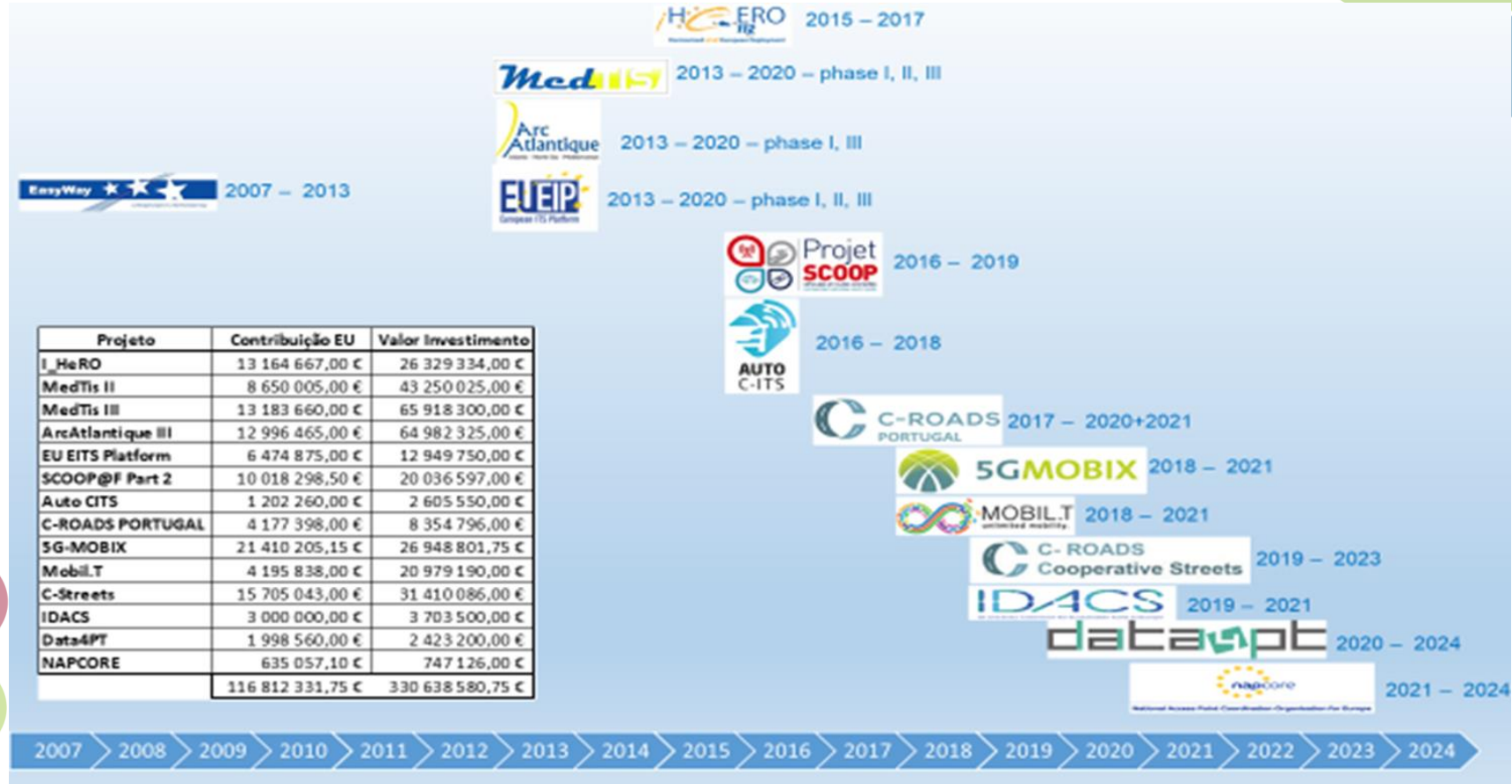




ITS – National framework

● Project Framework

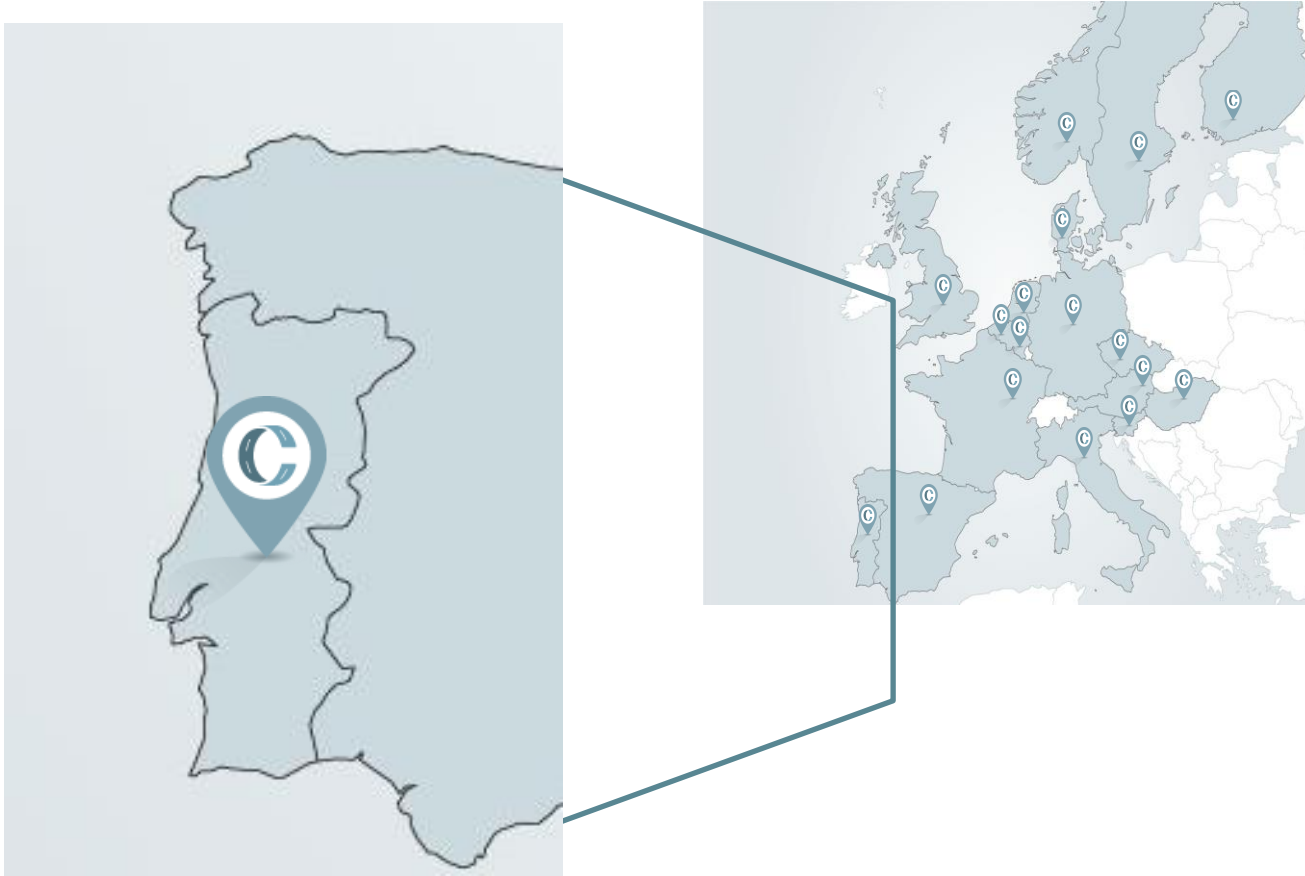


C-Roads Portugal – As part of the C- Family



2017 – Digital Transport Days - Tallin

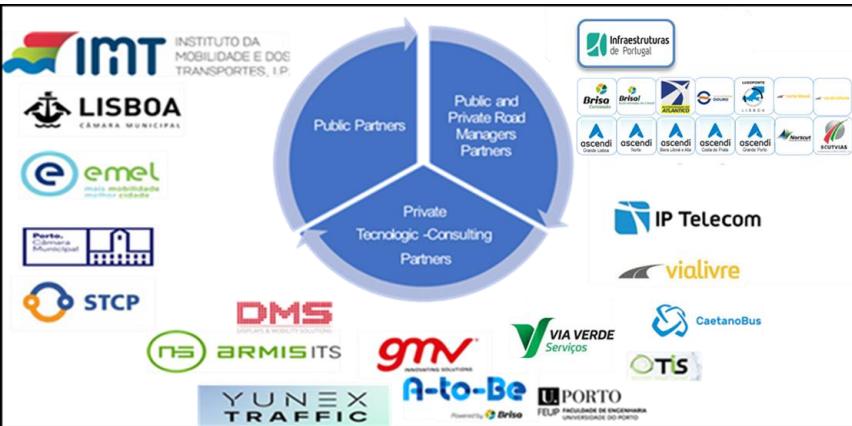
C-Roads Portugal – As part of the C- Family



C-Roads Portugal – The What and Why

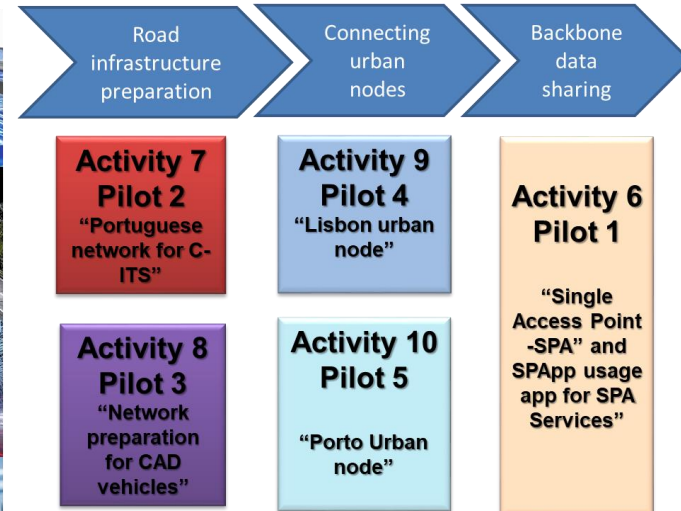
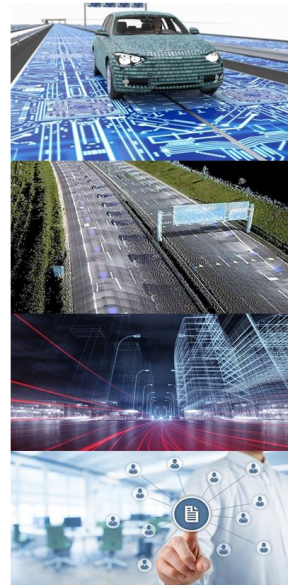
- C-Roads Portugal consists in the implementation of 5 ITS macro-pilots in the Atlantic Corridor in Portugal, covering several relevant sections of the road network and also the main urban nodes - Lisbon and Porto;
