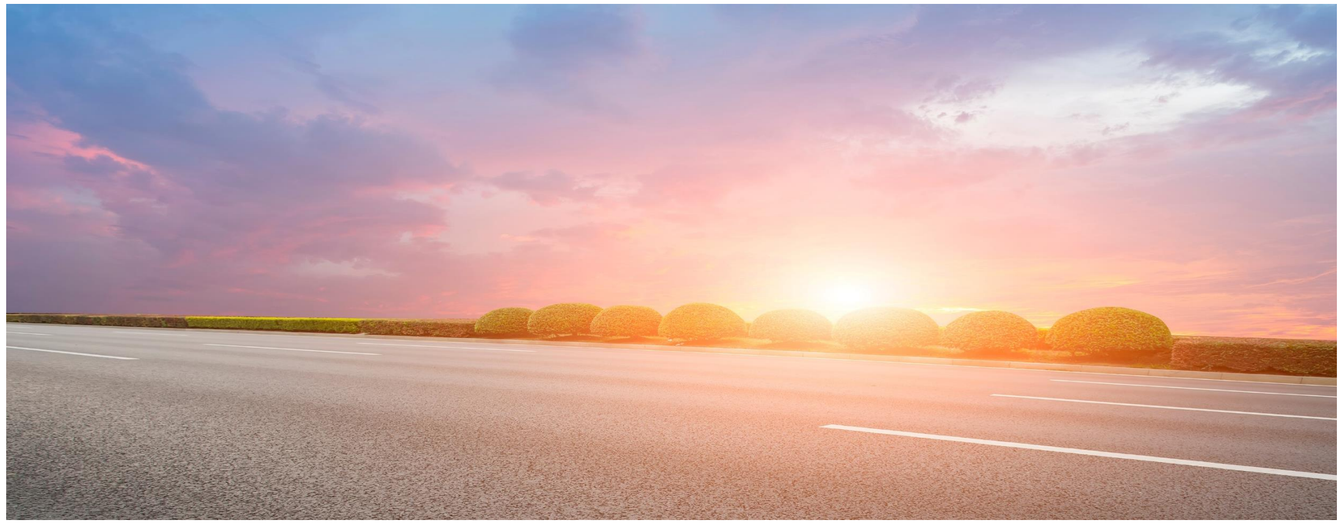
5GMED

Future mobility in the Mediterranean

Cross-Border Corridor

autopistas
an Abertis company

Index



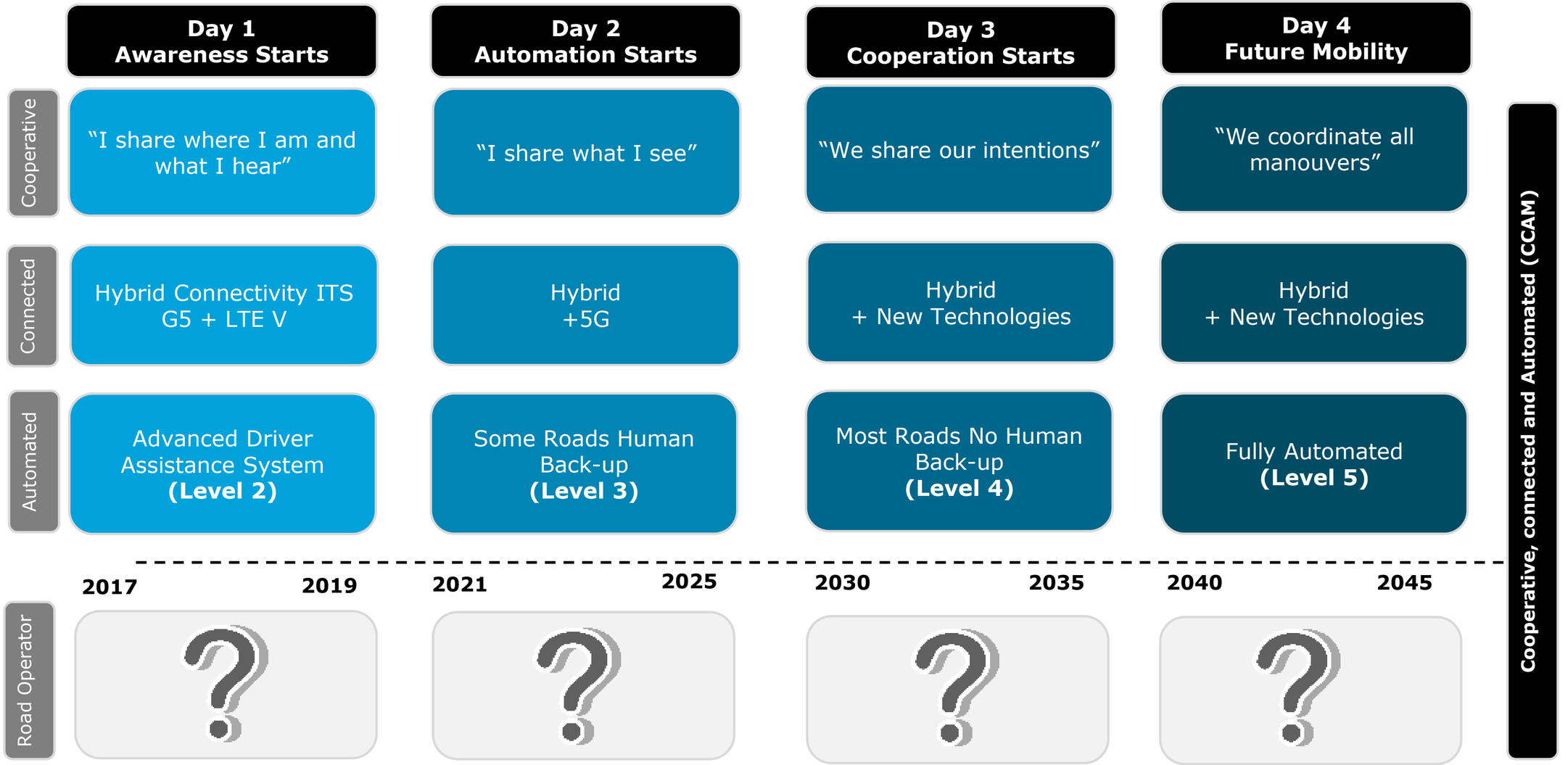
Introduction

What will be the role of infrastructure in connected cars & autonomous driving?

