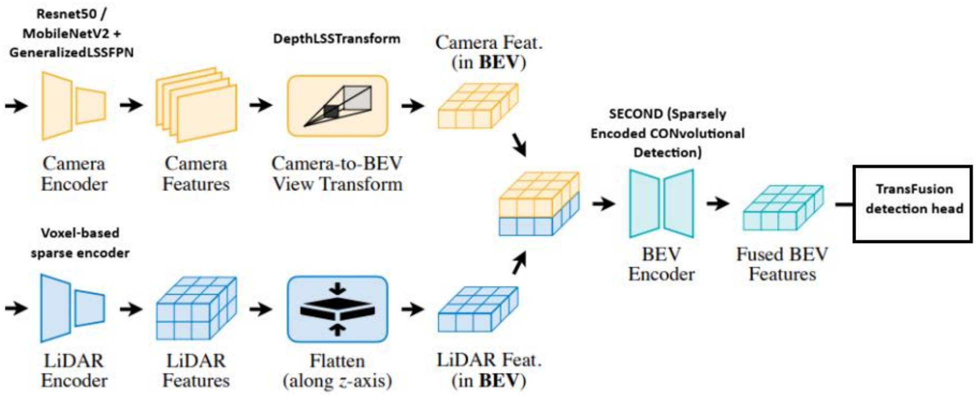
Shuttle by CTAG. Tecnologías clave: aplicaciones de IA para detección y clasificación mediante cámara

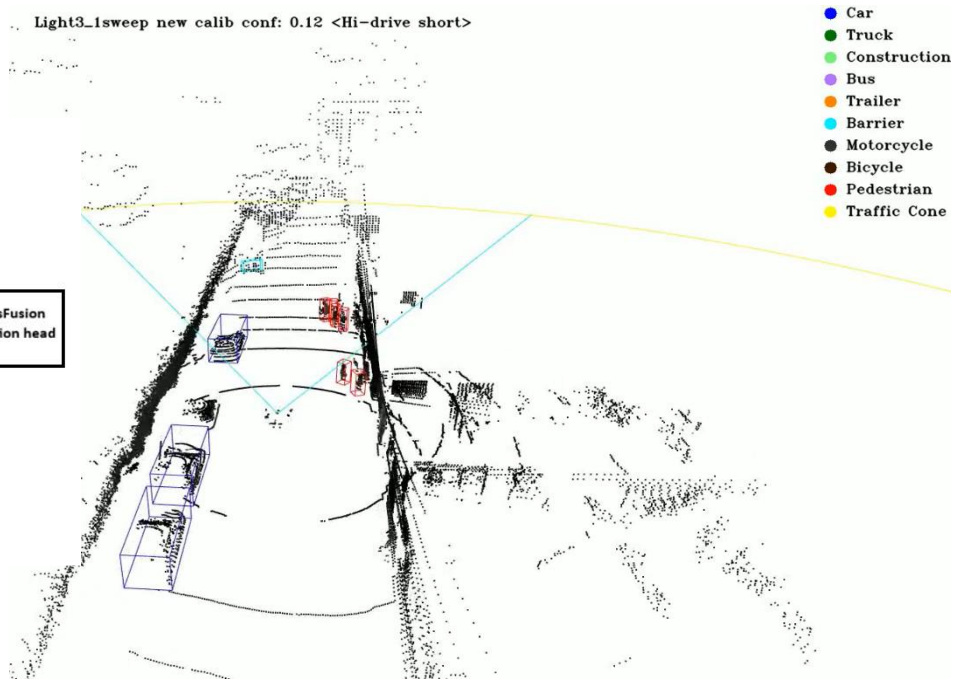


- Los modelos de deep learning, como YOLO26, consiguen altas tasas de detecciones y bajas incertidumbre en la clasificación de vehículos y VRUs, especialmente a distancias cortas, permitiendo al vehículo autónomo ajustar su comportamiento en situaciones específicas.
- Estos modelos son cada vez más eficientes permitiendo usar modelos más potentes con los mismos recursos de computacion
- Posibilidad de reducir la velocidad cuando se detectan VRUs, como en el ejemplo.

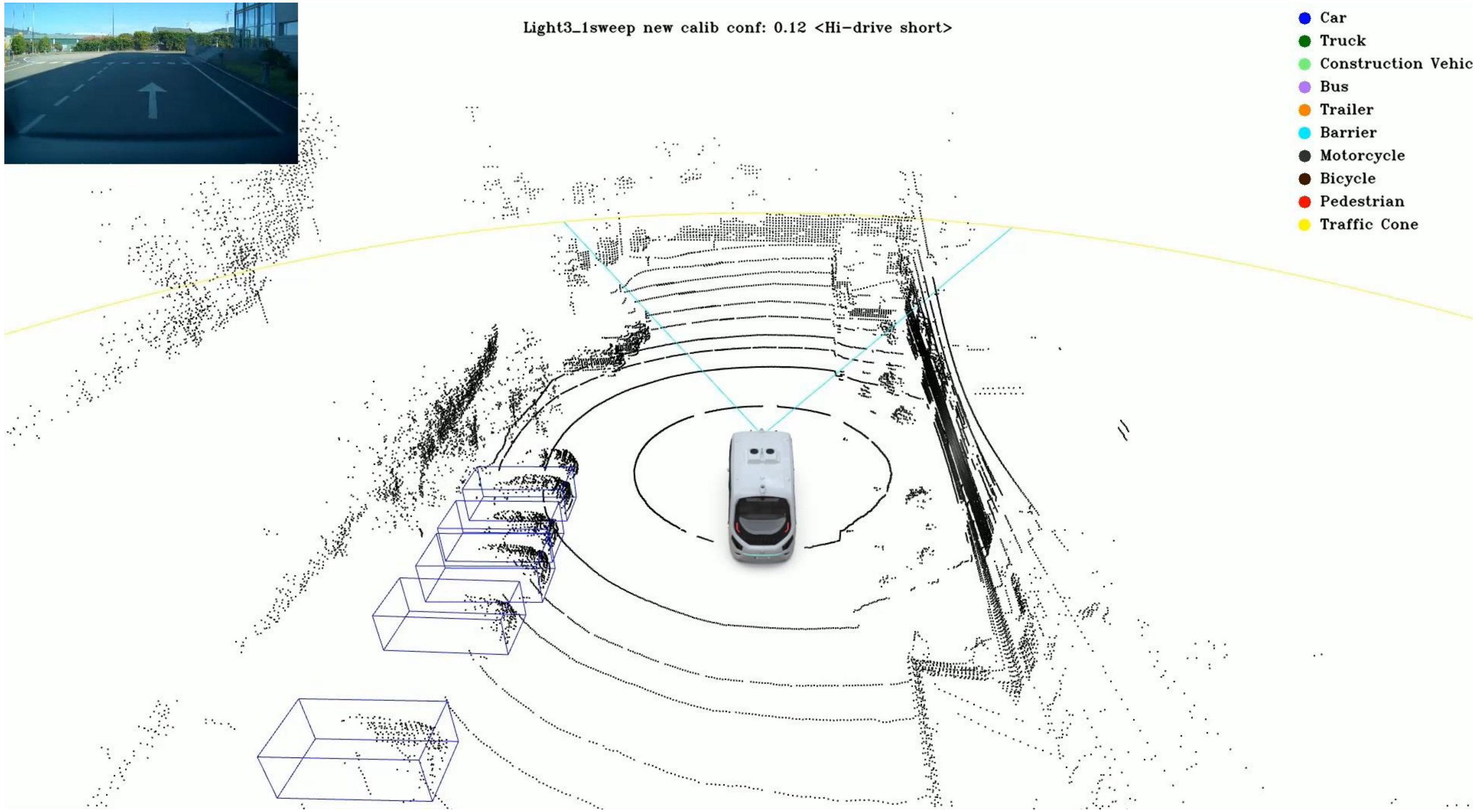
Shuttle by CTAG. Tecnologías clave: aplicaciones de IA: Fusión de nivel medio



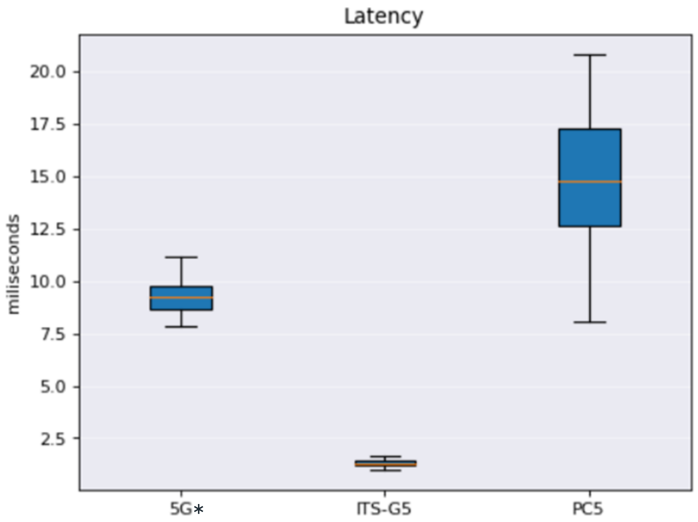




Shuttle by CTAG. Tecnologías clave: aplicaciones de IA: Fusión de nivel medio



Shuttle by CTAG. Tecnologías clave: Conectividad



	5G	ITS-G5	PC5
Mean	9,26 ms	1,31 ms	14,86 ms
St Dev	0,77 ms	0,15 ms	3,08 ms
Min	7,86 ms	1,01 ms	8,09 ms
Max	11,16 ms	1,62 ms	20,80 ms