- Through the combination of these pilots, the project aims to develop a feasibility study for the large-scale national implementation of C-ITS services, namely models: long-term viability, cost-effectiveness, governance and business models;
- Framed by the existing general approach of the C-Roads platform.

C-Roads Portugal – The Overview



- 31 partners
- 2017-2022 (1 year extension)
- 8,4 M€ invest. / 50% co-financ.
- Execution rate > 90%

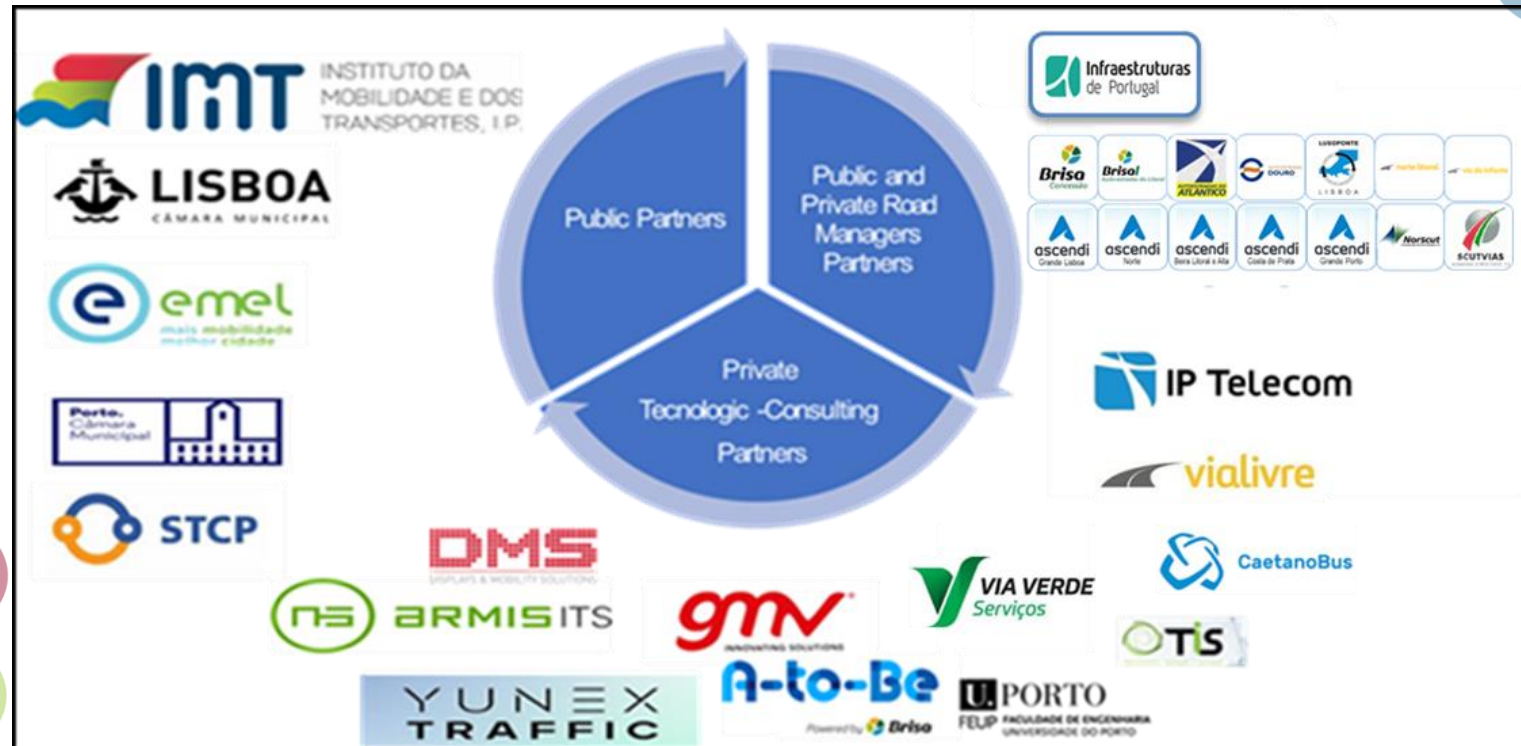
5 macro pilotos = 15 sub-pilotos específicos