Today **Tomorrow**

- The full automated future is still far. We will see a **long transition period** where all types of vehicles coexist in different proportions (conventional, connected and autonomous).
- In this long period of **mixed traffic** the infrastructure plays a crucial role.
- The infrastructure **needs to be digitalized** to support **CV/AV**. The TMC needs to guarantee a secure and smooth travel for all users
- Road network classification systems

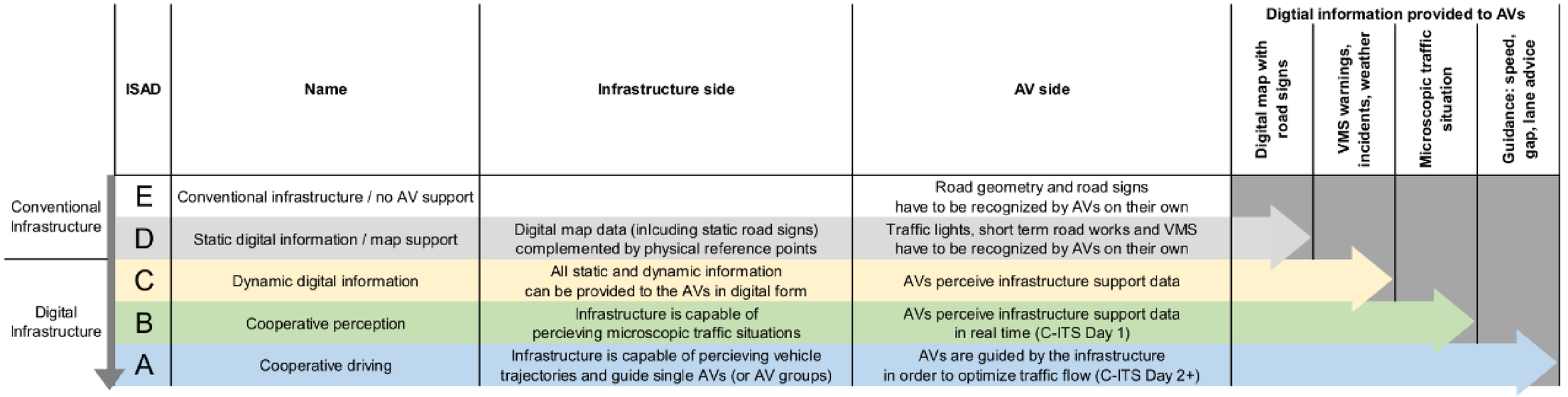
Introduction



Source: DG MOVE Directorate-General for Mobility and Transport - EU

Introduction

ISAD: Infrastructure Support levels for Automated Driving (ISAD)



	ISAD	Name	Infrastructure side	AV side	Digtial information provided to AVs: Digital map with road signs	Digtial information provided to AVs: VMS warnings, incidents, weather	Digtial information provided to AVs: Microscopic traffic situation	Digtial information provided to AVs: Guidance: speed, gap, lane advice
Conventional Infrastructure	E	Conventional infrastructure / no AV support		Road geometry and road signs have to be recognized by AVs on their own				
	D	Static digital information / map support	Digital map data (inlcuding static road signs) complemented by physical reference points	Traffic lights, short term road works and VMS have to be recognized by AVs on their own				
Digital Infrastructure	C	Dynamic digital information	All static and dynamic information can be provided to the AVs in digital form	AVs perceive infrastructure support data				
	B	Cooperative perception	Infrastructure is capable of percieving microscopic traffic situations	AVs perceive infrastructure support data in real time (C-ITS Day 1)				
	A	Cooperative driving	Infrastructure is capable of percieving vehicle trajectories and guide single AVs (or AV groups)	AVs are guided by the infrastructure in order to optimize traffic flow (C-ITS Day 2+)				

https://www.inframix.eu/wp-content/uploads/D5.4-Infrastructure-Classification-Scheme.pdf

Introduction

5G-MOBIX

- **Vigo - Porto (Spain-Portugal Corridor)**
- **Kipoi - Ipsala (Greece-Turkey Corridor) Hard borders**
- Berlin and Stuttgart *(German)*
- Espoo *(Finland)*
- Paris *(France)*
- Eindhoven-Helmond *(Netherland)*
- **China Test Site: Jinan*
- **South Korea Test Site: Yeonggwang*

5GMED

- **65 km, with 35 km of shared infrastructure road / train. Corridor E-15 Figueres – Perpignan**
- Castellolí Track *(Spain)*
- TEQMO Centre, Paris *(France)*

5G CARMEN

- **Corridor Germany-Austria-Italy**
- Trento *(Italy)*
- Munich *(Germany)*
- Brenner Pass *(Italy-Austria)*
- Kufstein *(Austria-Germany)*

5GCroCo

- **Corridor France-Germany-Luxembourg**
- Barcelona *(Spain)*
- Monthléry *(France)*
- Munich *(Germany)*
- A9 5G-ConnectedMobility Testbed *(Germany)*
- AstaZero *(Sweden)*

5G-Blueprint

- **5G cross-border in waterways and high-ways between Belgium and The Netherlands**