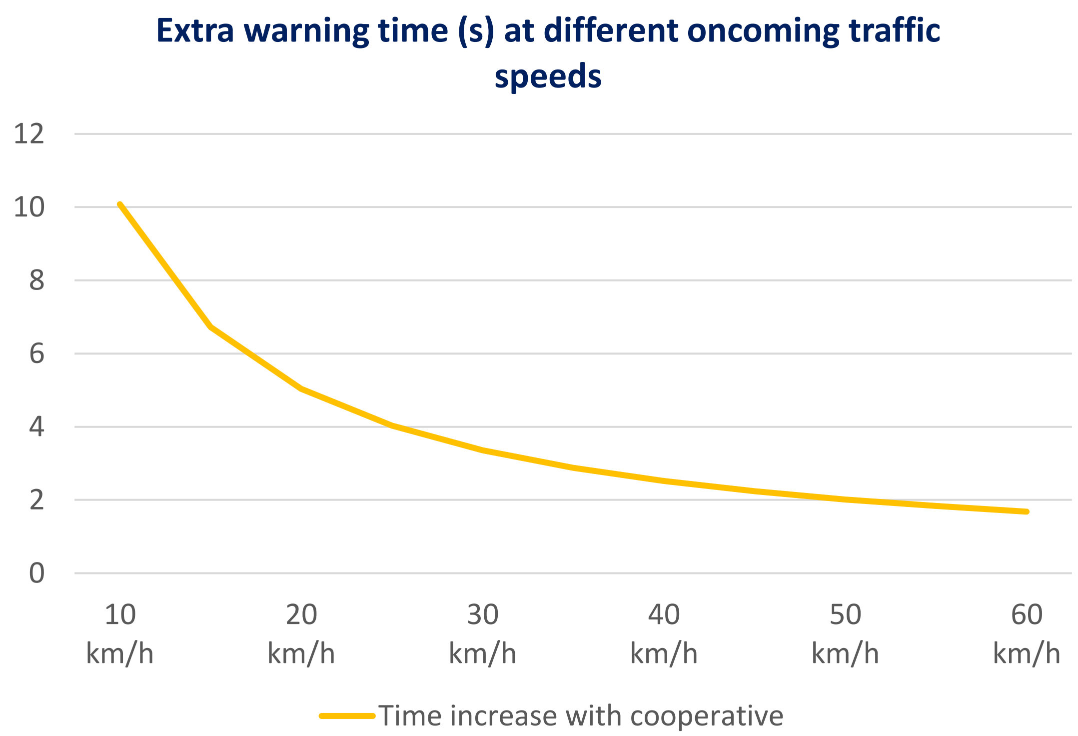
*Red 5G privada

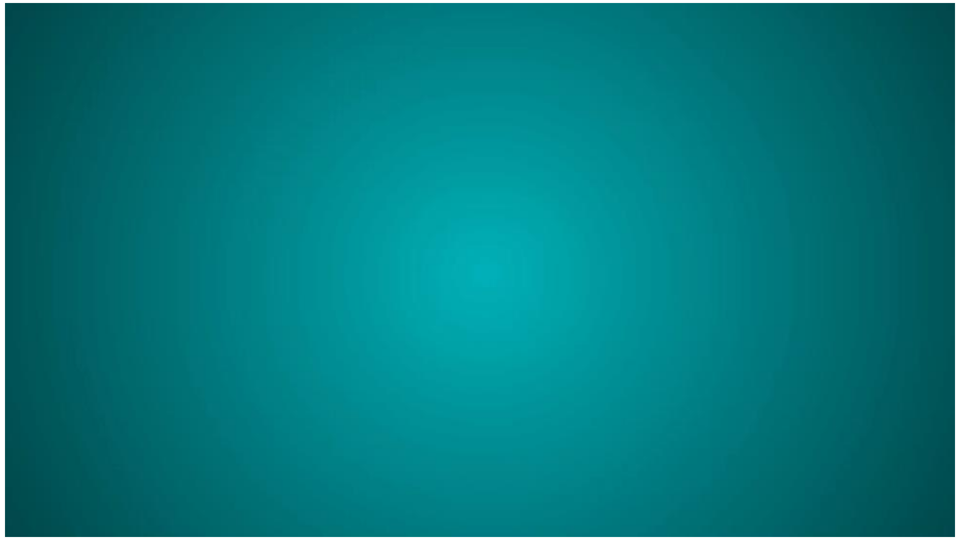
GLOSA in intersections

Cooperative VRU protection

Shuttle by CTAG. Tecnologías clave: Conectividad

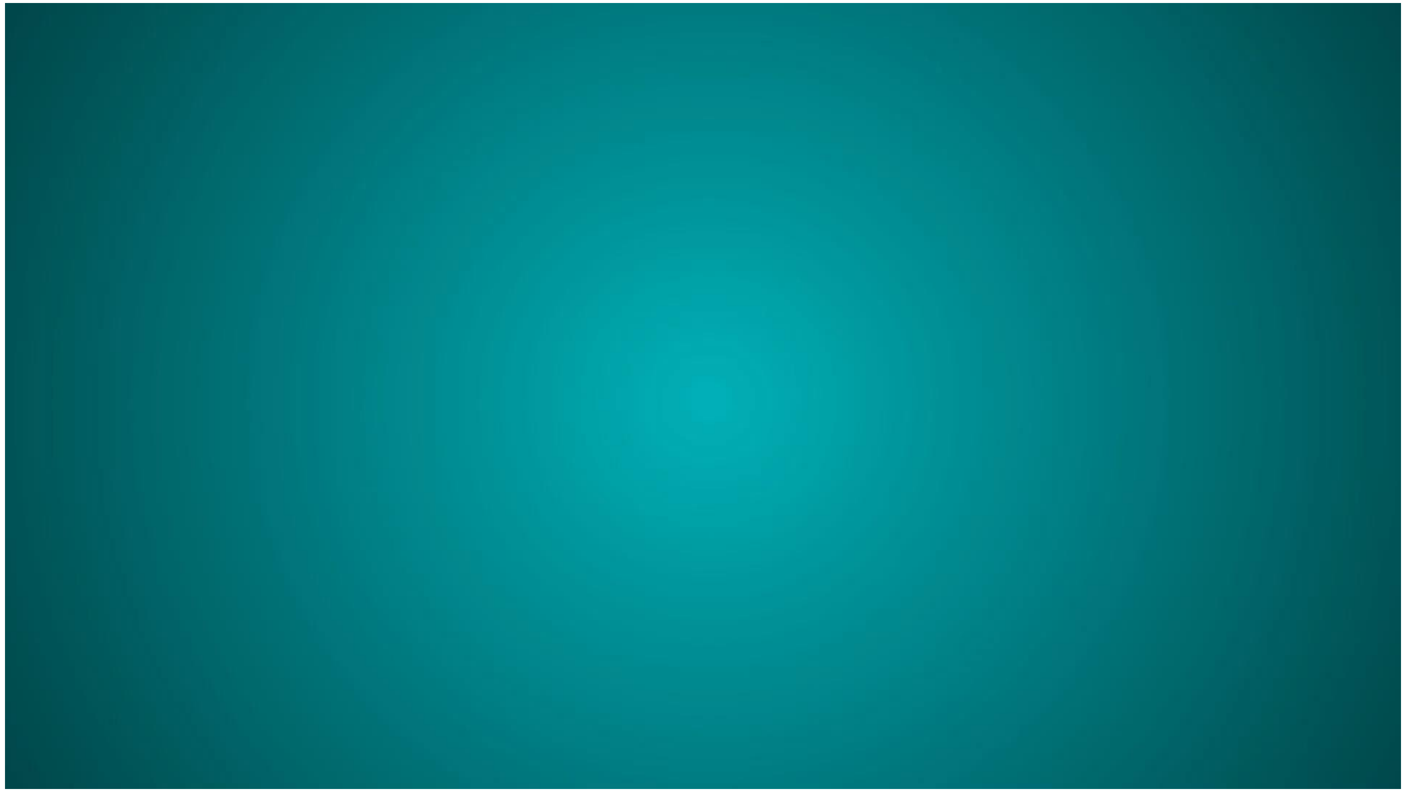
Incorporación cooperativa

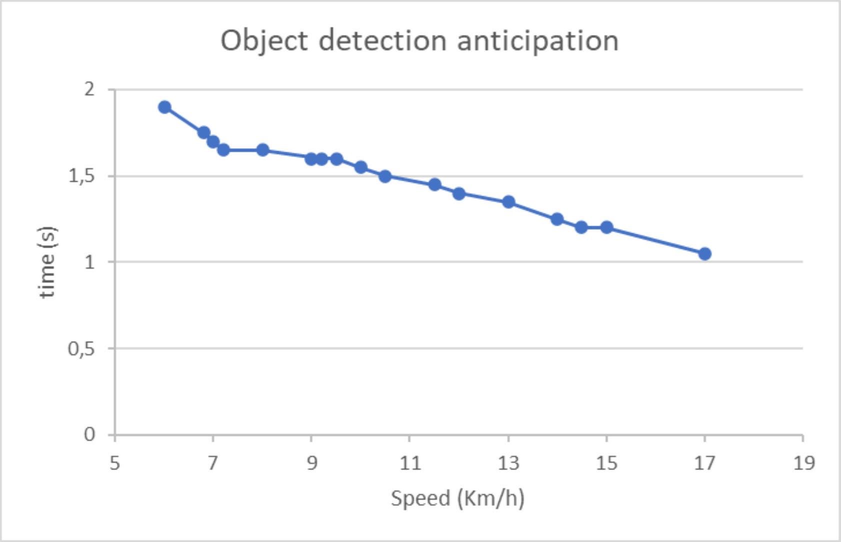




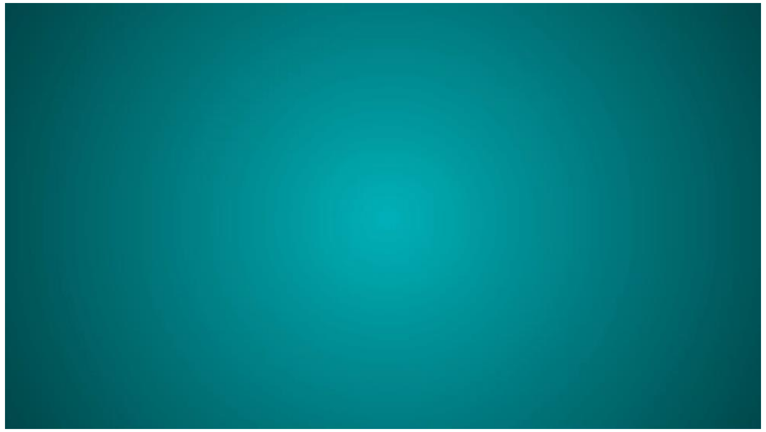
Shuttle by CTAG. Tecnologías clave: Conectividad