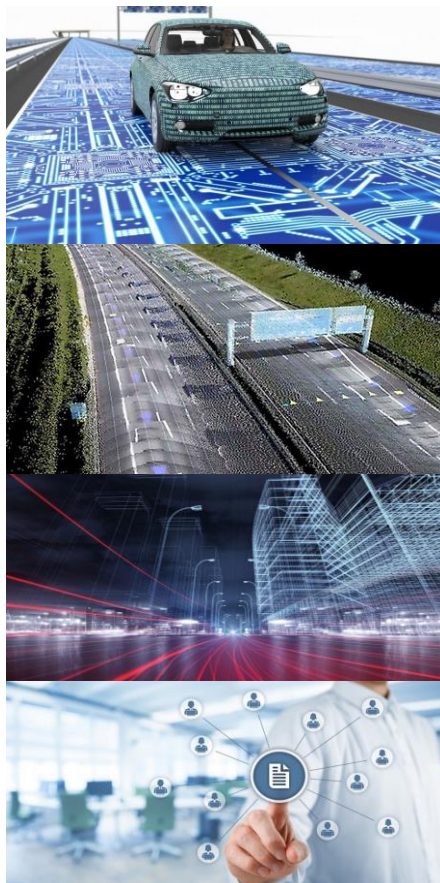
Co-financed by the Connecting Europe Facility of the European Union

C-Roads Portugal – The Partners

- 31 implementing entities >> demonstration of cooperation and collaboration at national level



C-Roads Portugal – The Pilots



3 dimensions | 5 macro pilots | 5 specific pilots



**Activity 7
Pilot 2**
“Portuguese network for C-ITS”

**Activity 9
Pilot 4**
“Lisbon urban node”

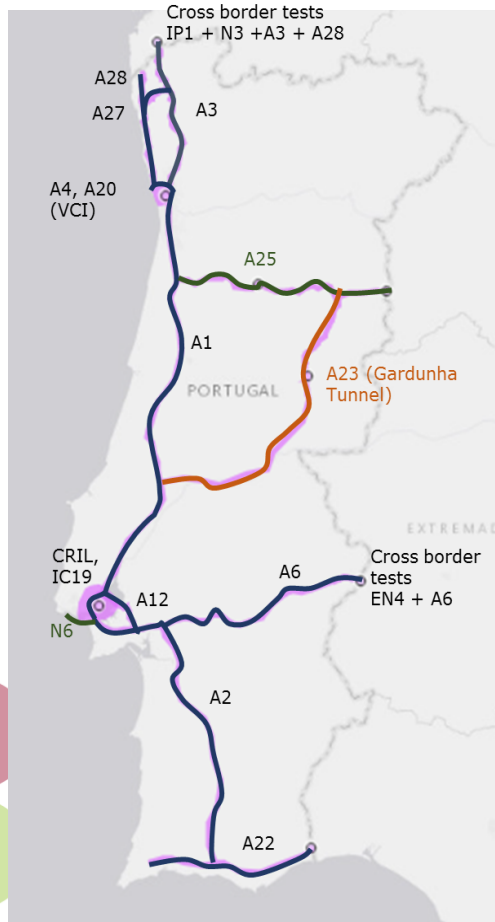
**Activity 6
Pilot 1**

“Single Access Point -SPA” and SPApp usage app for SPA Services”

**Activity 8
Pilot 3**
“Network preparation for CAD vehicles”

**Activity 10
Pilot 5**
“Porto Urban node”

Pilot 2: National C-ITS Network



Pilot case: Portuguese network for C-ITS

Demonstration of C-ITS services in core and comprehensive network (including entrances in urban nodes)

- A1 – 30 km
- A2 – 30 km
- A3 – 40 km
- A4 – 30 km
- A20 - VCI (Porto node circular) – 11 km
- CRIL (Lisboa node circular) – 19 km
- IC19 (Lisboa node circular) – 17 km
- A6 – 20 km
- A12 – 20 km
- A22 – 90 km
- A27 – 24,7 km
- A28 – 88,6 km