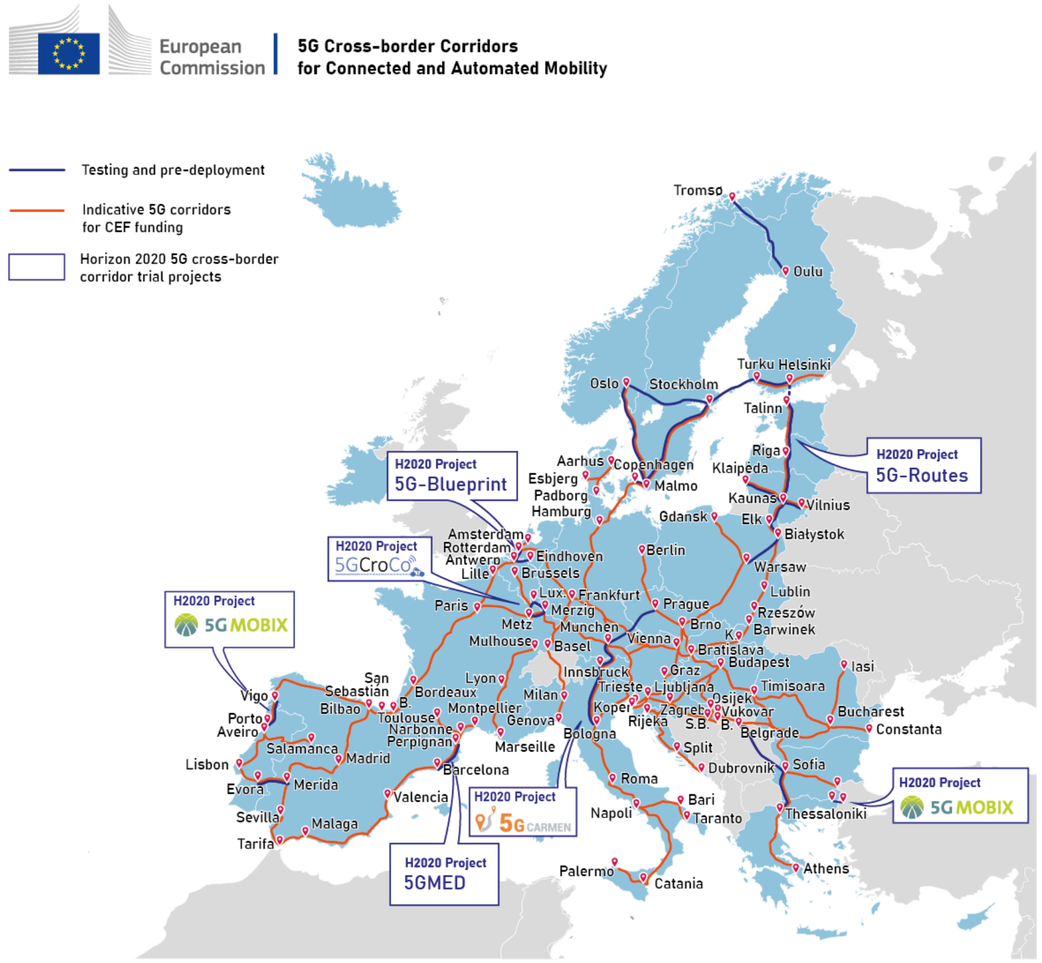
5G-ROUTES

- **5G cross-border Via Baltica-North corridor:**
  - Latvia - Estonia
  - Estonia - Finland

VITAL-5G

- Port of Galati *(Romania)*
- Port of Antwerp *(Belgium)*
- Port warehouse/logistics hub of Athens *(Greece)*

[5GPPP_TRIALS-AND-PILOTS-FOR-CONNECTED-AND-AUTOMATED-MOBILITY_C-V2X_brochure_Final.pdf (5g-ppp.eu)]



autopistas
an Abertis company

Introduction

5GMed will demonstrate advanced Cooperative Connected and Automated Mobility **(CCAM)** and Future Railway Mobile Communications System services **(FRMCS)** along the "Figueres – Perpignan" cross-border corridor between Spain and France.

Enabled by a multi-stakeholder compute and network infrastructure deployed by MNOs, neutral hosts, and road and rail operators, based on 5G and offering support for AI functions.

The consortium coordinated by Cellnex Telecom includes **21 partners** from 7 countries:

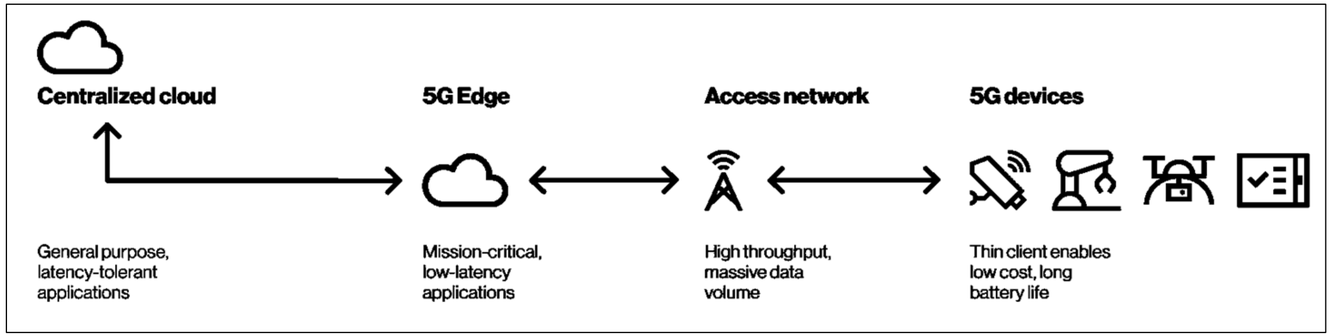
- Telecom Sector
- Transport and Mobility Sector
- Solution providers
- Consulting services providers
- Research institutions
- Outreach boosting organization