Intersección cooperativa

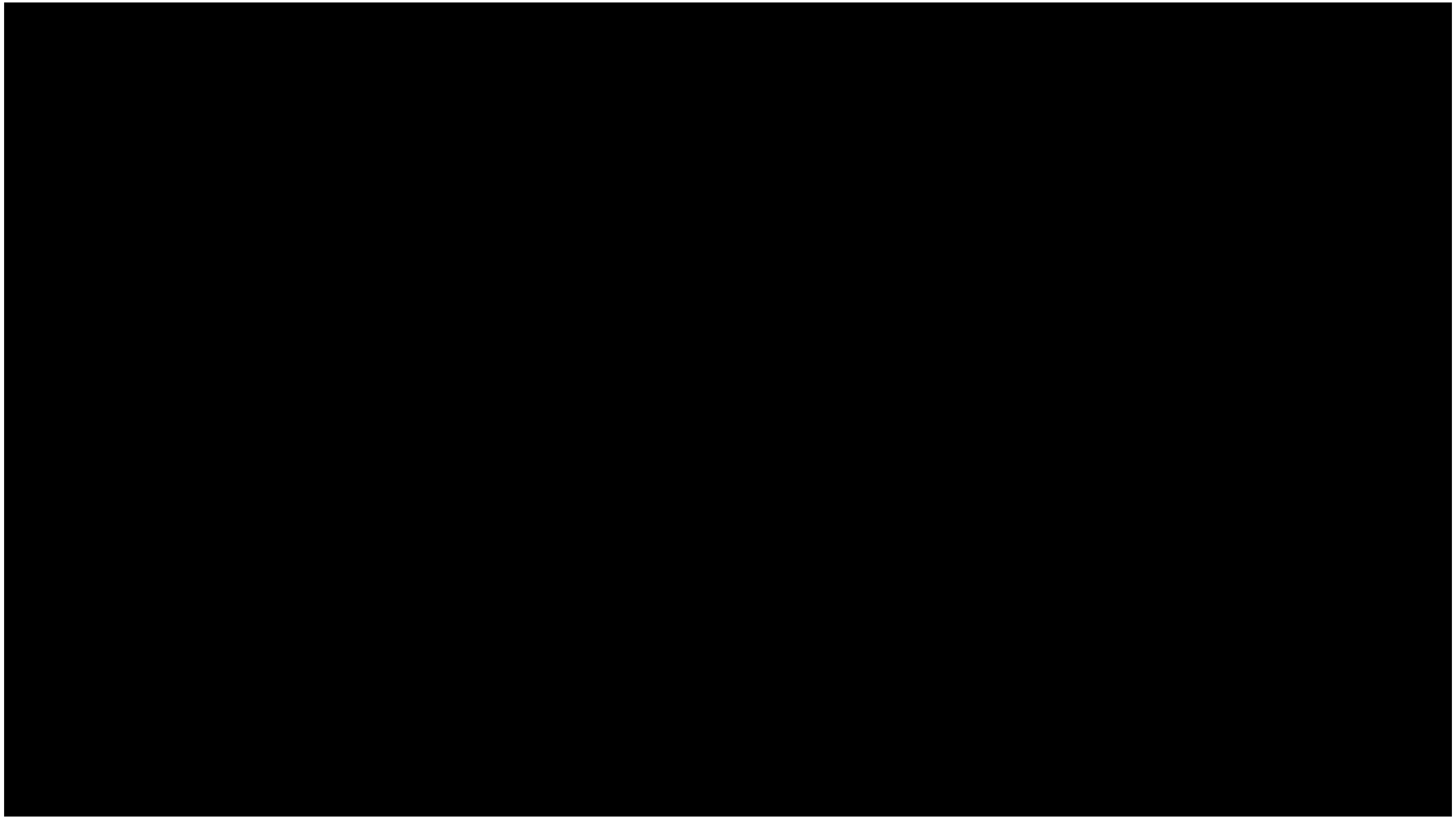




Shuttle by CTAG. Testing approach

Simulated Environment	Proving Ground	Open Environment
		
		

Shuttle by CTAG. Importancia de la validación virtual



Shuttle by CTAG. Pruebas en pista

Shuttle by CTAG. Safety First. Instrucción DGT

INSIA

CTAG

Shuttle by CTAG. Algunas cifras

+9.000
Pasajeros a bordo

+6.000 kms
en autónomo por vía pública

14
Pilotos realizados

+20
Eventos de movilidad

Shuttle by CTAG. Pilots and PoCs

Uvigo – Feb 2026 - Presente
Ruta circular en el Campus de la Universidad de Vigo

A Coruña – Sep 2022
Ruta demostrador en el Paseo de la Marina

Arteixo – Ago 2022
Ruta conectando dos playas

CTAG - Ene 2024 - *Presente*
Servicio de Movilidad Interno

Tui – Valença – Oct 2022
Conexión transfronteriza entre Tui y Valença.

Lisboa – May 2023
Demostración en Congreso ITS Europeo

ITS Seville – Mar 2023
Servicio en FIBES para el Congreso ITS Español & Iberoamericano

SERVICIOS PILOTO EN ESPAÑA 2022 - 2025

Torre del Oro– Mar 2025
Servicio que conectó Torre del Oro y Acuario de Sevilla

Madrid – Dic 2022
Piloto en entorno operacional de autobuses

Madrid – Oct 2023
Demostración en GMC IFEMA

Madrid – Sep 2024
European Mobility Week

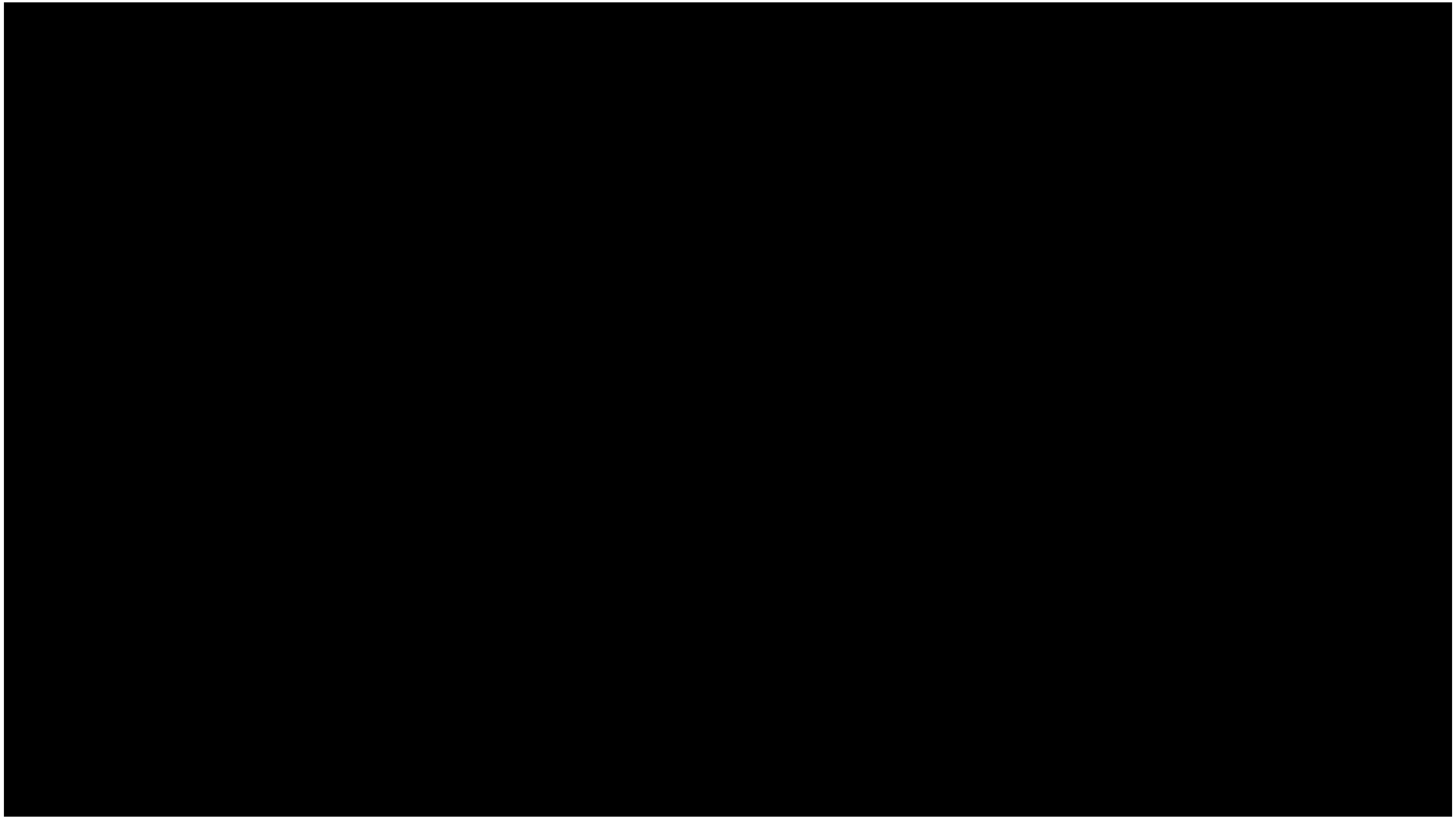
Madrid – Sep/Oct 2025
Servicio regular en Casa de Campo

