



Supporting large-scale deployment of  
cooperative intelligent transport systems  
and services across Europe

## Accelerating **C-ITS** **Mobility** Innovation and dep**L**oyment in **E**urope



Supporting large-scale deployment of  
cooperative intelligent transport systems  
and services across Europe

The C-Mobile Project (Accelerating **C-ITS** **Mobility** Innovation and dep**L**oyment in **E**urope) is deploying Cooperative Intelligent Transport Systems and Services (C-ITS) designed to deal with specific mobility challenges in complex urban areas across Europe. The project also helps local authorities deploy the C-ITS services they need and raises awareness of the potential benefits for all road users.

A total of eight C-ITS equipped cities and regions are involved in the project, all of which have previous experience in small scale pilot testing of C-ITS services for sustainable deployment. This experience, together with a common approach, ensures that interoperability and seamless service availability can be achieved at an acceptable cost for end-users.

### MAIN OBJECTIVES

Up-scale the deployment  
of integrated real-world  
C-ITS services across  
Europe

Demonstrate the economic,  
social and environmental  
value of C-ITS services for  
users

Assess the impact of C-ITS  
applications on road safety,  
social and economic  
sustainability, and the  
environment

## DEPLOYMENT SITES

C-MOBILE builds upon existing equipment and services deployed in the eight deployment sites across Europe.



**INTERNATIONAL COOPERATION**  
– Twinning with the US Department of Transport

### NEWCASTLE

- 52** equipped traffic light intersections (RSUs – G5)
- 5** km of roads

### VIGO

- 49** intersections (RSUs – G5)
- 108** inductive loop traffic detectors
- 60** bluetooth traffic detectors, acoustic signal for blind users activated by Bluetooth (81 intersections)
- 100+** km of interurban roads with **30** G5 RSUs

### BORDEAUX

- 583** intersections, Bordeaux parking areas
- 11** urban RSUs
- 30** inter-urban RSUs

### BILBAO

- 180** truck parking bays
- 1000** street parking bays
- 30** intersections with Wifi
- 20** km of roads with CCTV cameras
- 15** km roads with variable message signs

### NEWCASTLE

### NORTH BRABANT REGION

### COPENHAGEN

- 49** intersections
- 8** km (inter-) urban roads
- 9.3** km urban roads

### NORTH BRABANT REGION

- 50** intersections
- 20+** km of roads
- 50** km of motorway

### BARCELONA

- 35** intersections
- 45** km of roads
- 60** variable message signs

### THESSALONÍKI

- 17** intersections
- 10** km of roads
- 10** km of motorway

### BORDEAUX

### VIGO

### BILBAO

### BARCELONA

### THESSALONÍKI

C-MOBILE Partner Countries





## ARCHITECTURE



The C-MobILE architecture in the deployment sites connects back-end facilities and mobile nodes, such as vehicles and vulnerable road users, through hybrid communication using Wi-fi and cellular technologies.

## METHODOLOGY

C-MobILE uses state-of-the-art communication, roadside architecture, and service delivery technologies to define an interoperable architecture. Within this architecture, a series of C-ITS applications are demonstrated and tested in eight deployment sites across Europe for specific combinations – or bundles – of services.

Harmonisation at European level of communication protocols, technical and functional specifications and interfaces allows for interoperability, even when services and architectures are adapted to legacy systems existing locally.

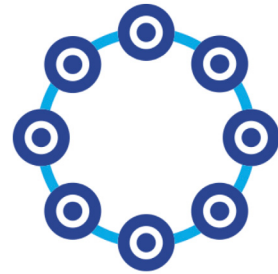
Results collected by the deployment sites are assessed, taking into account technical aspects and user/societal impacts, in order to define a deployment process and best practices for establishing C-ITS services. The result is a successful C-ITS rollout and a set of deployment guidelines allowing other cities and regions to deploy the C-ITS services they need.