Total cost: 15.717.822 €

5GMed: accelerating 5G deployment

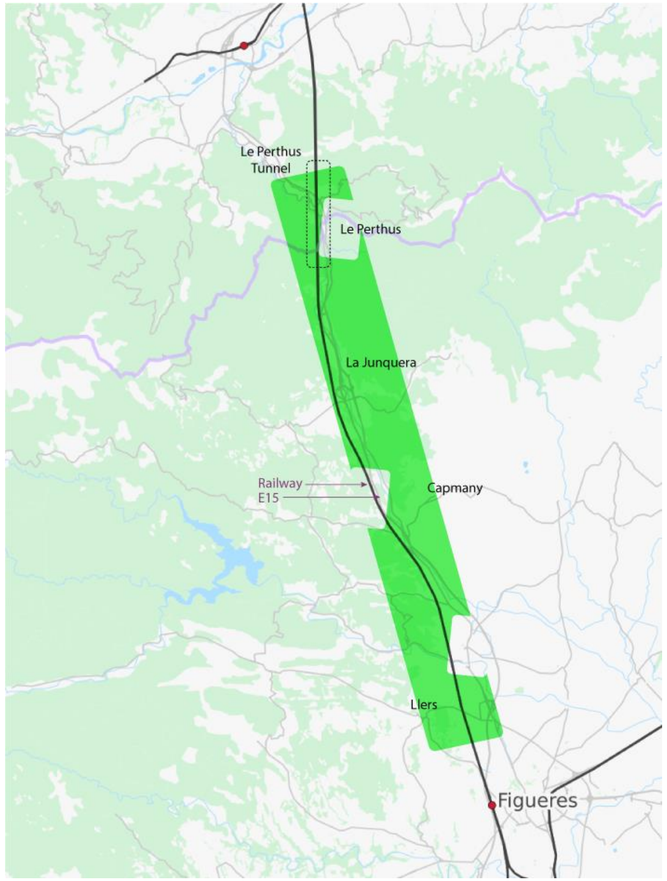
The project value proposition responds to everything required to make things happen:

- Overarching **5G architecture** perfectly suited to accommodate roadways and railways requirements.
- **Synergic joint 5G deployments for roadways and railways**, so that infrastructure could be shared and operations optimised.
- **Seamless MEC/EDGE and AI** embedded deployment, perfectly integrated by a **dynamic orchestration**
- A **multi-stakeholder** environment based upon **openly combining multiple technologies**
- Hybrid **multi-stakeholder** business models aimed at **reducing/optimising** the required **investments**.
- 5G **smart energy self-sustainable nodes**, including energy harvesting and dynamic energy management.
- Enabling 5G to support **CCAM** and the evolution to **FRMCS.**
- Embedded advanced network functionalities, such as **high-precision positioning-as-a-service.**



Mediterranean Corridor

MNO Coverage between Figueres and La Jorquera



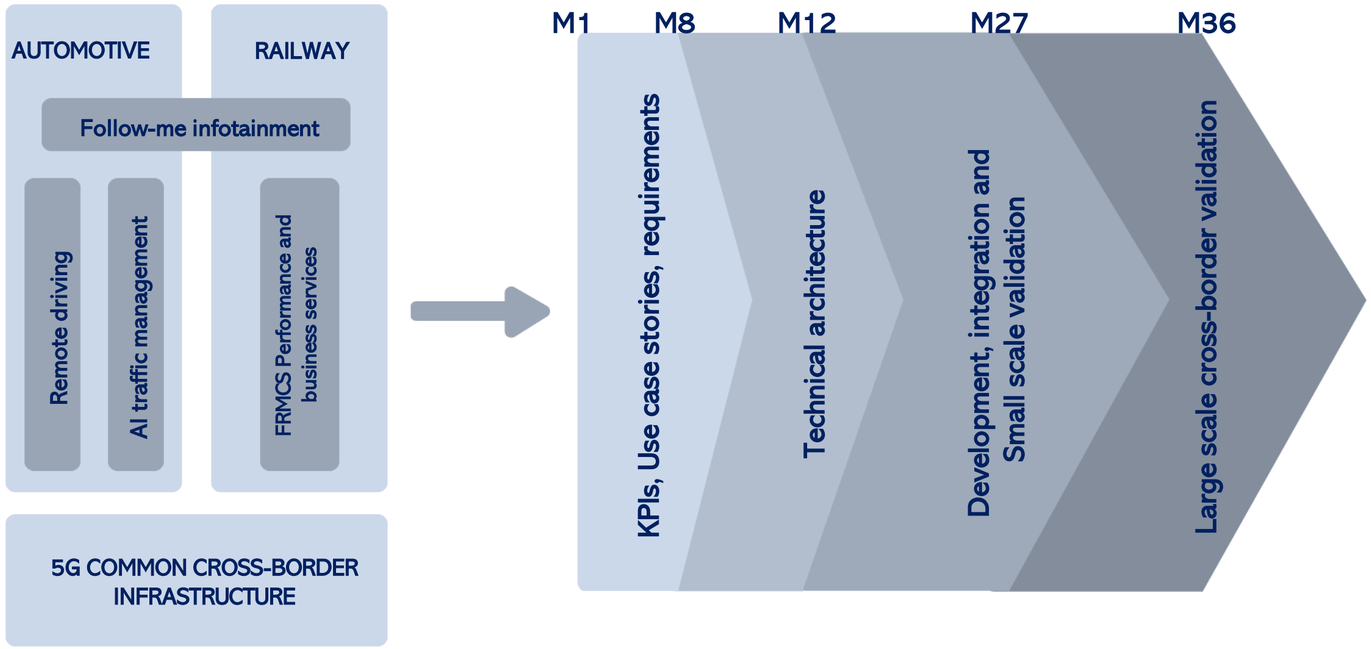
Preliminary coverage analysis at 3.5 GHz

Cross-Border corridor description

- Border between Spain and France:
  - 65 km between Perpignan and Figueras
- Value proposition:
  - High-speed rail track + highway run very
  - close to each other = deploy a single
  - multi-stakeholder infrastructure
- Two different scenarios:
  - **Spain:** Single MNO + Sidelink.
  - **France:** IaaS model for MNO & PaaS for other stakeholders.