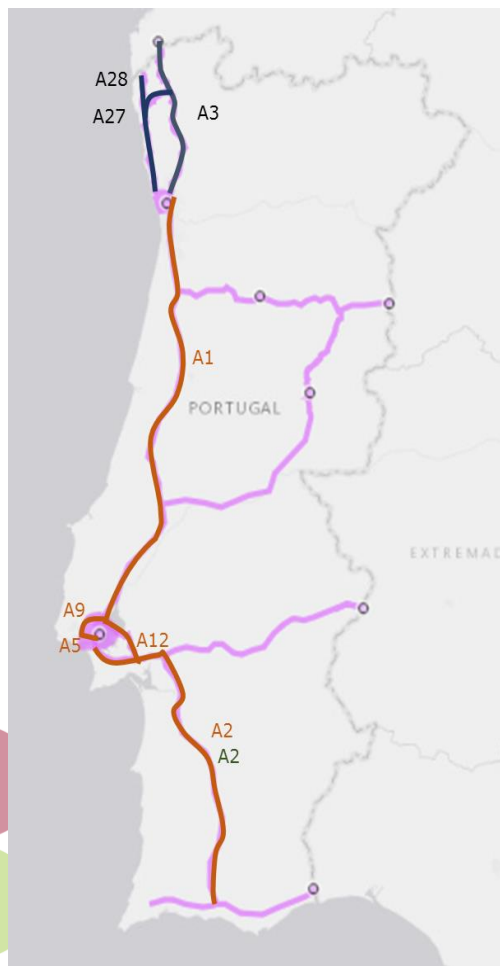
In-vehicle app to connect C-ITS server in TEN-T network and urban nodes connections

- A25 – 8 km (Viseu)
- N6 (Lisboa entrance) – 20 km

Development of C-ITS services in tunnels

- A23 – 20 km Gardunha Tunnel

Pilot 3: Preparation for CCAM



Pilot case: Network Preparation for Connected and Autonomous Vehicles

Connected and autonomous vehicles in open roads

- A3 – 40 km
- A27 – 24,7 km
- A28 – 88,6 km

A2 the Holiday motorway

- A2 – 240 km

Connected vehicles for advanced services

- A1 – 66 km
- A2 – 54 km
- A5 (urban access) – 25 km
- A9 (urban access) – 35 km
- A12 – 24 km

Pilot 4: Lisbon Urban Node



Pilot case: C-ITS Pilot in the Lisbon Urban Node

Traffic service level monitoring and travel time prediction in Lisboa node

- A36 (2ª circular) – 10,5 km

Parking availability system in Lisboa node

- Lisboa central axis (Entrecampos – Marquês) – 2,7 km

In-vehicle app to connect C-ITS server in Lisboa node

- A36 (2ª circular) – 9,8 km

Signal corridors and bus corridors prioritization in Lisboa node

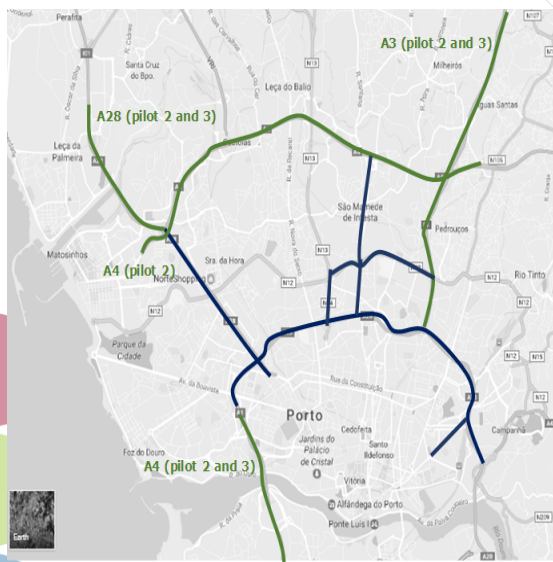
- Lisboa central axis (Campo Grande – Marquês) – 4,1 km

Mobility Hub in Lisboa node

- A2 (urban access) – 40 km
- A5 (urban access) – 15 km
- A9 (urban access) – 35 km



Pilot 5: Porto Urban Node



C-ITS Pilot in the Porto Urban Node

Traffic service level monitoring in real time and 2-hour travel time prediction in the Porto node

- 5,9 km (central area)
- A28 – 6 km
- A20 – 17 km
- N14 – 5,2 km

V2I and I2V integration of the CaetanoBUS vehicle with the infrastructure in Porto node

- 1,4 km (central area)

Demonstration of C-ITS services in Porto node (see pilot 2)

- A4 – 30 km
- A20 – VCI – 11 km

(Pilot activity A.3.2)

Pilot 1: Single Point of Access (SPA/NAP)



Pilot case : SPA and SPApp usage app for SPA Services

**Backbone data sharing
prototype**

To identify the technical and effort requirements to establish the NAP, both in terms of hardware and software, specifically requirements identification and analysis, the system modelling including the data interfaces according to the DATEXII model, the normalization of the data frames sent by each road operator and the “discovery/search and browse” functionality. We also aim at developing a prototype to validate the approach and analyse the different required functionalities

SPApp usage app

Test the potentialities of a mapping system that aims to demonstrate de use case scenarios based in Google’s Maps, helping uses to connect then self’s to the connected roads understand their surroundings and path. The system will compile transportation data from the nodes provided by the SPA prototype to be used by a consumer-facing app, serving as a travel companion beyond the driver and the infrastructure. The app will offer real-time traffic updates, display upcoming road hazards, provide the locations of events.

Pilot 1: Single Point of Access (SPA/NAP)



HomeSearch InformationMembersAboutSearch Multimodal

?

EN

Register/Login



Welcome to National Road Information Access Point

ACTIVE ROAD SUPPLIERS
15

PROCESSED DATA
18,2 M

USERS
140

MULTIMODAL RECORDS
114

About NAP

Within the scope of [Directive 2010/40/EU \(ITS Directive\)](#), of the European Parliament and of the Council and the various Delegated Regulations (Actions):

- [Delegated Regulation 1926/2017 \(31.MAY.2017\)](#) – concerning the



Pilot 1: Single Point of Access (SPA/NAP)

The screenshot displays the NAP (Single Point of Access) web application interface. The main map shows Portugal with various regions labeled (GALICIA, CASTILE AND LEÓN, MADRID, EXTREMADURA, CASTILE-LA MANCHA, ANDALUSIA, CIBRALTAR). The map is populated with numerous orange and blue dots representing incidents. A sidebar on the left contains filters for Realtime Information, Road Safety, and Parking. The right sidebar shows search results for various suppliers, including Infraestruturas de Portugal, Brisa, Scutvias, Lusoponte, and Norscut.