## APPROACH



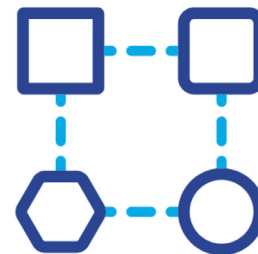
### CONNECTIVITY

Enabling C-ITS services to support applications both in-vehicle and on personal nomadic devices (smartphones) and two-way communication with the road infrastructure (such as traffic lights or VMS), based on appropriate data access and sharing



### INTEROPERABILITY

Full interoperability across Deployment Sites will provide a seamless user experience for supported services. Interoperability testing will be conducted by the consortium to ensure end-to-end compatibility and functionality



### DEPLOYMENT

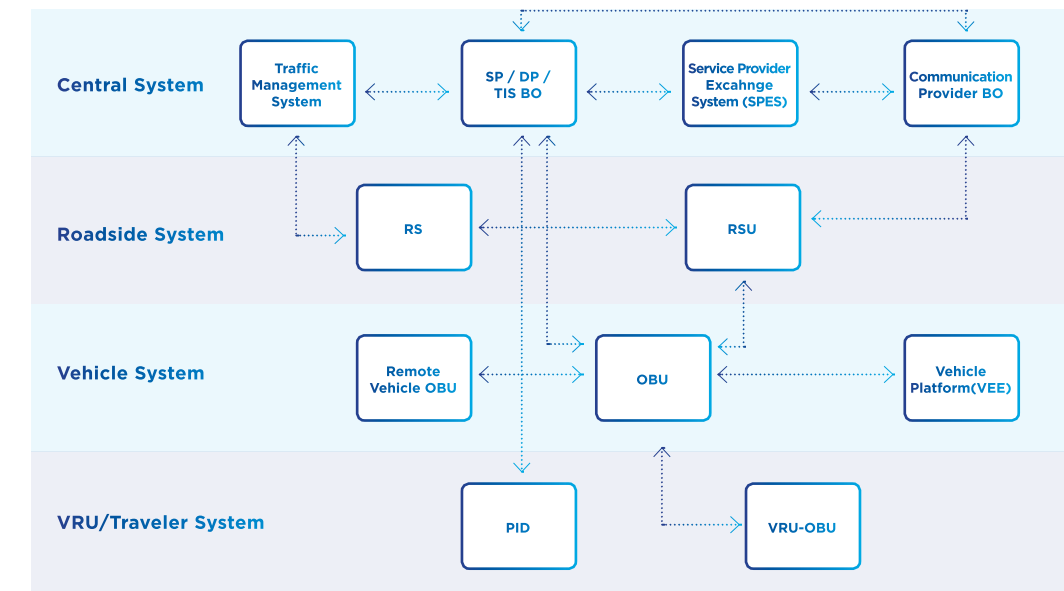
Demonstrating, assessing and evaluating the benefits of C-ITS services for urban mobility

## REFERENCE ARCHITECTURE

The architecture from the projects CONVERGE, MOBiNET and DITCM forms the starting basis of the C-Mobile architecture, with further adaptations to ensure interoperability with initiatives such as C-ROADS and InterCor.

The main functions of the systems are sensing, communication, situation monitoring and assessment, and acting and trust management.

### BDD(Package) Design Model (Functional Components)

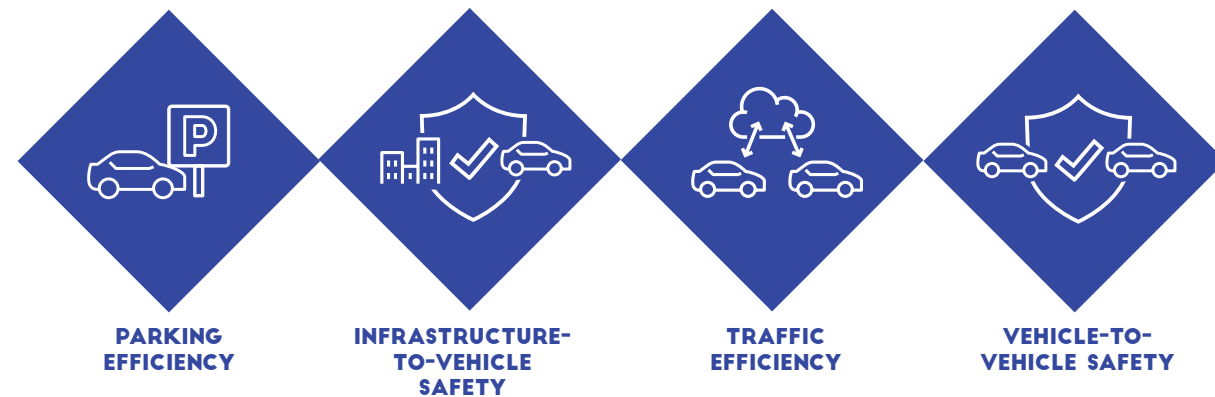


*High-level functional architectural model for the C-Mobile applications*

# THE BUNDLE APPROACH

## APPLICATION BUNDLES

Based on a stakeholder assessment, C-MobILE provides several C-ITS services in the form of open, modular and extendable bundles creating one common C-ITS user environment with rich user experience features:



The objective of the C-MobILE service bundles is to:

- Provide end-users with a single C-ITS application covering multiple C-ITS services
- Assist infrastructure operators/traffic managers in integrating C-ITS into operational traffic management, as a solution to congestion.