Methodology

- Cross-operator service orchestration
- Innovations in multi-connectivity supporting high-speed vehicles and trains
- Self-sustainable 5G access network infrastructure that can be deployed when power and backhauling resources are scarce
- Enhancements to speed up roaming transitions across MNOs and neutral hosts
- Novel high-speed access network architectures for railways
- The ability to support AI enabled functions executing at the edge of the network

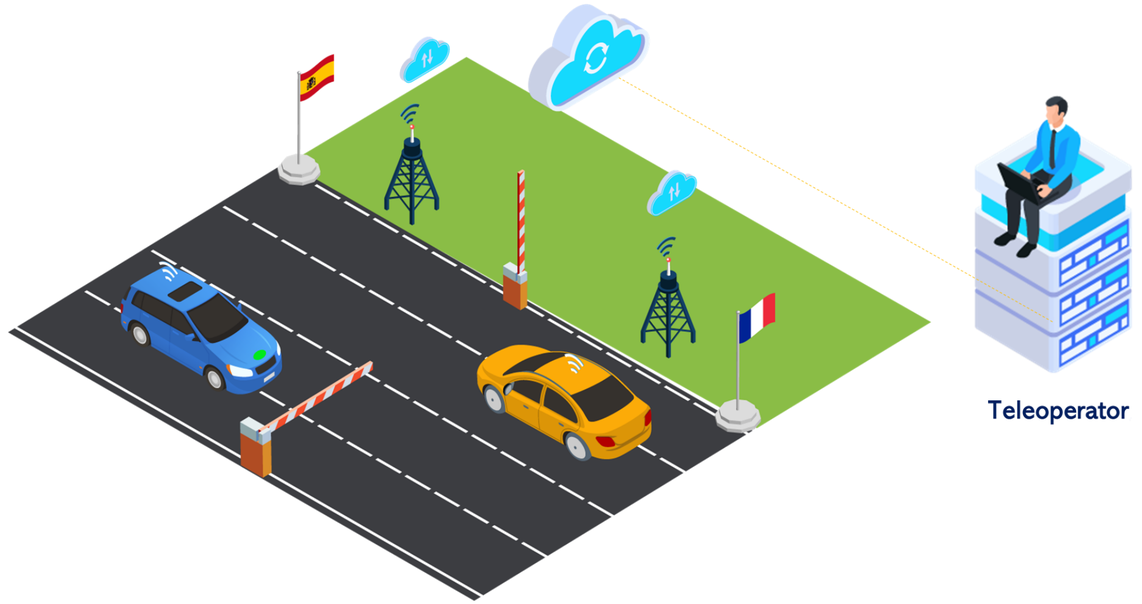


3 project phases:

- Analysis, Requirements & Design (1st year)
- Small-scale interactive development and test (2nd year)
- Large-scale deployment, 65 km pilot (3rd year)

Use Case 1: Remote Driving

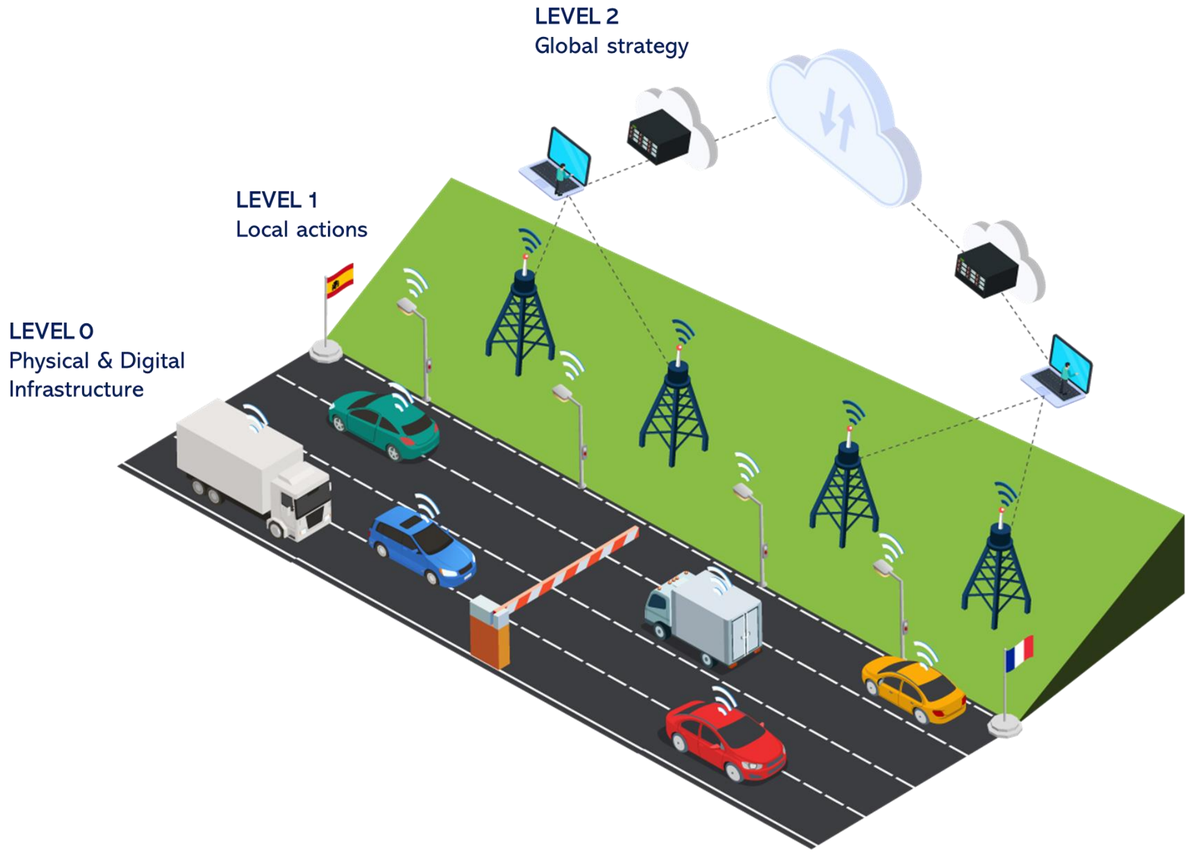
Automated driving on highways can be performed in full safety, even when a critical event occurs on the Automated Driving System (ADS) preventing the normal system operation beyond the homologated Operation Design Domain (ODD)