Valencia – Feb 2024
Transfer en el eMobility Expo World Congress

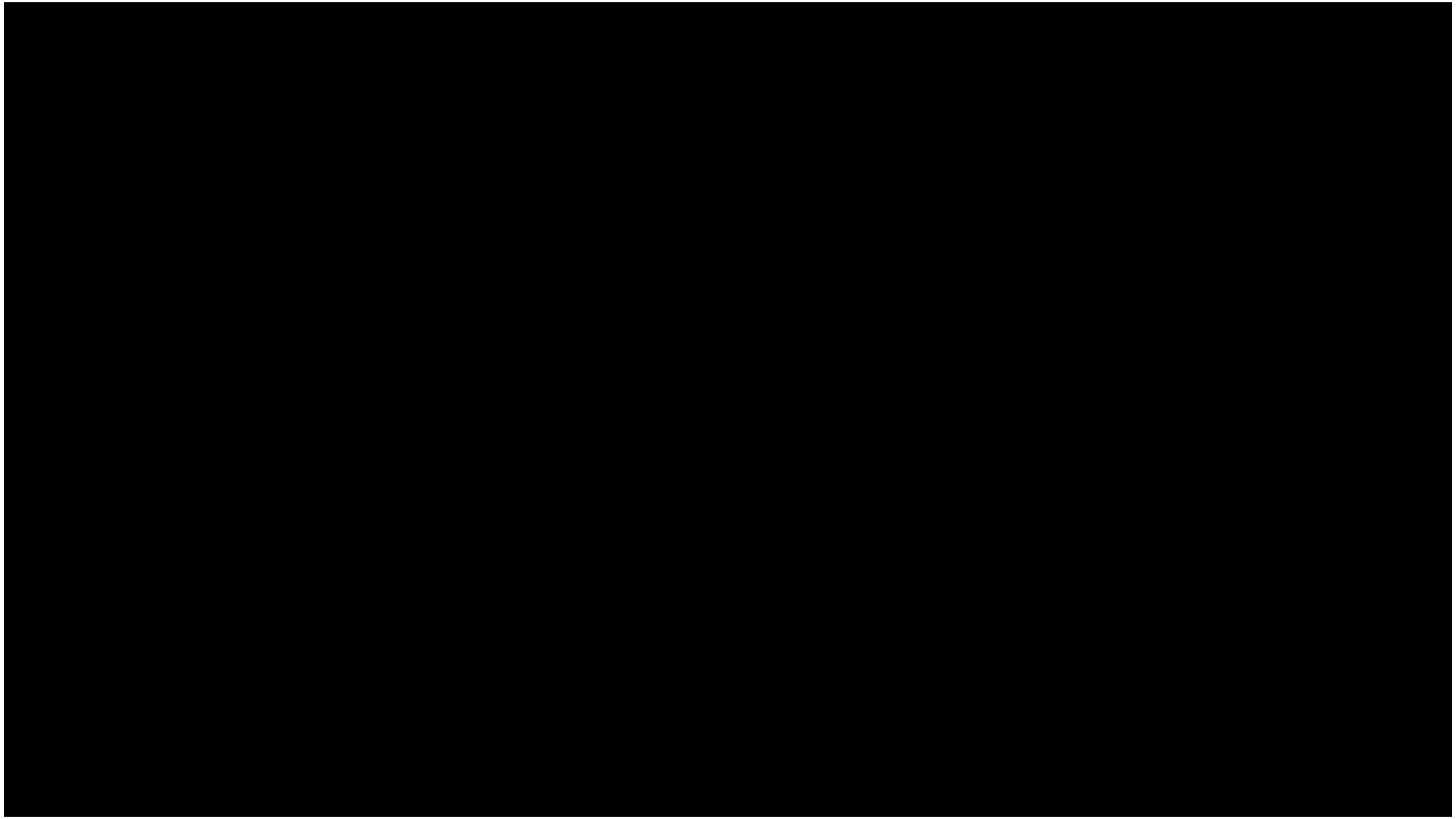
Valencia – Abr 2023, 2024
Servicio Piloto en iENER Congress

Benidorm – Sep 2022
Ruta demostrador en el entorno del Ayuntamiento

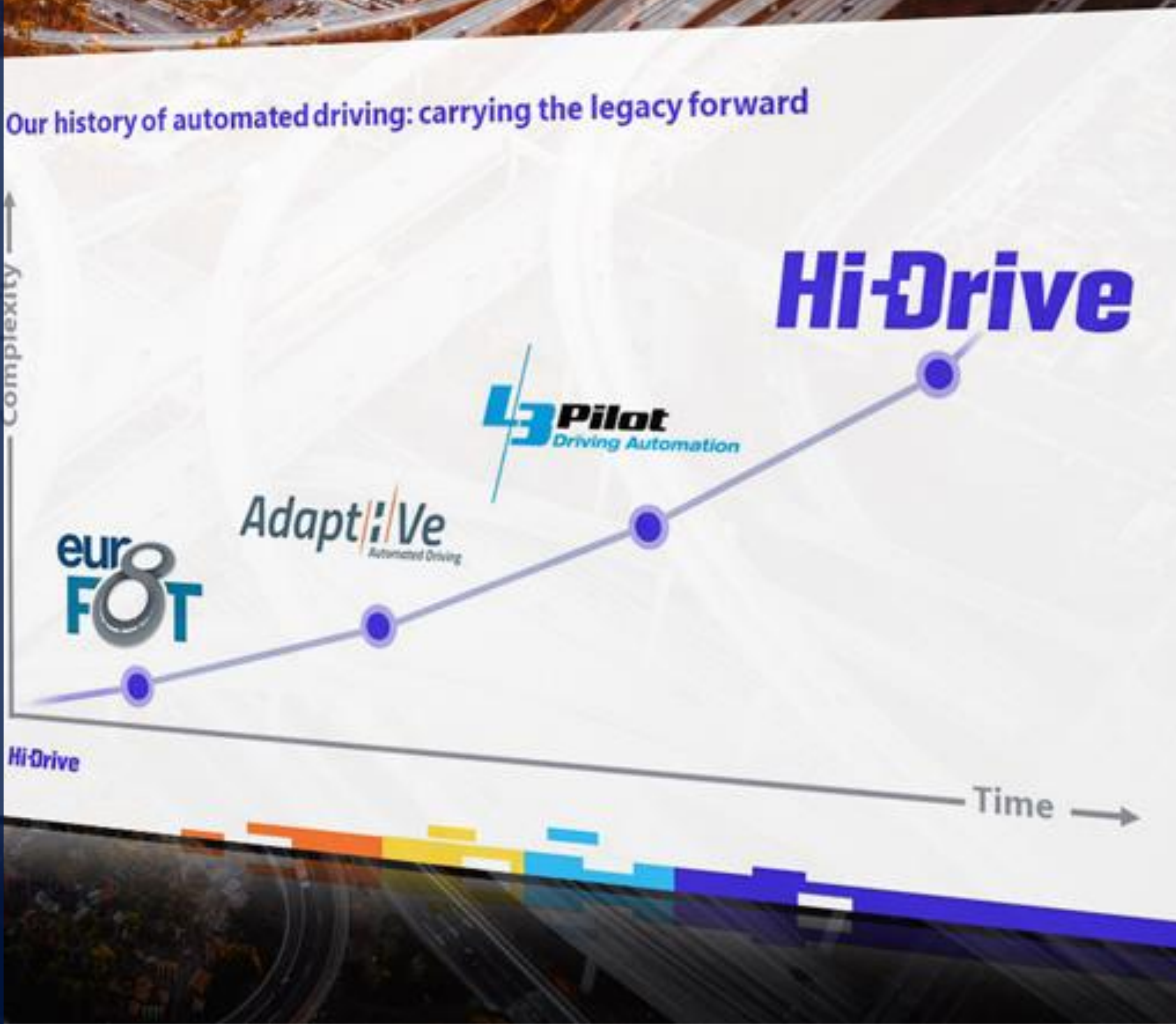
Shuttle by CTAG. Piloto Madrid, Casa de Campo