Realtime Information

- ☒ Accidents
- ☒ Roadworks
- ☒ Traffic information
- ☒ Traffic data
- ☐ Other incidents

Road Safety

- ☐ Temporary slippery road
- ☒ Animal, people, obstacles, debris on the road
- ☐ Exceptional weather conditions
- ☐ Unprotected accident area
- ☐ Short-term roadworks
- ☐ Reduced visibility
- ☐ Wrong-way driver
- ☐ Unmanaged blockage of a road

Parking

- ☐ Registration of available parks
- ☐ Parking availability
- ☐ Available services

Multimodal Information

Search Results

Supplier: [Dropdown] Clear

Infraestruturas de Portugal

Roadworks **1**

Brisa

Roadworks **39**

Traffic information **5**

Accidents **1**

Animal, people, obstacles, debris on the road **16**

Scutvias

Roadworks **3**

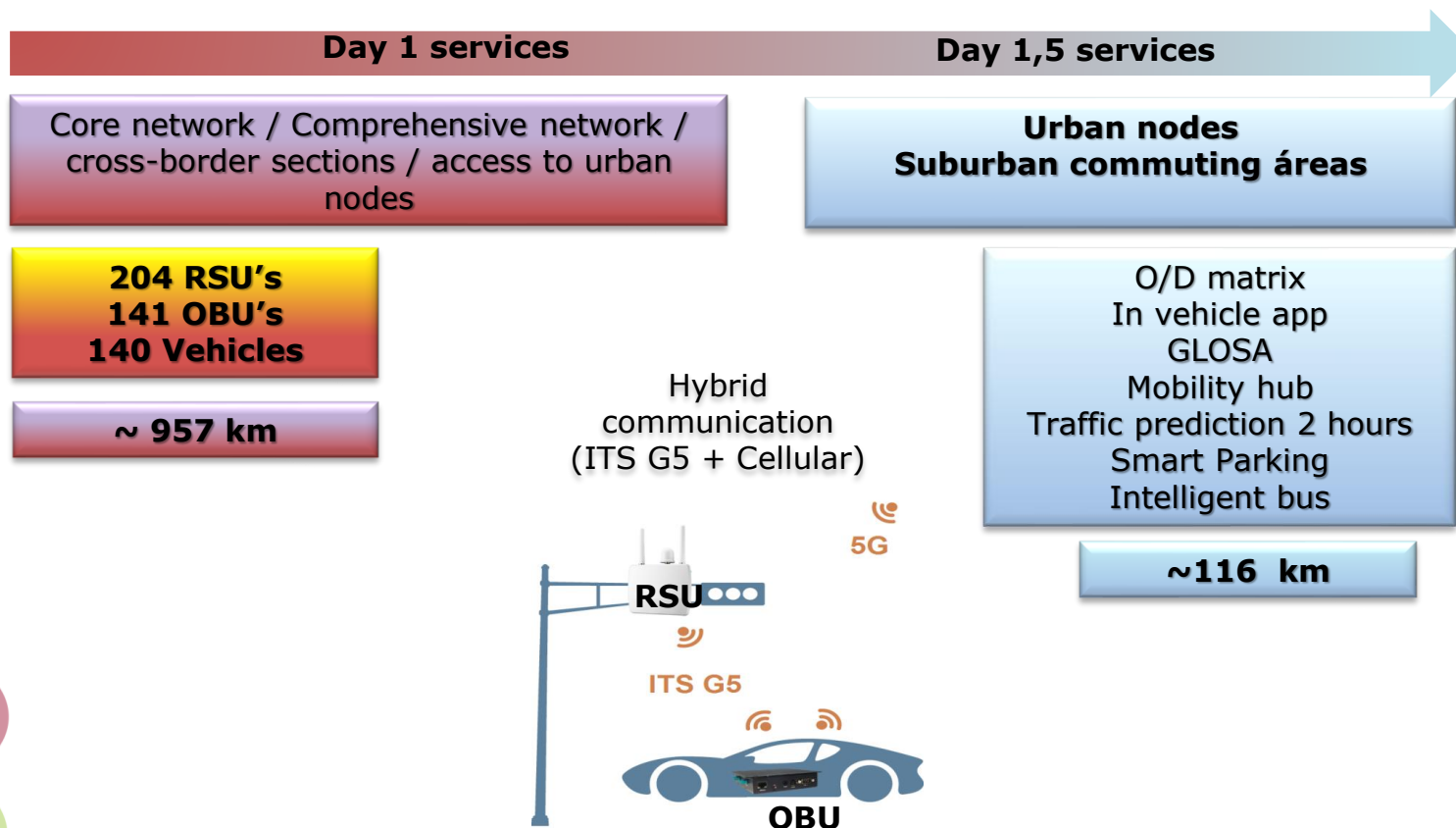
Lusoponte

Roadworks **3**

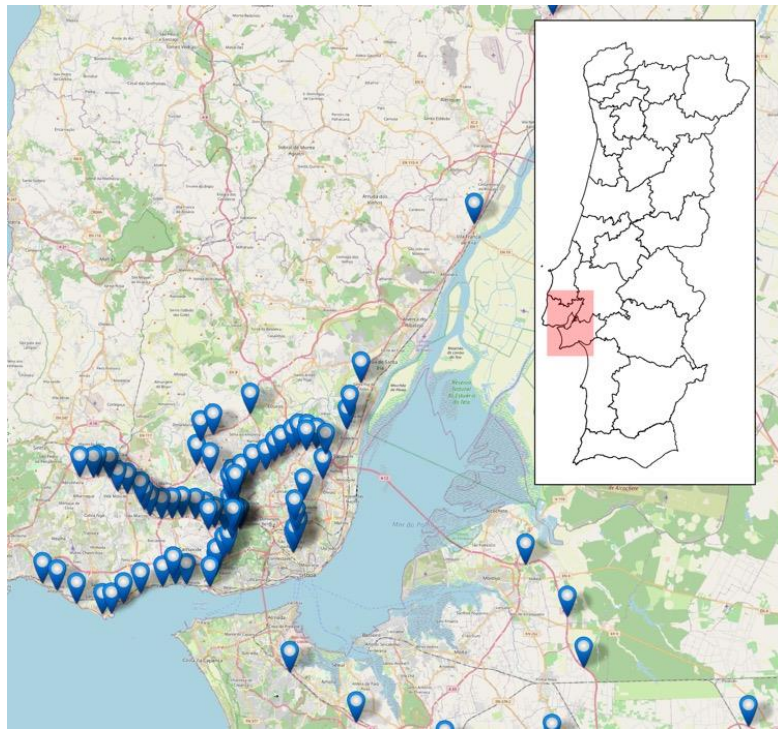
Norscut

Traffic data **54**

C-Roads Portugal – The Deployment KPI's



C-Roads Portugal – The RSU's map

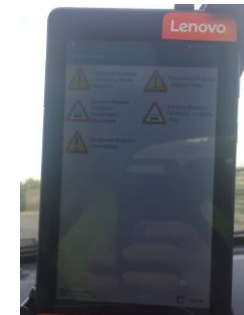
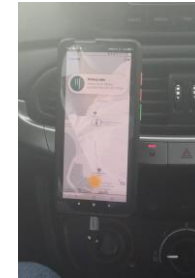
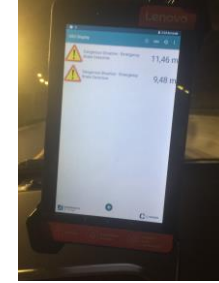