- The vehicle Valeo's Cruise4U will operate automatically in the highway crossing the boarder, a **teleoperator** will take the control of the vehicle from a remote location when a situation of danger happens using 5G.
- The Valeo vehicle can operate in automated modes SAE Level 3 and Level 4 on highways within its ODD (Operation Design Domain).

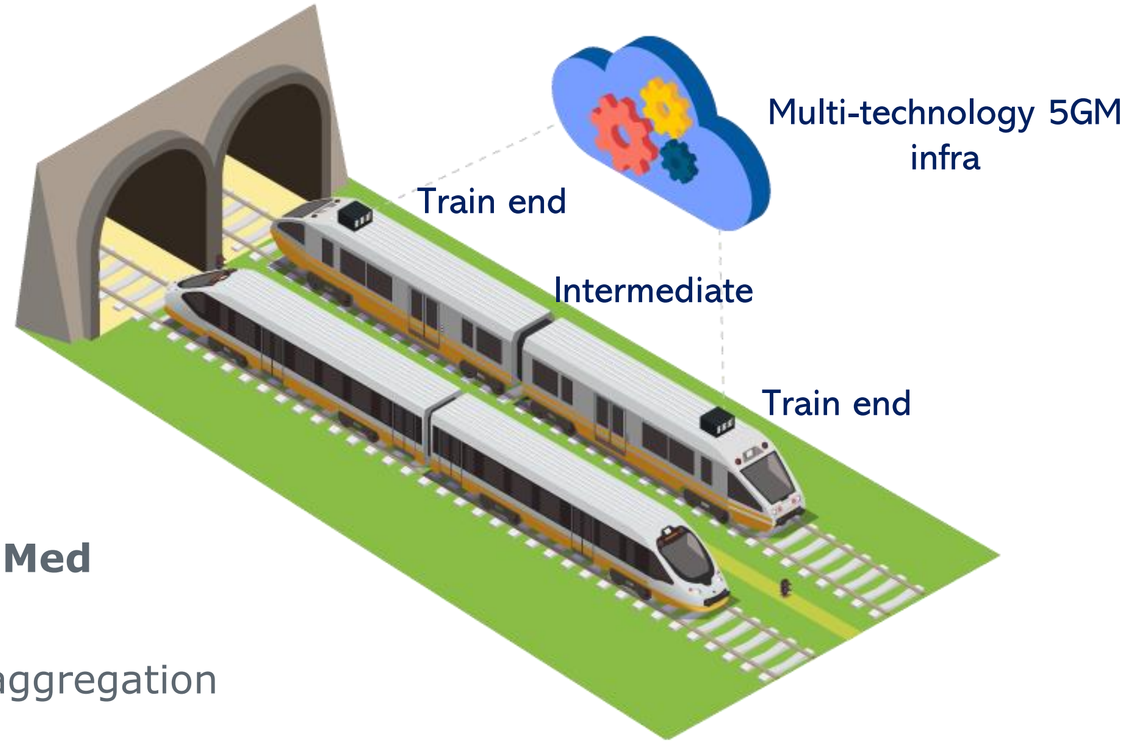
Case 2: Road infrastructure digitalization
for intelligent management of connected and automated vehicles mobility

- The road infrastructure will be digitised digitalisation for intelligent traffic management of the connected and automated vehicles
- Uninterrupted, safe, and efficient mobility will be ensured for mixed conventional and automated traffic.
- Bring road infrastructure closer to support levels for automated driving
- Infrastructure can guide groups of vehicles for traffic optimisation.



Case 3: Future Railway Mobile Communications
System services apps and business service continuity

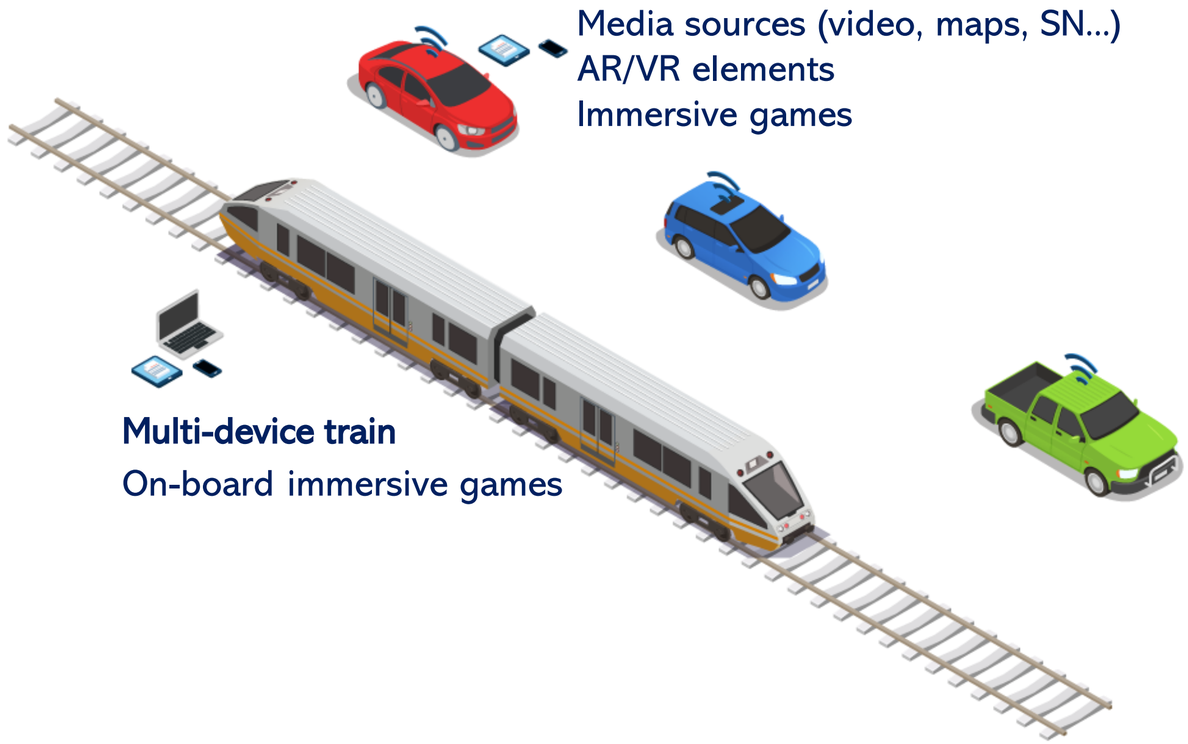
- Transition of a commercial train between ADIF in Spain and SNCF in France, advanced applications in cross-border situations.
- On-board media server will offer a seamless service continuity, coping with multiple media types, service QoS requirements, handover between service orchestrators, and edge network transitions.