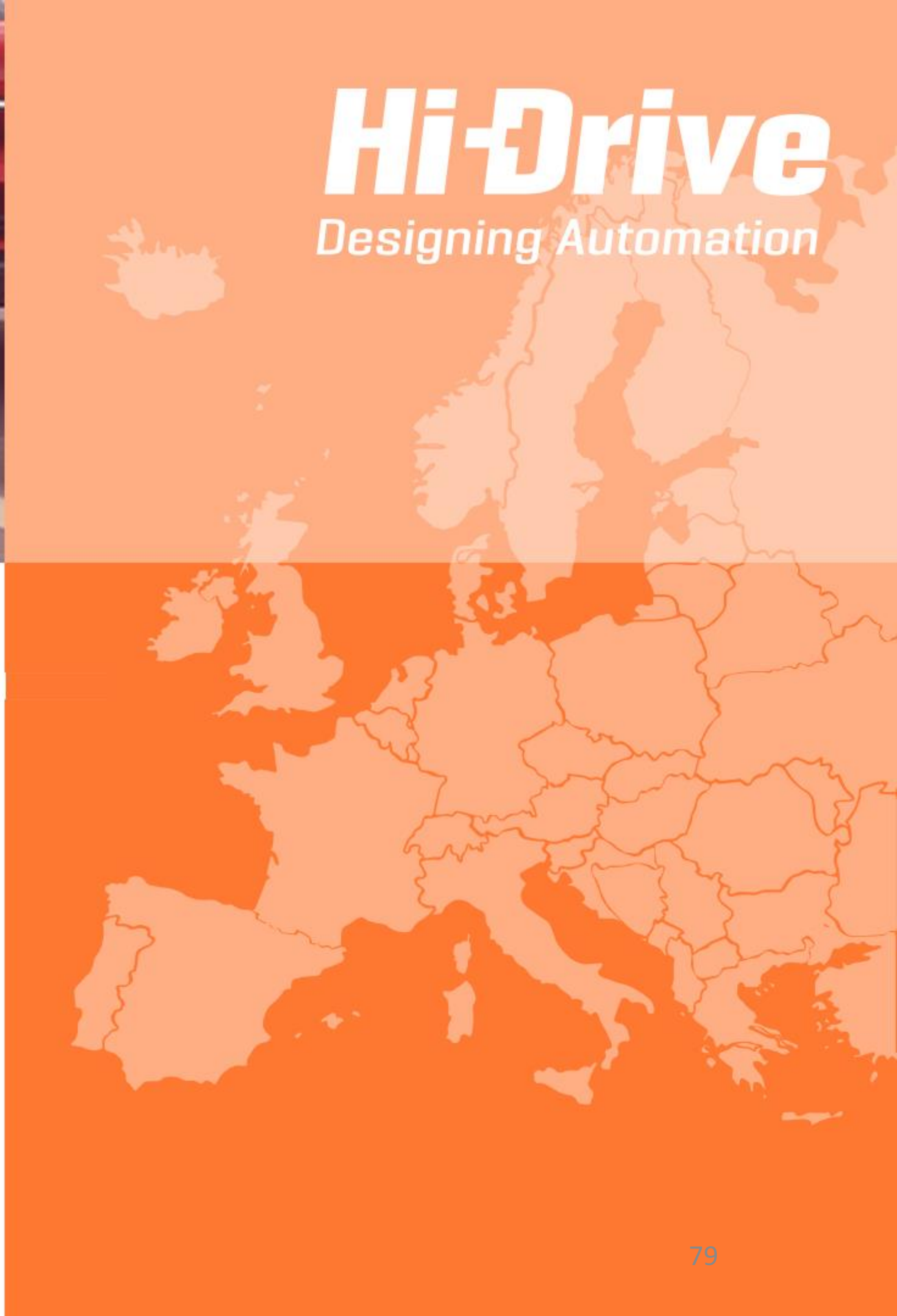


Shuttle by CTAG. Piloto Universidad de Vigo



Hi-Drive
EU Project

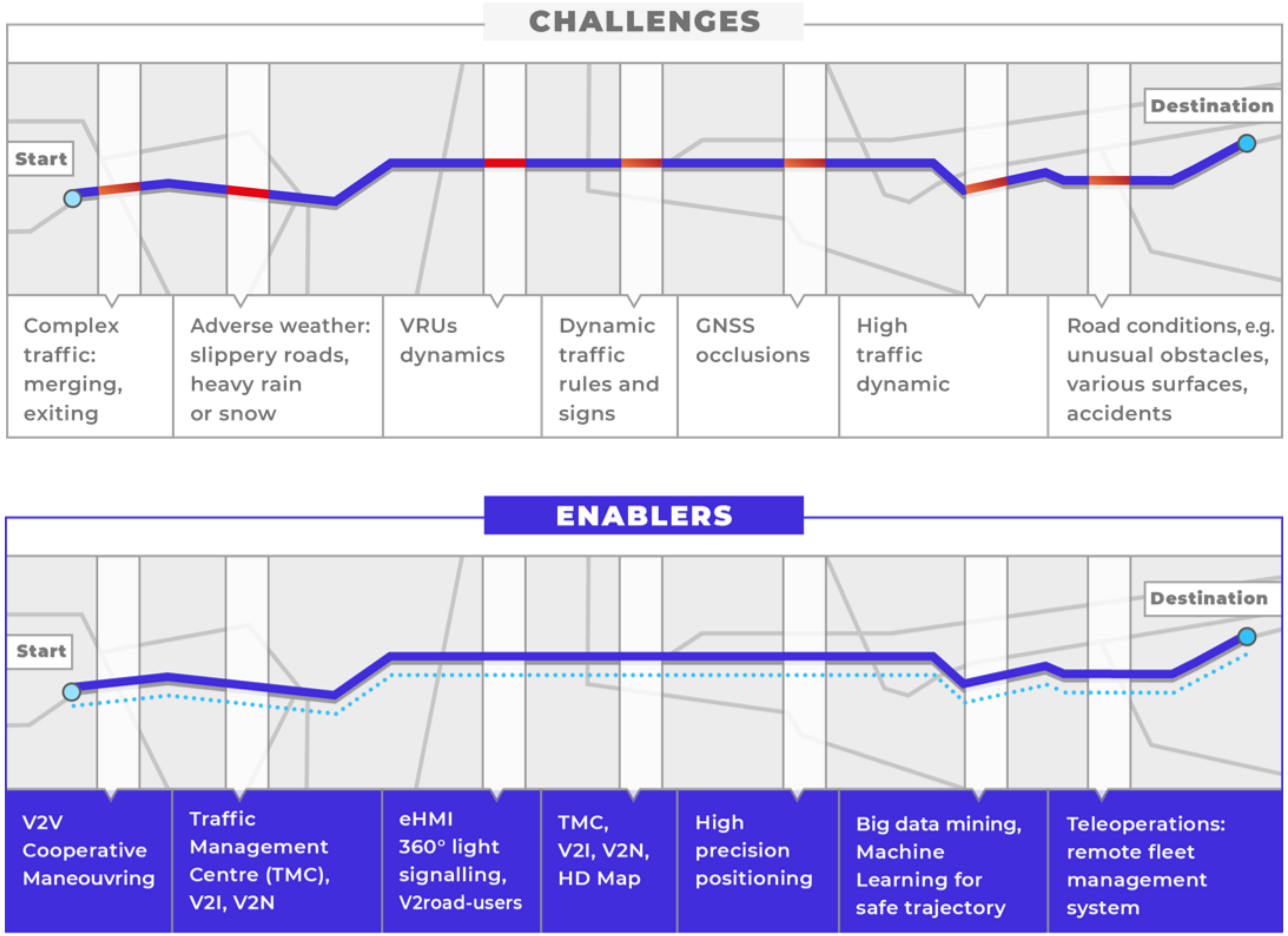




PUSH TOWARDS HIGHER AUTOMATION

- Robust and reliable automated driving
- Extended and defragmented ODDs
- Interoperability across countries and brands

Defragmentation of the Operational Design Domain (ODD)



ODD

MANUAL DRIVING

AUTOMATED DRIVING

Cybersecure, interoperable, interactive and **user-aware vehicles**

Hi-Drive

Project Facts

€60 MILLION BUDGET

€30 MILLION FUNDING

48 MONTHS from July 2021 to June 2025

53 PARTNERS among them OEMs, automotive suppliers, research institutes, associations, traffic engineering, deployment organisations and mobility clubs

13 COUNTRIES involved: Belgium, France, Finland, Germany, Greece, Hungary, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom

Supported by the European Council for Automotive R&D

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006664

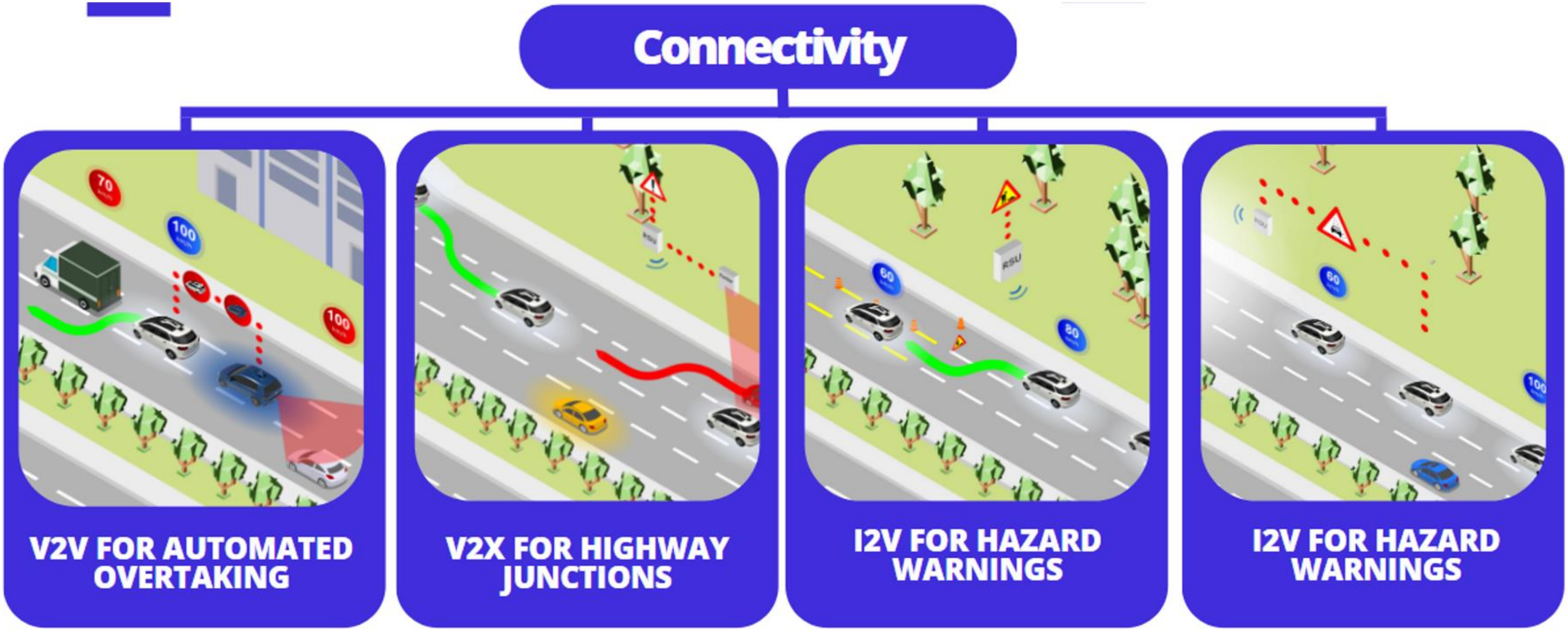
Partners

SPANISH PILOT

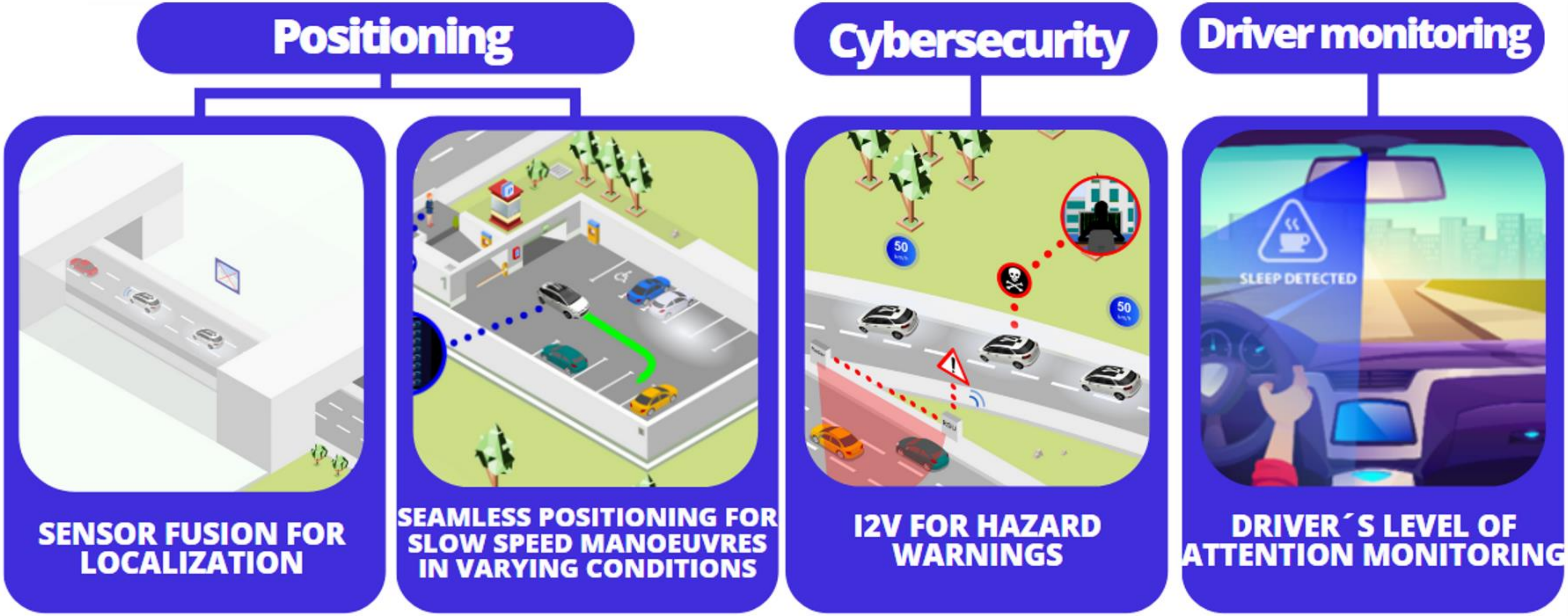
- Participation with automated vehicles from CTAG and SEAT where different technologies where developed and integrated in the prototype vehicles as enablers to close different ODD gaps.