C-Roads Portugal – @ European RSU's map

<https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/map/maps.html>

The screenshot displays the TENTec Interactive Map Viewer interface. At the top, the European Commission logo is on the left, and the text "MOBILITY AND TRANSPORT TENTec Interactive Map Viewer" is on the right. Below this is a navigation bar with four tabs: "Corridors", "Layers", "Backgrounds", and "Legend". The "Corridors" tab is active, showing a list of corridor types on the left and a map of Europe on the right. The list includes: "Commission Proposal 2021 (COM(2021)812) / 2022(COM(2022)384)", "Comprehensive/Core Network" (marked with a '1'), "Projects/Actions", "Alternative Fuels", "AFIF Eligibility Maps", "Safe & secure parkings for trucks and commercial vehicles", "Border Crossing Points (BCPs)", "C-ITS stations" (checked), "Reception, Information, Transfer hubs", "Rail Freight Corridors", and "TEN-T Compliance Indicators". The map shows a dense network of red lines representing the Core Network across Europe, with various countries labeled. At the bottom left of the map area, there are two icons: a trash can and a list icon.

C-Roads Portugal – The real field deployments





Thank you!

ricardo.z.tiago@imt-ip.pt

C-ITS Projects

ITS European Congress 2023 - Lisbon

May 23, 2023

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Globalvia - A23 Beira Interior Concession



C-Roads Gardunha Tunnel Pilot



5GAuto Project



Resume

GLOBALVIA - A23 BEIRA INTERIOR CONCESSION

CONCESSION		INFRASTRUCTURE		EQUIPMENTS		Via	Tun.
Location	Portugal Abrantes – Guarda	Interchanges	27	Variable Message Panels	21 +	8	
Extension	177,5 Km	Services Areas	5	Surveillance cameras	27 +	10	
Duration of Concession	1999 a 2032	Tunnels	4	Electronic Signalling		77	
Grantor	Portuguese State	Bridges	32	IAD Cameras		78	
Concession	Scutvias S.A. (a Globalvia Concession)	Structures	257	Traffic Countings	27		
		Maintenance depots	1 + 2	SOS	194 +	16	
		Traffic Control Center	1	environment sensors		52	
				Ventilators		31	
				UPS/ Generators		12	
				Toll Sites (Multilane free flow)	13		
WE ARE GLOBALVIA							