Services are grouped into four thematic application bundles based on relevance to deployment sites, feasibility and potential for market uptake. They use hybrid communication and address a range of use cases and different road-users.

The bundles will be able to operate either in one of two modes:

### AUTOMATED MODE

Uses C-ITS services automatically to provide context, location and user-preference based information and guidance to the end user.

### USER-SELECTED MODE

The end user can select specific services relevant to their needs.

### DATA SHARING AND ACCESS:

*ensured by standard, open interfaces and in line with C-ITS Platform recommendations and C-Roads Platform harmonisation.*

### CROSS-MODAL INTEGRATION:

*some service bundles will include pedestrians, cyclists, motorcyclists and multimodal public transport (train and bus).*

### CROSS-MODAL APPLICATION:

*a single smartphone app or on-board unit covers multiple use cases for a range of users such as drivers, cyclists, or pedestrians.*

### CROSS-MODAL SERVICE BUNDLES:

*the same services cover different users groups.*





BUNDLE 1

## PARKING EFFICIENCY

### REST TIME MANAGEMENT

Rest time indication to help drivers manage their rest time by displaying available truck and coach parking areas.

### MOTORWAY PARKING AVAILABILITY

Information for truck and coach drivers on parking lots location, availability and services, via mobile internet or infrastructure-to-vehicle technology.

- ✓ Information on roadside truck parking spaces released by another user
- ✓ Reservation of a truck parking space released by another user
- ✓ Driver guidance for port terminal and truck parking access

### URBAN PARKING AVAILABILITY

This service provides parking availability information and guidance for drivers to make informed choices about available parking places. This service aims to reduce congestion, time loss, pollution, and stress caused by cruising for parking.

- ✓ Information about a vehicle parking space released by another user
- ✓ Reservation of a vehicle parking space released by another user
- ✓ Loading zone availability information for urban freight
- ✓ On-street parking availability information



BUNDLE 2

## INFRASTRUCTURE-TO-VEHICLE SAFETY

### ROAD WORKS WARNING

This service provides in-vehicle information and warnings about road works and changes to the road layout, reducing accident risk for drivers and workers.

- ✓ Road Works Warning: provides awareness messages and instructions to adapt speed, change lanes, etc, using mobile internet or 802.11p

### ROAD HAZARD & TRAFFIC JAMS WARNING

Provides advance warnings about dangerous situations such as objects on the road, potholes, traffic jams, or extreme weather.

- ✓ Hazardous Location Notification
- ✓ Traffic Conditions Warning
- ✓ Weather Conditions Warning

### EMERGENCY VEHICLE WARNING

Delivers in-vehicle information and warnings about approaching emergency vehicles from behind, from the front or from the side at an intersection, before they become visible or audible.