Hi-Drive

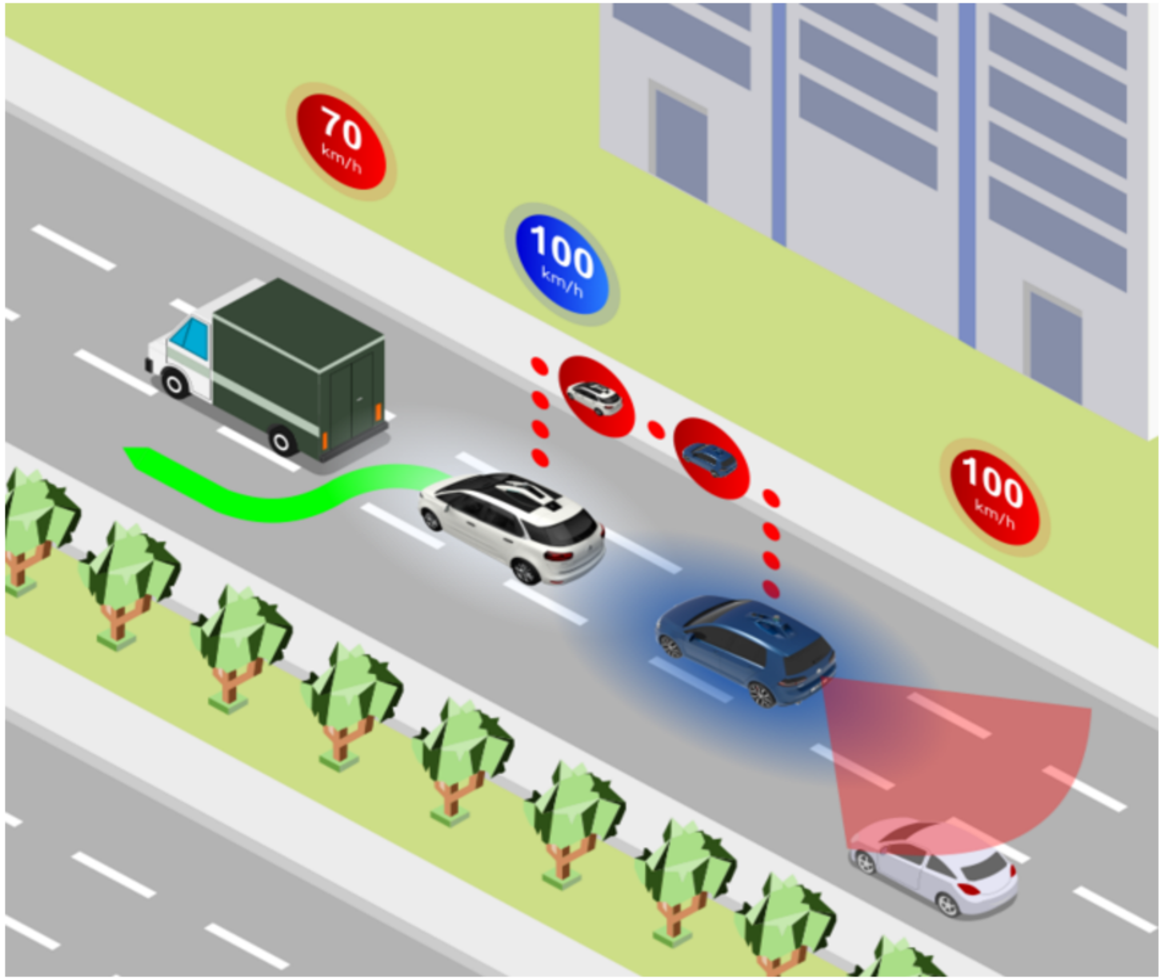
CTAG ENABLERS



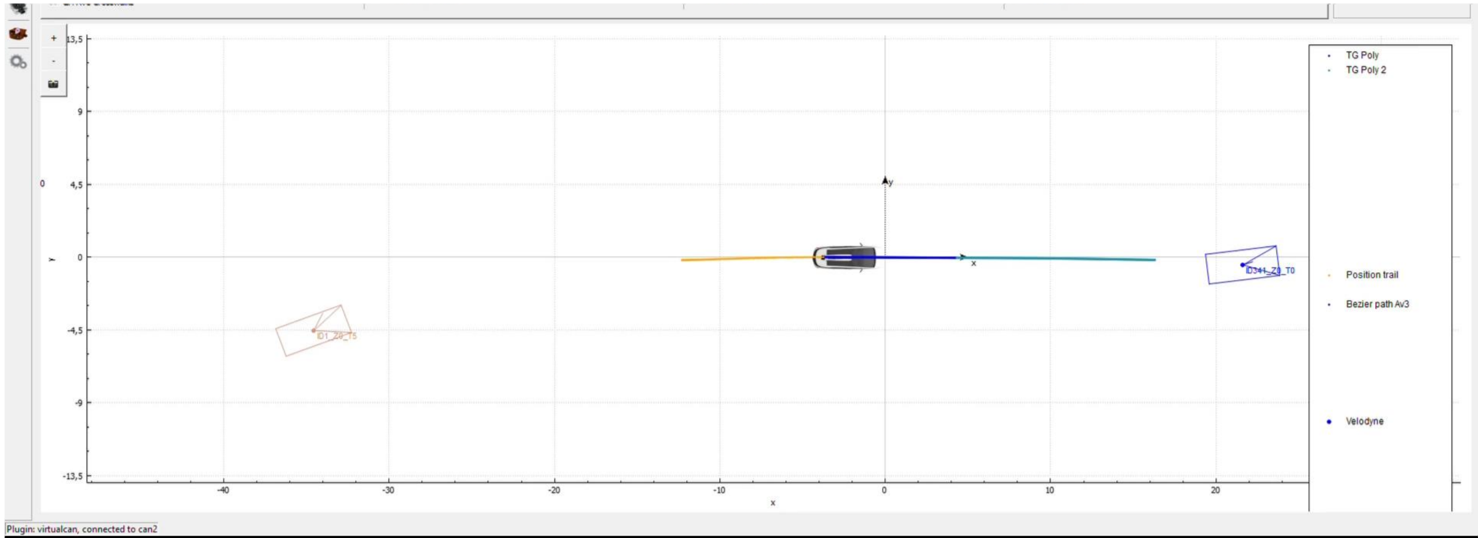
CTAG ENABLERS



V2V FOR AUTOMATED OVERTAKING

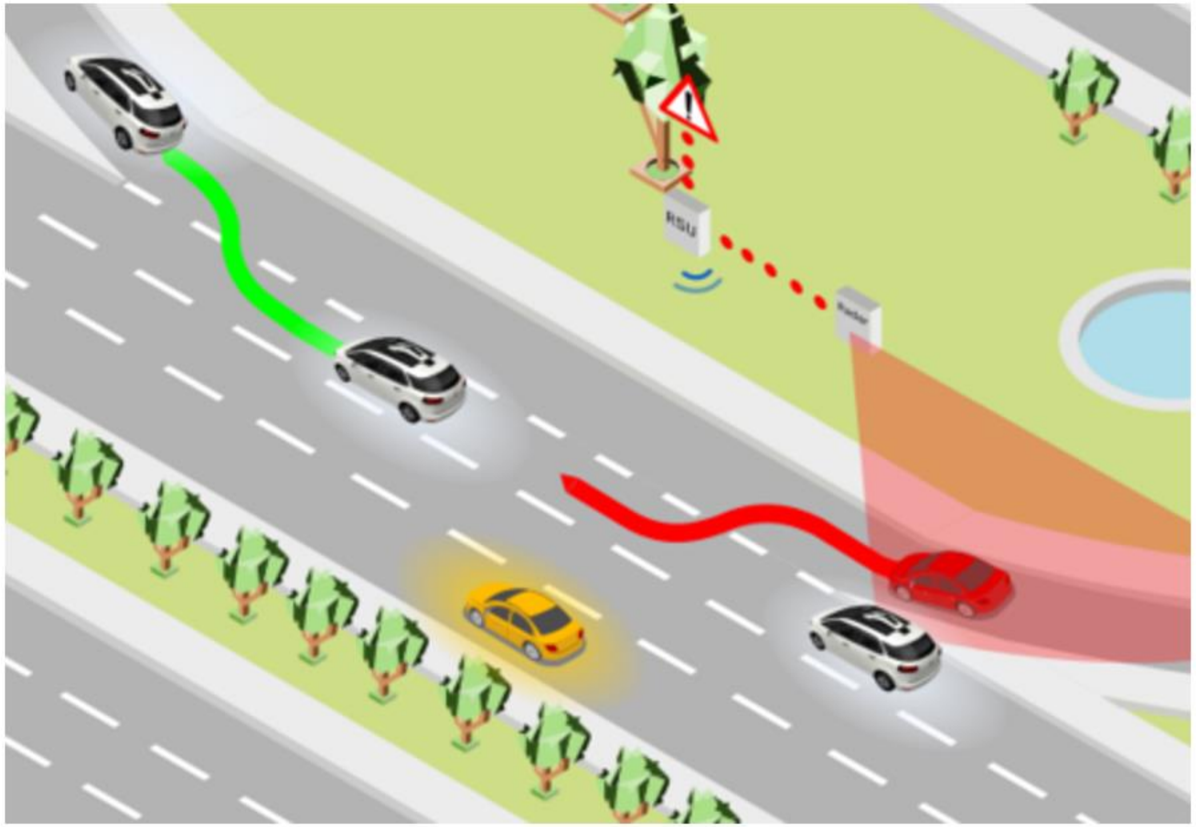


- When the ego vehicle is driving autonomously on a motorway, it detects a vehicle driving ahead which speed is lower than ego vehicle. Therefore, an automated overtaking must be executed.
- However, as the ego vehicle perception is occluded by other vehicles, the information about the lane availability for the maneuver performance is received by V2V connectivity.
- Then, if the lane is available, the ego will perform an overtaking maneuver, and if not, it will adapt the speed to the vehicle ahead.

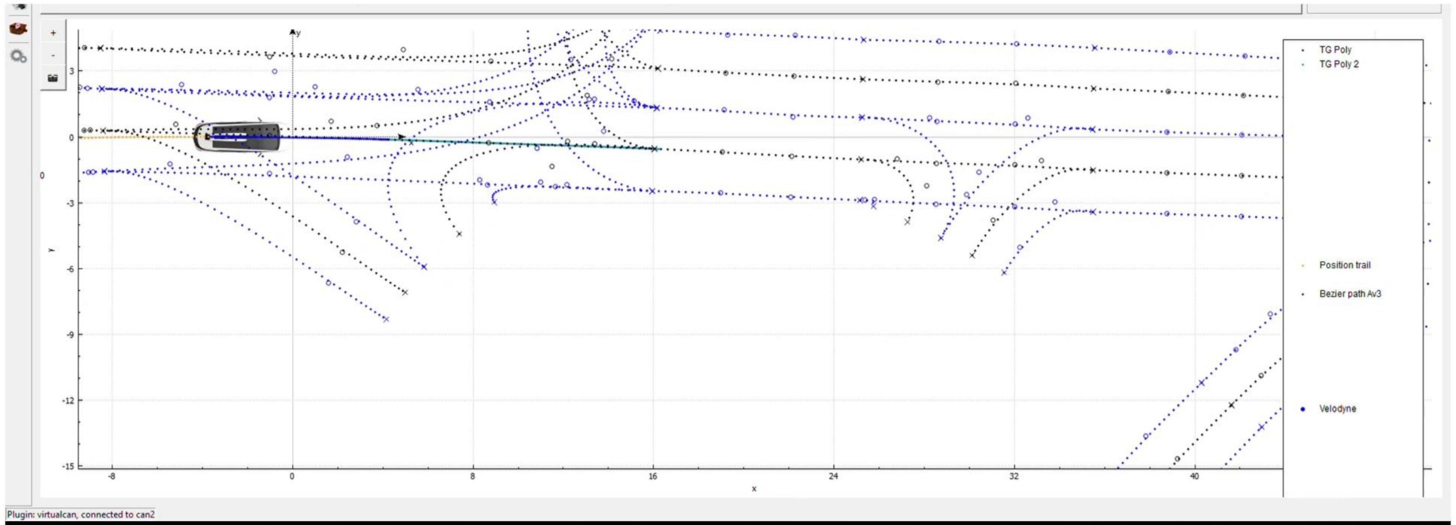

TG Poly
TG Poly 2
Position trail
Bezier path Av3
Velodyne
Plugin: virtualcan, connected to can2

Hi-Drive

V2X FOR HIGHWAY EXIT



- The ego vehicle needs to take an off-ramp to continue the route and reach its destination. However, the junction geometry is hardly difficult to be managed by the ego vehicle by its own.
- There is a radar installed at the roadside to monitor the environment that sends its data to a a RSU (Roadside Unit).
- Then, the ego vehicle shall be able to enhance the objects information detected with its own sensors with the information received via I2V so that it can handle the situation successfully.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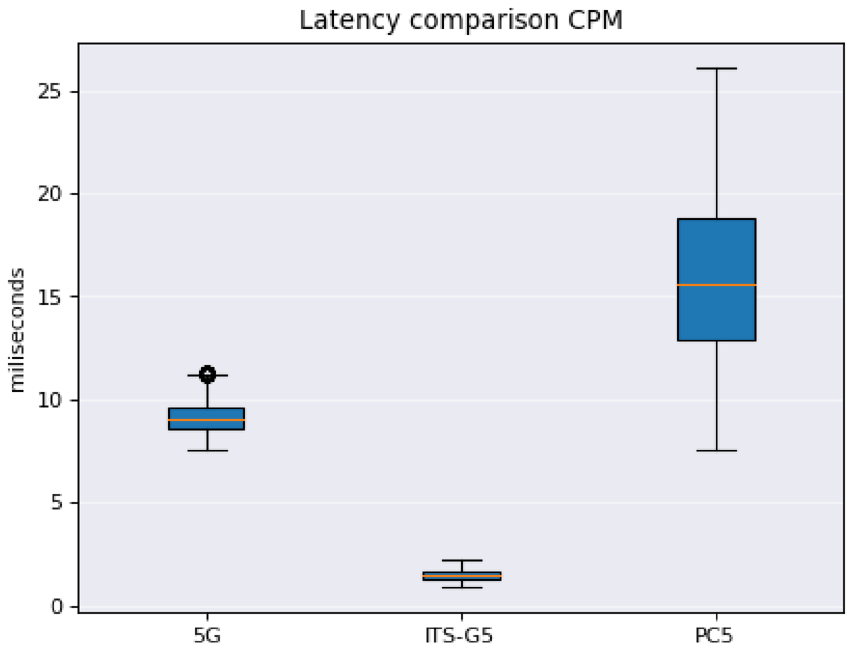
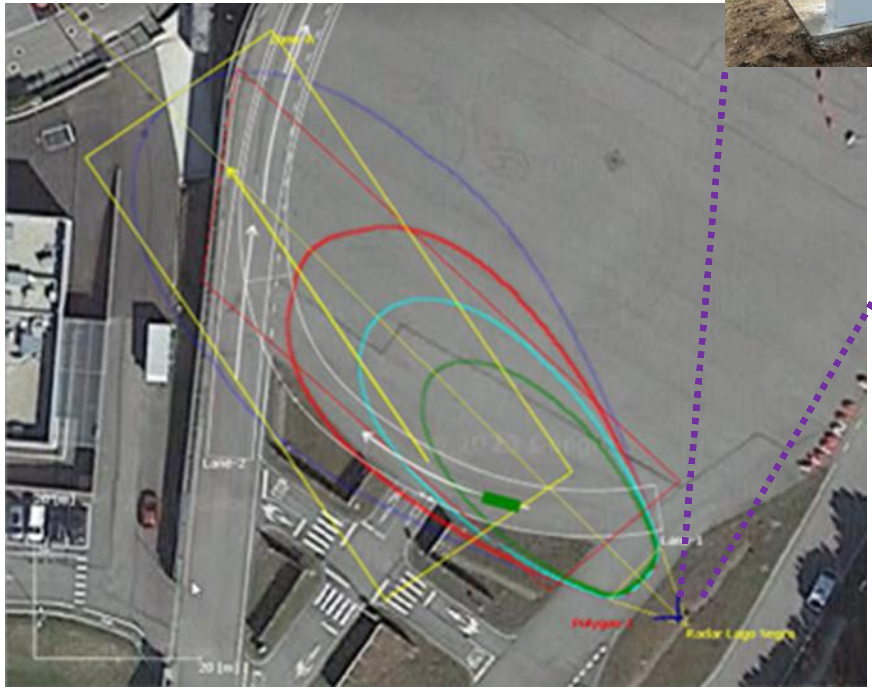
V2X FOR HIGHWAY EXIT