GLOBALVIA - A23 BEIRA INTERIOR CONCESSION

SPAIN

16 concessions
+ 1 high-speed rail

UNITED STATES

1 concession

PORTUGAL

2 concessions

IRELAND

3 concessions
+ Go-Ahead Group buses

COSTA RICA

1 concession

CHILE

5 concessions

UK

Go-Ahead Group rails and
buses

NORWAY

Go-Ahead Group rail
services

GERMANY

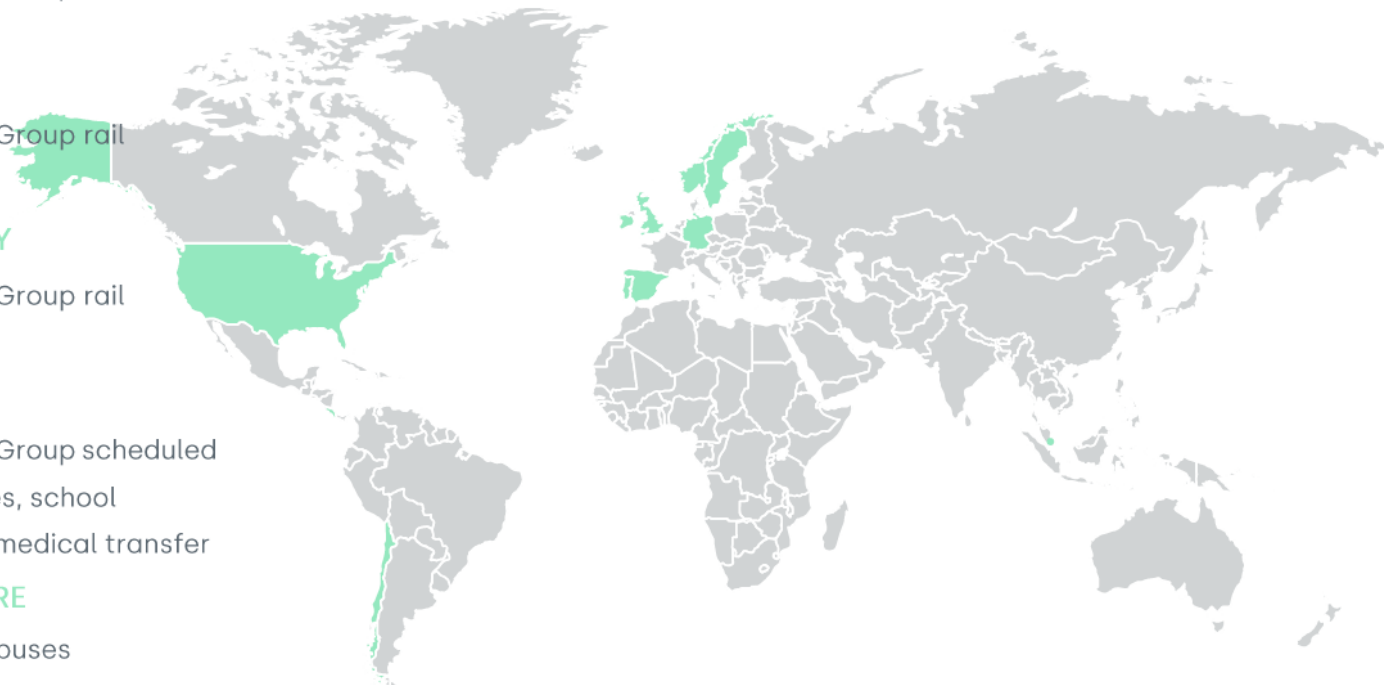
Go-Ahead Group rail
services

SWEDEN

Go-Ahead Group scheduled
bus services, school
transport, medical transfer

SINGAPORE

Go-Ahead buses

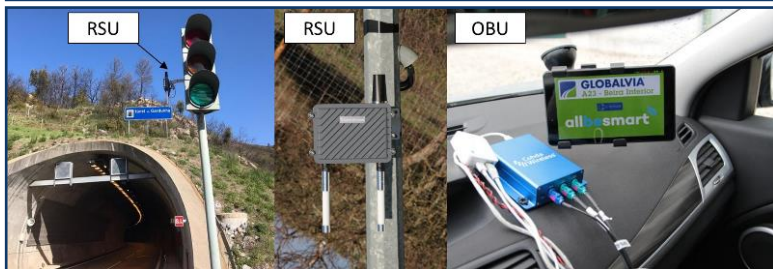


V2X - C-ROADS GARDUNHA TUNNEL PILOT



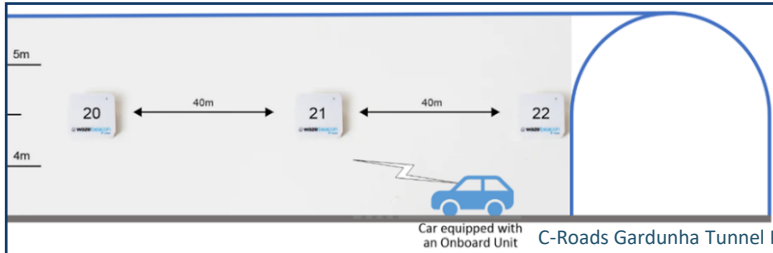
Consisted:

- Creation of a V2X (Vehicular-to-everything) communications network in the Gardunha Tunnel area.



Involved:

- Installation of RSUs and OBUs equipments;
- Software development for C-ITS services;
- Interoperability testing and monitoring.



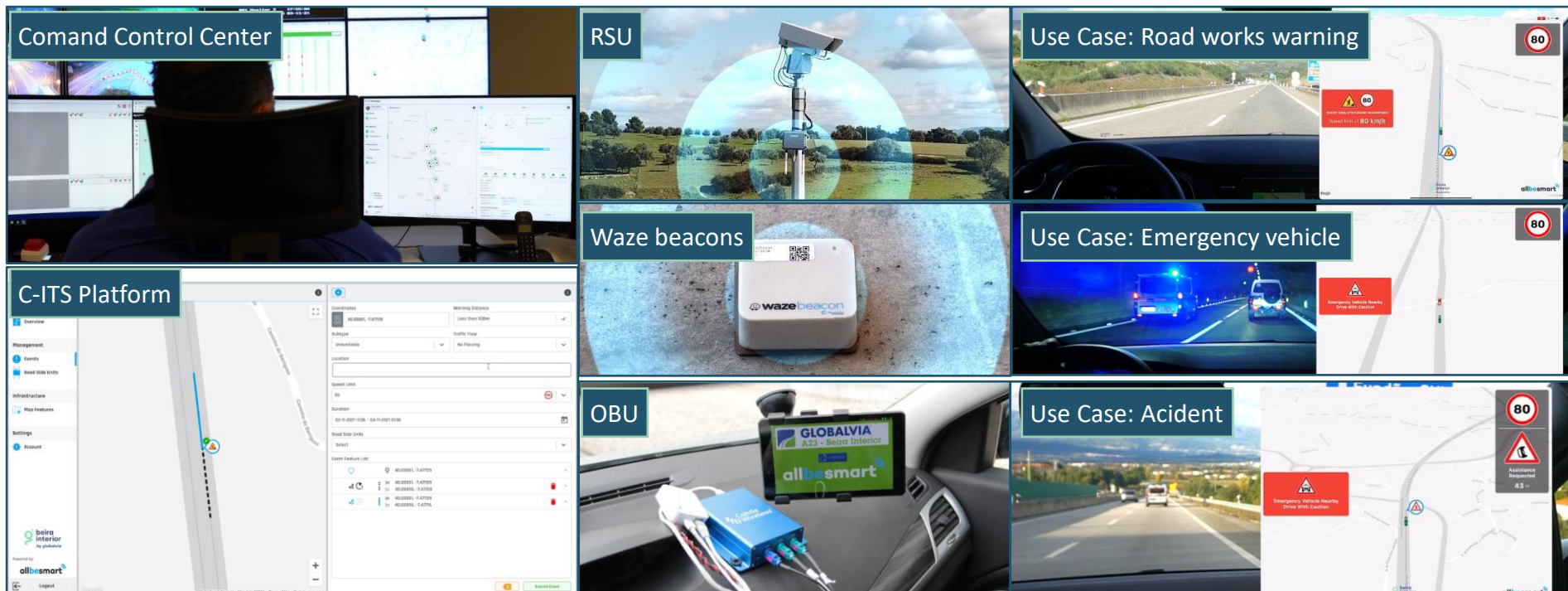
Additional:

- Installation and integration of Waze Beacons for the dissemination of GPS information inside the tunnel.

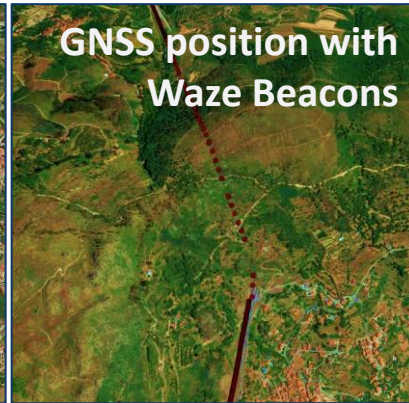
Car equipped with an On Board Unit

C-Roads Gardunha Tunnel Pilot was part of the C-Roads Portugal consortium (led by IMT)

V2X - C-ROADS GARDUNHA TUNNEL PILOT

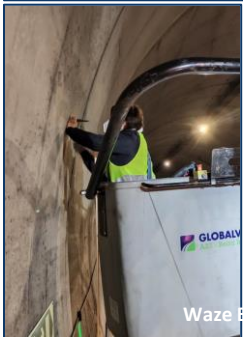


V2X - C-ROADS GARDUNHA TUNNEL PILOT



Geolocation inside tunnels

- Global Navigation Satellite Systems (GNSS) fail to provide a reliable position inside tunnels
- Waze Beacons transmit a wireless signal that can be received by any equipment with Bluetooth® wireless technology enabled



RSU firmware was adapted to provide GPS coverage and enable C-ITS services inside tunnels.

V2X - C-ROADS GARDUNHA TUNNEL PILOT



- **C-Roads Gardunha Tunnel interoperability tests :**
- The main objective was to test the interoperability between C-ITS implementations made under the C-Roads project in Portugal in the Gardunha tunnel C-ITS infrastructure.