### SIGNAL VIOLATION WARNING

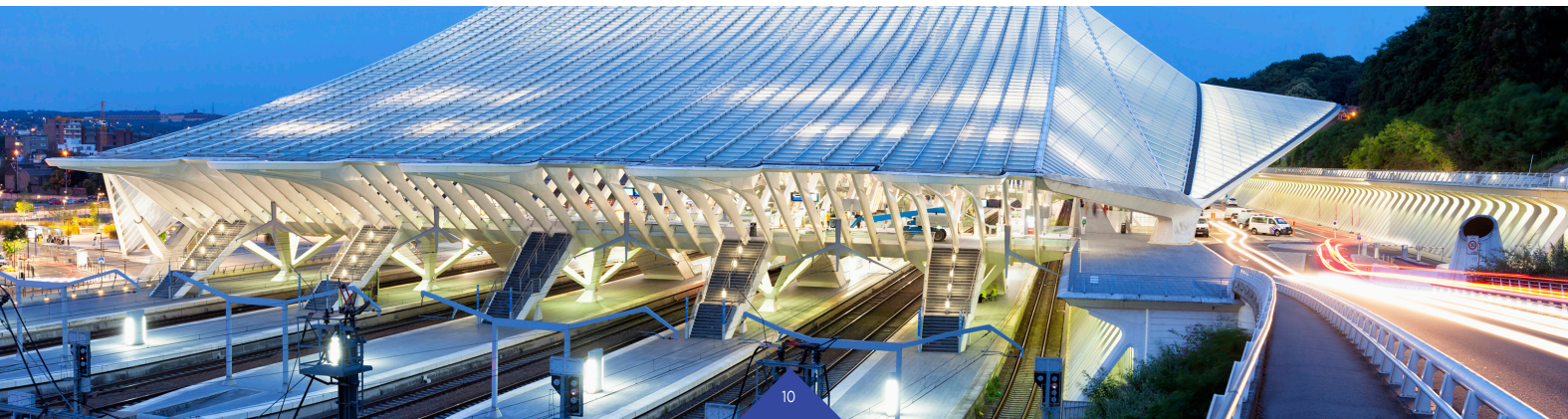
Provides timely in-vehicle information on a red light violation downstream.

- ✓ Red light warning provides information on status of traffic signals ahead
- ✓ Own violation warning to the driver and to other vehicles
- ✓ Emergency vehicle warning – when an approaching emergency vehicle is expected to run a red light
- ✓ Turning warning – oncoming traffic
- ✓ Turning warning – vulnerable users crossing at an intersection

### WARNING SYSTEM FOR PEDESTRIANS

Detects risky situations for pedestrians at intersections and warns drivers accordingly. Can be extended to cover cyclists.

- ✓ Safe travelling experience by warning signage: Vulnerable Road User presence detected by VRU beacon system, roadside pedestrian presence, bicycle-to-car Communication, or Pedestrian-to-Car Communication, and warning issued to approaching drivers.





BUNDLE 3

# TRAFFIC EFFICIENCY

## GREEN PRIORITY FOR DEDICATED VEHICLES

Green Priority aims to increase punctuality and response time for public transportation and service and emergency vehicles, holding off conflicting traffic and ensuring continued right-of-way.

- ✓ Green Priority for Dedicated Vehicles

## GREEN LIGHT OPTIMAL SPEED ADVICE (GLOSA) / 'DYNAMIC ECO-DRIVING'

Provides drivers with an optimal speed advice when they approach a controlled intersection equipped with traffic lights, ensuring a smoother traffic flow and reducing unnecessary stops, fuel consumption and noise pollution.

- ✓ Optimized Driving Experience with GLOSA

## COOPERATIVE TRAFFIC LIGHTS FOR VULNERABLE USERS

Also known as Traffic Light Prioritisation for Designated Vulnerable Road Users, it adapts the length of red/green phases to provide cyclists and pedestrians with a safer and smoother travel experience.

- ✓ Traffic Light Prioritisation for Designated VRUs equipped with a dedicated smartphone application
- ✓ Cooperative Traffic Light with VRU Counting, using VRU detection and counting



## FLEXIBLE INFRASTRUCTURE (PRIORITY LANES)

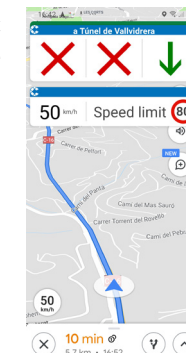
Informs drivers about the status of reserved lanes throughout the day.

- ✓ Dynamic Lane Management - Lane Status Information allows operators to open and close traffic lanes and notify users
- ✓ Dynamic Lane Management - Reserved Lane (with or without use of vehicle probe data) notifies users about upcoming reserved lanes and whether or not their vehicle is allowed in.

## IN-VEHICLE SIGNAGE (DYNAMIC SPEED LIMIT)

Shows both static and dynamic information of road signs inside the vehicle, including speed limits.

