Supporting large-scale deployment of cooperative intelligent transport systems and services across Europe
The C-Mobile Project (Accelerating C-ITS Mobility Innovation and deployment in Europe) 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**
C-MobILE builds upon existing equipment and services deployed in the eight deployment sites across Europe.

DEPLOYMENT SITES

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

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

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

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

BARCELONA
- 49 intersections
- 8 km (inter-) urban roads
- 10 km of roads
- 60 variable message signs

COPENHAGEN
- 49 intersections
- 8 km (inter-) urban roads
- 9.3 km urban roads
- 50 km of motorway

NORTH BRABANT REGION
- 50 intersections
- 20+ km of roads
- 50 km of motorway

THESSALONIKI
- 35 intersections
- 45 km of roads
- 10 km of roads
- 10 km of motorway

INTERNATIONAL COOPERATION
- Twinning with the US Department of Transport

C-MobILE Partner Countries
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.

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.
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.

**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**
  - Enabling interoperability across systems by testing and validating common standards.

- **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](image)
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.

**THE BUNDLE APPROACH**
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.
- Road Hazard & Traffic Jams Warning: 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.
- Emergency Vehicle Warning - when an approaching emergency vehicle is expected to run a red light
- Turning warning - vulnerable users crossing at an intersection

Signal Violation Warning
Provides timely in-vehicle information on a red light violation downstream.
- Signal Violation Warning: red light violation status
- 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.
- Warning System for Pedestrians: safe travelling experience by warning signage
- Traffic Conditions Warning
- Weather Conditions Warning

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

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

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.
- Road Hazard & Traffic Jams Warning: 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.
- Emergency Vehicle Warning - when an approaching emergency vehicle is expected to run a red light
- Turning warning - vulnerable users crossing at an intersection

Signal Violation Warning
Provides timely in-vehicle information on a red light violation downstream.
- Signal Violation Warning: red light violation status
- 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.
- Warning System for Pedestrians: safe travelling experience by warning signage
- Traffic Conditions Warning
- Weather Conditions Warning
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

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

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
**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.

**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)
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 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

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.
June 2017 – November 2020

€ 15 million

Applus+ IDIADA

c-mobile-project.eu

CMobile_Project

www.linkedin.com/groups/5073878

info@c-mobile-project.eu