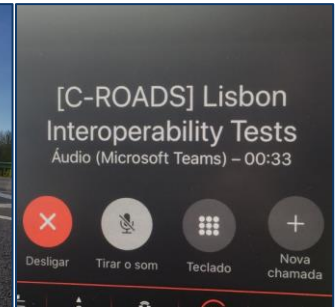
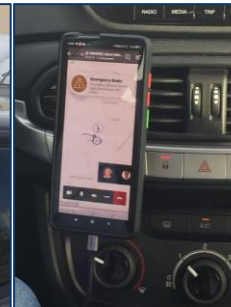
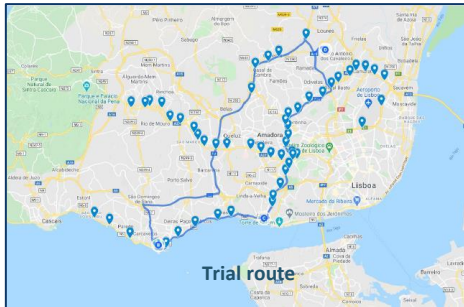


V2X - C-ROADS GARDUNHA TUNNEL PILOT

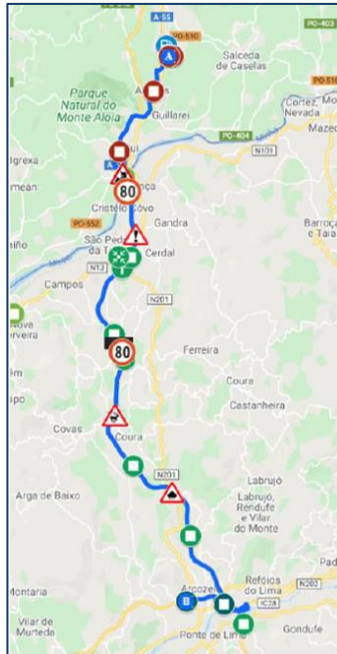


Lisbon interoperability tests

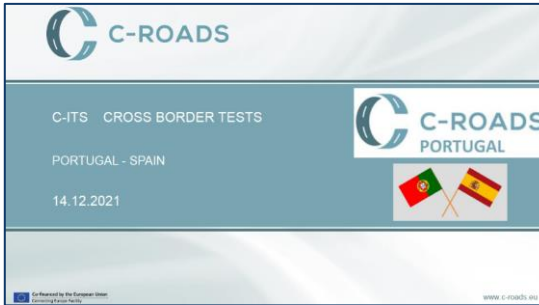
- **C-Roads Lisbon Metropolitan area interoperability tests :**
- The main objective was to test the interoperability between C-ITS implementations made under the C-Roads project in Portugal in the Lisbon Metropolitan Area C-ITS infrastructure.



V2X - C-ROADS GARDUNHA TUNNEL PILOT



Trial route



- C-ITS Cross Border Test between Minho (Portugal) and Spain (SP) regions :
- The main objective was to test the interoperability between C-ITS C-Roads projects in Portugal and Spain.



Portuguese and Spanish participants



Test

V2X - C-ROADS GARDUNHA TUNNEL PILOT



V2X – 5GAUTO PROJECT

lte 4G Enhanced V2X C-V2X 3GPP Rel 14 Basic V2X IEEE 802.11p ITS G5 - V2V, V2I - Safety	Advanced V2X C-V2X 3GPP Rel 15 and future Rel 16, etc - Longer range - Higher density - Very high throughput - Very high reliability - Wideband ranging and positioning - Very low latency 5G 5GAUTO	
--	--	--

Consisting of:

- Investigate, develop and test hardware and software solutions to support C-ITS services over 5G V2X radio telecommunications infrastructure.

--	--

RSU 5G V2X in A23

LIDAR technology for people and obstacles detection through AI

Involves:

- Develop radio equipment to support vehicular communication and autonomous driving;
- Explore and apply MEC technology over 5G;
- Investigation of AI algorithms;
- Development of C-ITS service management platform.

Co-financiado por:



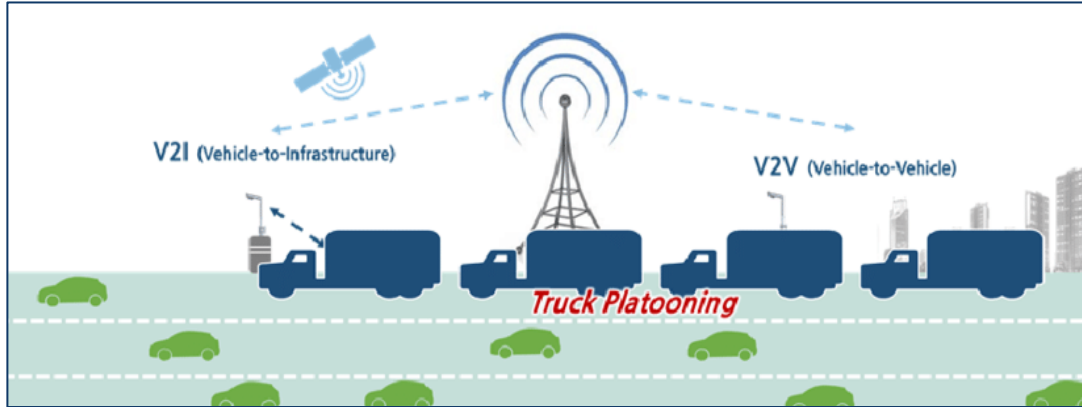
V2X – 5GAUTO PROJECT

C-ITS Platform proven in operational environment (TRL 9)



Thanks to powerful dashboard, road operators can easily configure road alerts for many C-ITS use cases

V2X – 5GAUTO PROJECT

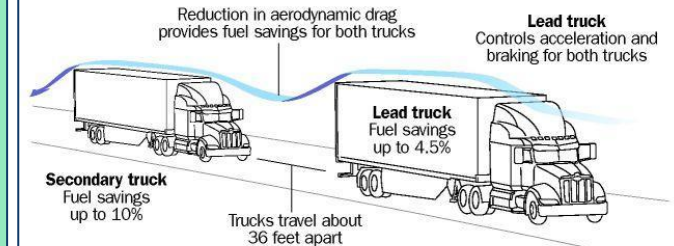


The V2X connectivity prepares the A23 for advanced C-ITS cases such as Truck Platooning with a strong impact on reducing emissions.



HOW PLATOONING WORKS

Peloton's system wirelessly connects the braking and acceleration between the two trucks. The reduction in aerodynamic drag provides fuel savings for both the trailing and leading trucks.



SOURCE: Peloton Technology

THE WORLD-HERALD

CONCLUSIONS

- The C-ROADS pilot has shown that the ITS-G5 communication technology has reached a level of maturity that now enables cooperative systems to roll out and operate in the field.
- C-ITS technology opens a direct communication channel between Globalvia and the highway users, with a lot of potential for innovative and useful applications.
- As next steps we highlight the deploy and test the new connectivity standard 5G V2X.

Obrigado!