- ✓ In-Vehicle Signage, dynamic traffic signs: includes dynamic speed limits and instructions to change lanes.
- ✓ In-Vehicle Signage, static traffic signs



## MODE & TRIP TIME ADVICE

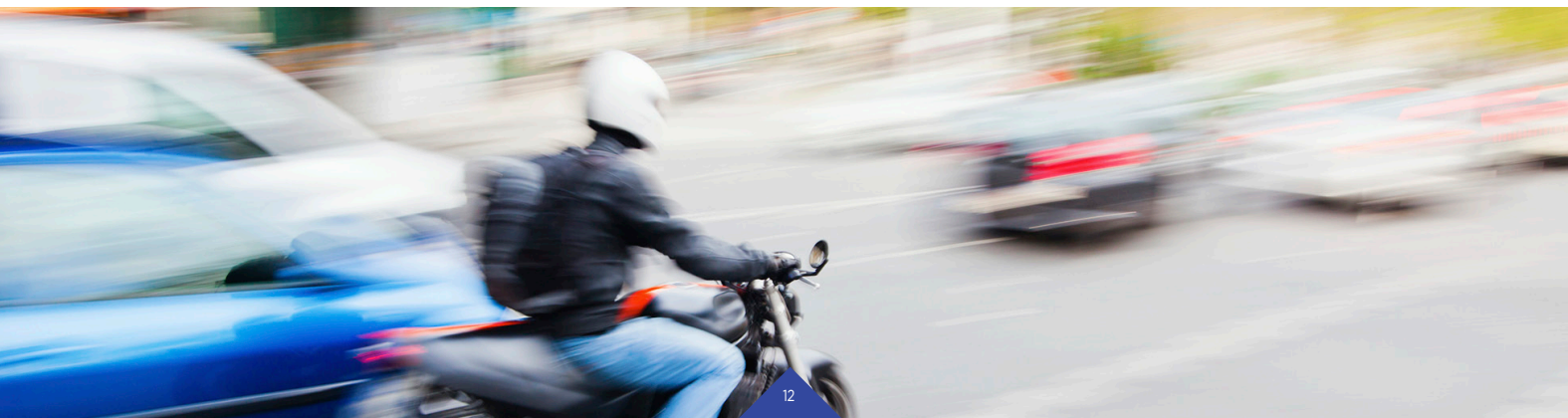
Provides itinerary for multimodal passenger transport with real-time travel information.

- ✓ Mode and Trip Time Advice for Event Visitors
- ✓ Mode and Trip Time Advice for Drivers
- ✓ Mode and Trip Time Advice for Cyclists

## PROBE VEHICLE DATA

Probe vehicle data, or Floating Car Data, generated by vehicles can be used as input for real-time operational traffic management, long-term strategic planning, and traveller information services. Includes position, speed, direction, and additional information such as windscreen wiper status, ABS, ESP, etc. This data can serve to warn drivers about disruptions ahead, traffic jams, slippery surfaces.

- ✓ Basic probe vehicle data
- ✓ Extended probe vehicle data







BUNDLE 4

## VEHICLE-TO-VEHICLE SAFETY

### EMERGENCY BRAKE LIGHT

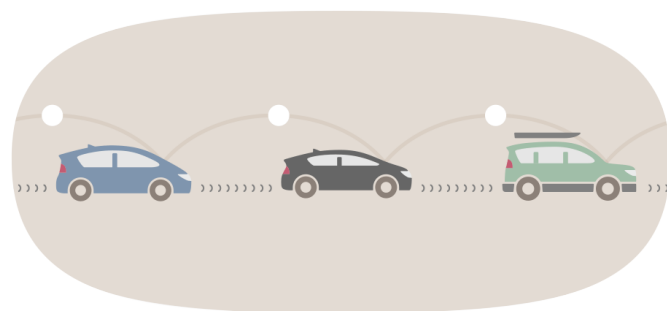
Warns drivers about vehicles ahead braking abruptly, and operators about sudden slowdowns.

- ✓ *Emergency electronic brake lights*

### COOPERATIVE ADAPTIVE CRUISE CONTROL (URBAN ACC)

CACC-equipped vehicles improve traffic flow through inter-vehicle information exchange.

- ✓ *CACC passenger vehicles approaching urban or semi-urban environment (small-scale demonstration)*



### SLOW OR STATIONARY VEHICLE WARNING

Helps drivers avoid or mitigate rear-end collisions with stopped or slow traffic ahead.