- FRMCS **services in the train will be connected to the 5GMed infrastructure and satellite.**
- A bandwidth manager device will enable the transition and aggregation between the different available connections.

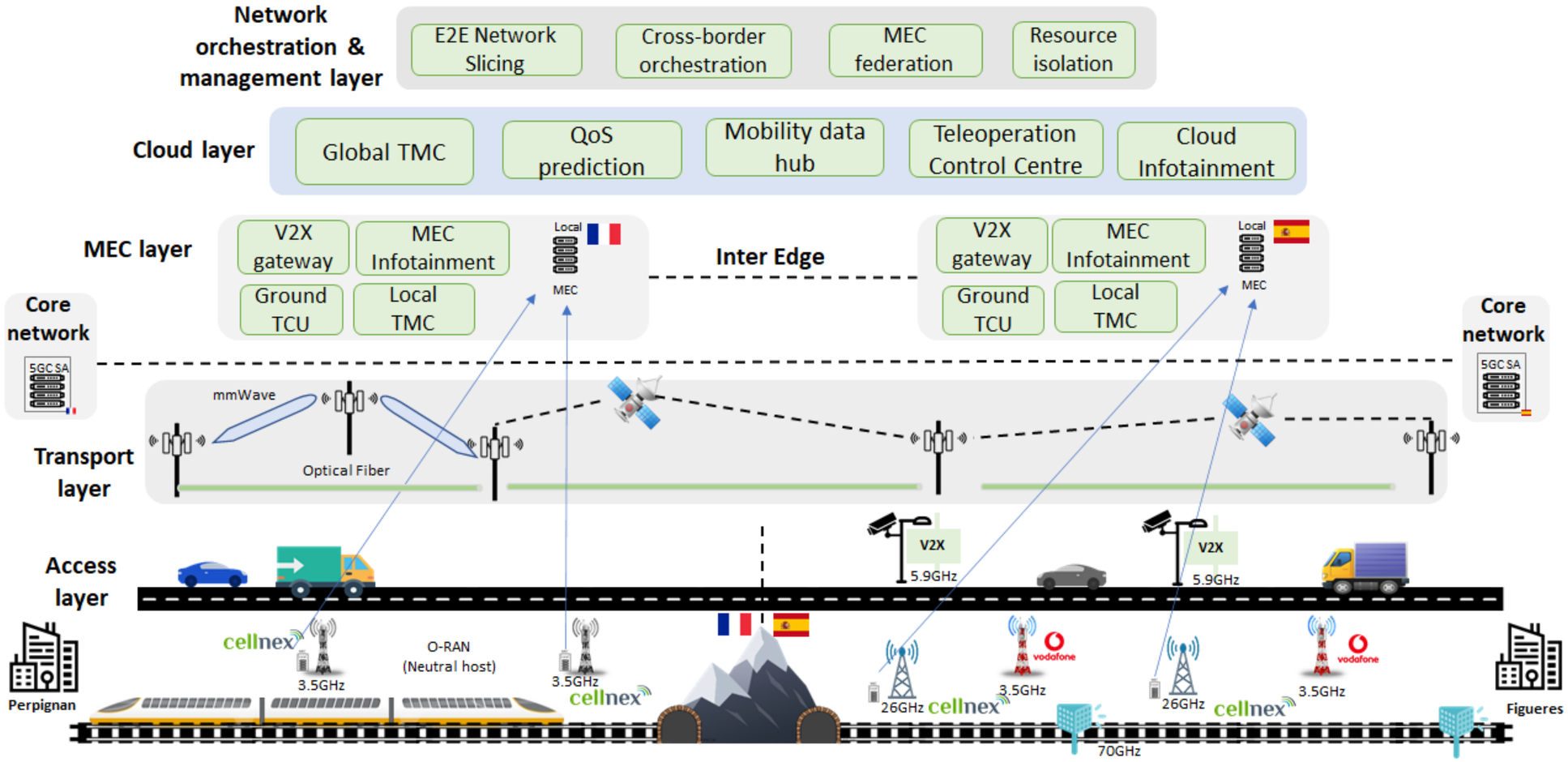
Use Case 4: Follow-ME Infotainment

- Virtual reality applications and enriched 3D map models providing autonomous car drivers more information regarding the surroundings and road conditions.
- On-board media server needs to offer a seamless service continuity (handover between service orchestrators, and edge network transitions)



Media modules will be integrated into the network edge node and enable enhanced content distribution strategies, where devices may share media with other car occupants or train passengers.