Technology	Mean	Confidence 95%
5G	9.15 ms	(9.10, 9.11)
ITS-G5	1.38 ms	(1.37, 1.39)
PC5	16.19 ms	(15.91, 15.47)

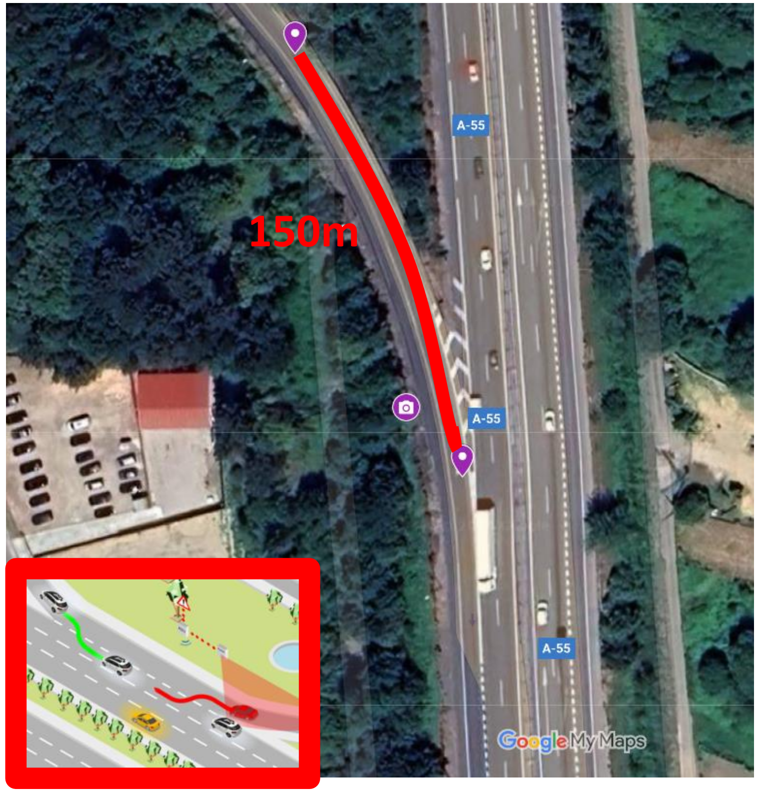


OPERATIONS IN OPEN ROAD

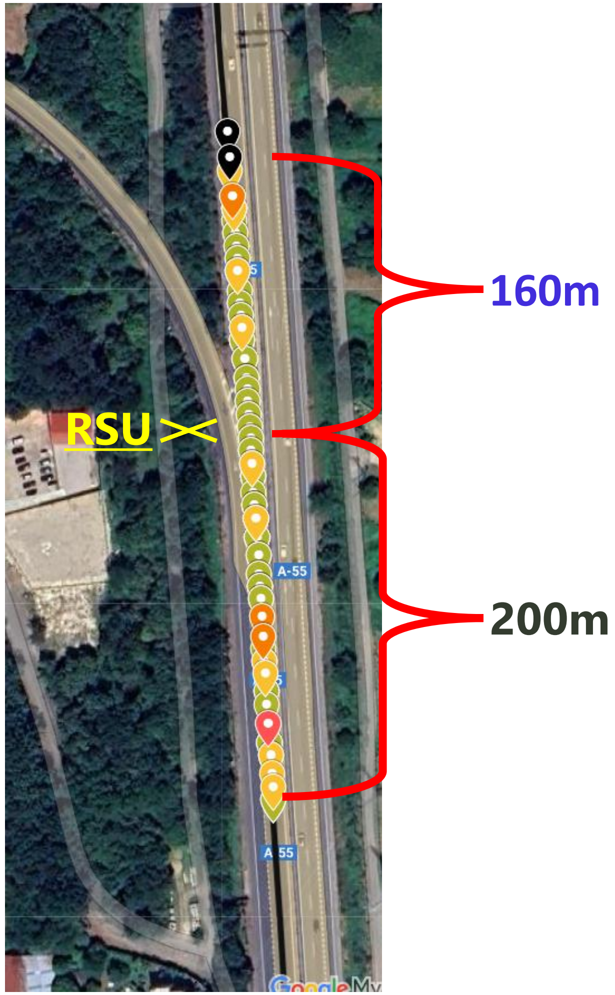
Hi-Drive

EXAMPLE V2X FOR HIGHWAY EXIT/ENTRY

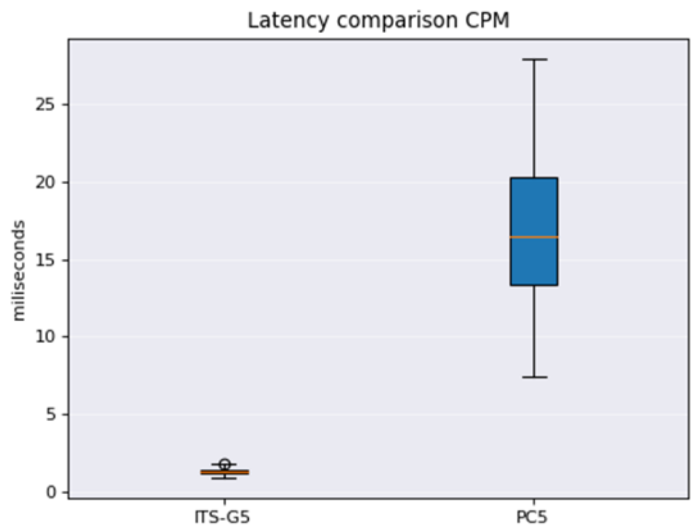
RADAR COVERAGE

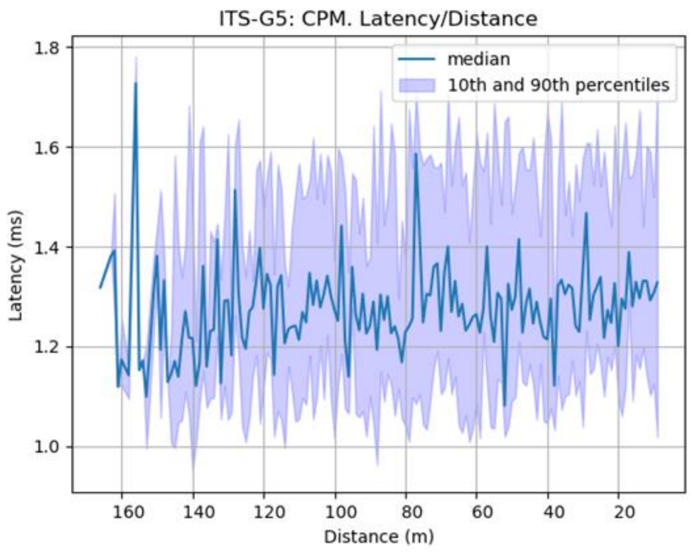


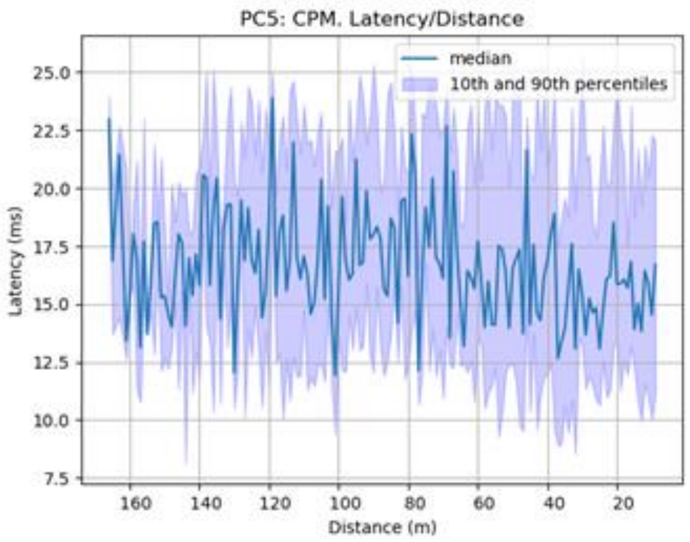
V2X COVERAGE



EXAMPLE V2X FOR HIGHWAY EXIT/ENTRY







technology	mean	min	max	confidence 95%
ITS-G5	1.30 ms	0.90 ms	1.81 ms	(1.29 ms, 1.31 ms)
PC5	16.83 ms	7.39 ms	27.92 ms	(16.61 ms, 17.05 ms)

The V2X information was received 160 meters in advance
At 100km/h → 5,8s in advance!!!

Hi-Drive

03

Conclusions

Conclusiones

- La movilidad evoluciona hacia la **conectividad**, **electrificación**, **automatización** y hacia el **transporte multimodal**.
- **Desarrollo seguro** y **progresivo** de los diferentes niveles de automatización.
- **Nuevas oportunidades** y **nuevos medios de transporte** que enriquecerán y ampliarán el portafolio de soluciones de movilidad.
- **Retos:** Tecnológicos, legislativos y sociales.
- La **Cooperación** entre diferentes **actores** y **sectores** es imprescindible.

Muchas gracias

- Francisco Sánchez Pons -

CTAG