- ✓ *Slow or stationary vehicle warning*

### MOTORCYCLE APPROACHING INDICATION (INCLUDING OTHER ROAD USERS)

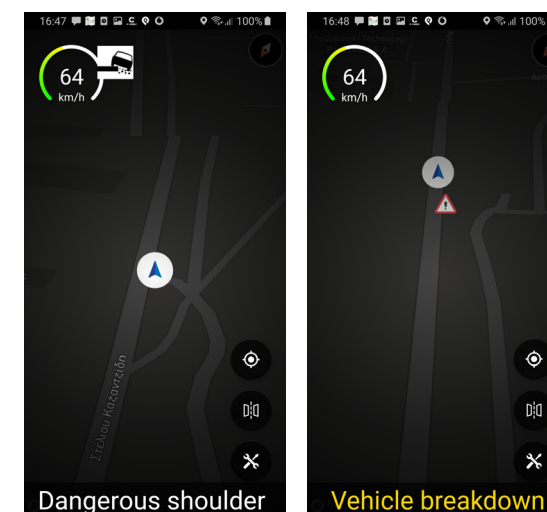
Based on broadcasted messages, a driver is able to identify an approaching two-wheeler, and both vehicles can determine whether a critical situation can occur.

- ✓ *Two-Wheeler Approaching Warning (V2V)*
- ✓ *Two-Wheeler Approaching Warning (V2V & V2I)*

### BLIND SPOT DETECTION & WARNING

Blind spot detection/warning warns drivers about other vehicles of any type located out of sight.

- ✓ *Digital Road Safety Mirror (V2I): detects other vehicles of any type located in predefined blind spot locations, using ITS-S*
- ✓ *Digital Road Safety Mirror for VRU (V2I): detects other vehicles of any type located in predefined blind spot locations, using ITS-S*



## SERVICE DEPLOYMENT 2019-2020

Services	Barcelona	Bilbao	Bordeaux	Copenhagen	Newcastle	North Brabant	Thessaloniki	Vigo
Rest time Management						☑		
Motorway Parking Availability		☑	☑			☑		
Urban Parking Availability		☑	☑					
Road Works Warning	☑	☑	☑	☑	☑	☑	☑	☑
Road Hazard Warning	☑	☑	☑	☑	☑	☑	☑	☑
Emergency Vehicle Warning	☑		☑			☑	☑*	☑
Signal Violation Warning	☑*		☑			☑		☑
Warning System for Pedestrians	☑		☑*	☑*	☑	☑	☑*	☑
Green Priority			☑	☑	☑	☑	☑	☑
Green Light Optimal Speed Advice	☑*		☑	☑	☑	☑	☑	☑
Cooperative Traffic Light for VRUs			☑*			☑	☑*	
Flexible Infrastructure	☑		☑		☑		☑	
In-Vehicle Signage	☑		☑		☑		☑	☑
Mode & Trip Time Advice			☑				☑	
Probe Vehicle Data	☑		☑*		☑		☑	☑
Emergency Brake Light			☑*					☑
Cooperative Adaptive Cruise Control			☑*			☑*		☑
Slow and Stationary Vehicle Warning			☑*					☑
Motorcycle Approaching Indicator	☑		☑*					☑
Blind Spot Detection		☑	☑*			☑		

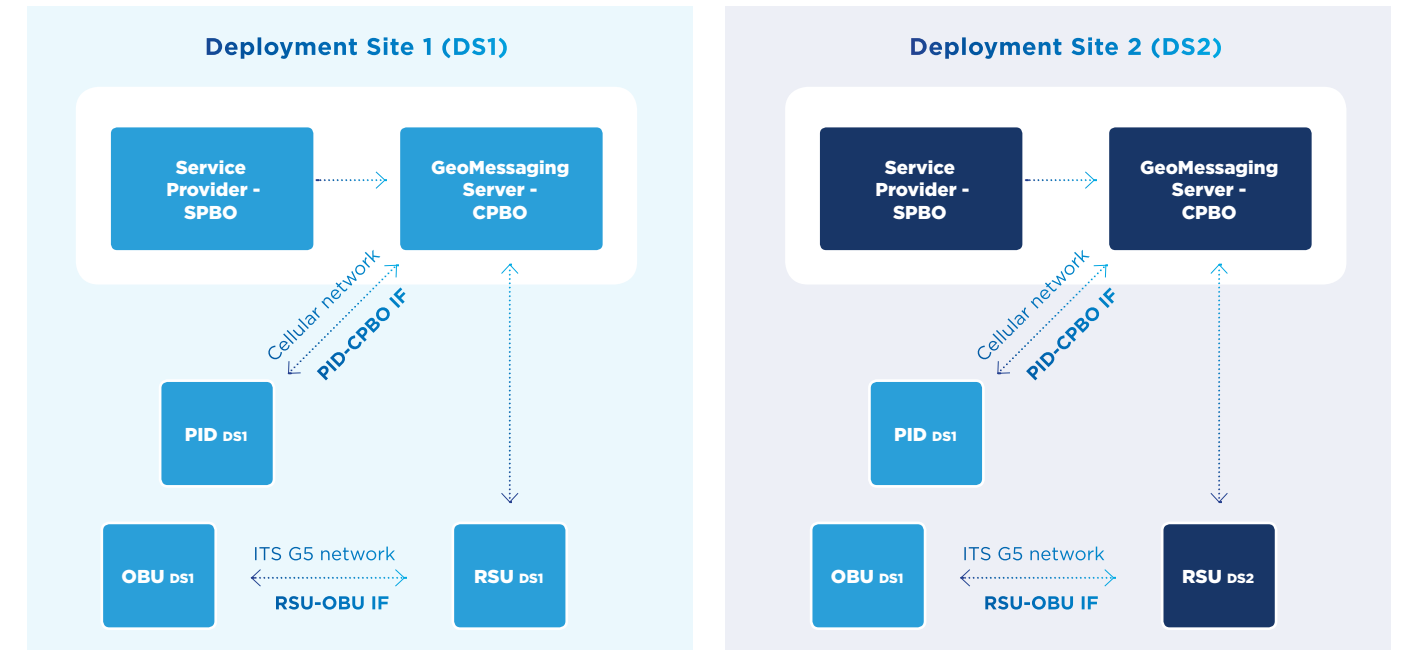
\* service deployed as a proof of concept