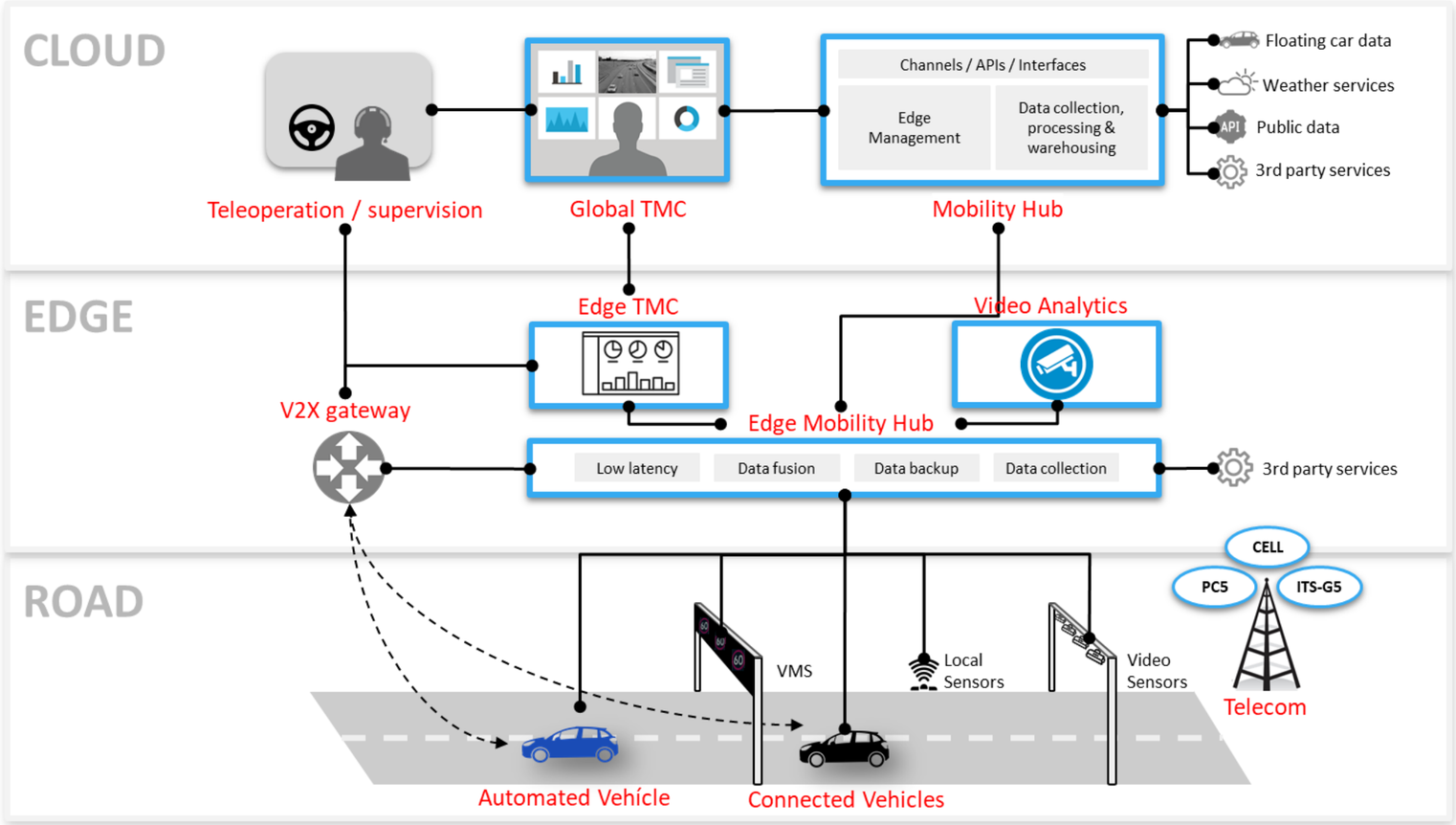
5GMED Architecture



autopistas
an Abertis company

Abertis Developments

- ROAD:
  - Digitalization (sensors, CV…)
- EDGE:
  - Edge mobility Hub
  - Specific Components (Local TMC, Video Analytics, Data Gateway, Data Repository),
- CLOUD:
  - Mobility Hub Platform
  - Specific Components (Global TMC, Data Gateway, Data Repository).



5GMED Opportunities

Abertis Developments

- Need to increase **5G infrastructure** density in the next years, for:
  - **New markets** (e.g., mobility, personal services and infotainment, IoT, health)
  - **Future new advanced services** (Liaison between usage models and business models)
- How to deploy 5G in interurban areas:
  - The **Hybrid solutions** are a clear opportunity for road operators (fiber optics, Sidelinks, 5G infrastructure as services). **optimizing investments-** The same solution in different countries (Neutral operator & road operators).
  - Some Europe countries plans to reserve **frequencies directly to industrial companies** would allow them to directly build their own private 5G networks for industrial automation without relying on telecom operators
  - Public-private partnerships can be a good solution to deploy 5G networks that are not yet cost-effective

- The highest impact of 5G is expected in key sectors such as **transport, health and manufacturing**, with a benefit exceeding **€500 billion** worldwide per year for 5G-enabled service providers.
- CCAM paradigm:
  - Is an important driving force justifying the need and importance of 5G in all transport roads (not just urban but in inter-urban).
  - Vehicles need reliable, radical and unnegotiable technical performances (high speed, minimum latency).
  - Guaranteed service continuity

autopistas
an Abertis company

Síguenos en:

@autopistas_ @infoautopista youtube.com/abertisautopistas autopistas

Descárgate la APP:

autopistas en ruta

Accede a:

autopistas.com

https://5gmed.eu/