## INTEROPERABILITY

Full interoperability allows users traveling from one C-Mobile Deployment Site to another to benefit from available services using their PID (Personal Information Device) and OBU

(On-Board Unit), together with local Roadside Units (RSU) and local data provided by their usual GeoMessaging Server.

### The interoperability approach



**CPBO:** Communication Provider Back Office

**SPBO:** Service Provider Back Office

**PID:** Personal Information Device

Interfaces required for service interoperability:

**RSU-OBU IF:** interface on the ITS G5 channel.  
Based on existing European standards and profiles.

**PID-CPBO IF:** emulates RSU-OBU IF based on MQTT over the cellular channel.



## EXPECTED RESULTS

- A C-ITS framework for proposing key deployment solutions covering organizational concepts, legal aspects, certification, privacy, security, liability, data ownership, user acceptance and transitional aspects
- A Strategic Research Agenda that promotes C-ITS deployments and leads towards automated transport
- An assessment of the real-life benefits of bundling C-ITS applications and integrating multiple transport modes in the C-ITS ecosystem
- An open deployment platform for C-ITS, featuring open data access, secure software libraries and development platforms to support front-end applications for road users
- Demonstrating an open and secure large-scale deployment of C-ITS applications, in complex urban environments, interoperable across countries, and involving large groups of end-users

## GET INVOLVED

C-MobILE offers opportunities for engagement for experts, researchers, public authorities and policy-makers, with:

- ✓ *Local consultations*
- ✓ *C-ITS Training Sessions*
- ✓ *Online Surveys*
- ✓ *Webinars and Seminars*
- ✓ *TESTFEST and Hackathon*
- ✓ *C-ITS City Pool Workshops for public authorities*

## JOIN THE C-ITS CITY POOL

Through regular workshops, the C-ITS City Pool provides a space where transport authorities can share real-life experiences, receive feedback and learn about best practices and business opportunities for the deployment of C-ITS. Join the C-ITS City Pool today: you will learn from other cities about C-ITS and what it can bring to your community, but also what hurdles you should expect when trying to implement. Share knowledge, speak with your peers and make arrangements for follow-up contacts. More info: <http://c-mobile-project.eu/citypool>

## JOIN OUR STAKEHOLDER FORUM

Join the C-MobILE Stakeholder Forum today to receive updates on project developments, outputs and events, and discover opportunities to share comments and feedback on the project's work, at <https://c-mobile-project.eu/contacts>



# CONSORTIUM





🕒 **June 2017 – November 2020**

€ **15 million**

👥 **Applus+ IDIADA**

🌐 **c-mobile-project.eu**

🐦 **CMobile\_Project**

🌐 [linkedin.com/company/c-mobile-project/](https://www.linkedin.com/company/c-mobile-project/)

✉ [info@c-mobile-project.eu](mailto:info@c-mobile-project.eu)



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