Regulation Study for Interoperability in the Adoption of the Autonomous Driving in European Urban Nodes

AUTOCITS

LISBON Pilot

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Pilot Overview

**Autonomous and connected vehicles:**
- A9-CREL;
- Between junction with A16 and Avenida Marginal;
- 2 Service Stations for support;
- Distance of 7km (6km of A9 and 1km of N6-1).

**Autonomous shuttles:**
- Near of National Stadium;
- Transporting people between the parking and the main buildings.

**ITS stations:**
- 6 RSUs will be deployed along the highway A9;
- Each vehicle will have an On-Board Unit (OBU)
Day 1 C-ITS services

Slow or stationary vehicle(s) & Traffic ahead warning
- Stationary vehicle due to break down;
- Traffic jam volume increasing;
- Slow driving maintenance vehicle;
- Public transport vehicle is stationary at bus stop.

Weather conditions
- Low road adhesion due to ice on the road;
- Low visibility due to Heavy Rain;
- Awareness about Strong Winds;
- Soft Hail.

Other hazardous notifications
- Rock falls detected on the road surface;
- Big objects detected on the road.
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Autonomous and Connected Vehicles

- **Autonomous vehicle**
  - INSIA - Instituto Universitario de Investigación del Automóvil, Universidad Politécnica de Madrid

- **Connect vehicle**
  - ATLASCAR from University of Aveiro.

- **Invitations ongoing to more autonomous vehicle suppliers**
  - other relevant investigation groups and known automobile brands
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Autonomous Shuttles – the MOVE

Benefits from C-ITS services
- Stationary Vehicle – Public transport vehicle is stationary at bus stop;
- Weather conditions – Road adhesion;
- Other hazardous notifications – Surface Condition, Obstacle on the Road.
3rd Workshop – Lisbon Pilot

Test-cases (overview) for the Lisbon-Pilot’s scenarios

- The focus is on study/analysis of C-ITS and autonomous driving technologies, and their impact on the Regulations for autonomous vehicles
- We are going to have a series of tests and scenarios
- **Simulated** and **Real-world** events

**Main goals**
- **Connected vs non-connected**: some test-cases will be carried out to evaluate the pro-and-con of C-ITS
- **RSU and OBU**: interoperability tests of the technologies
- **Evaluation, analysis and future directions**: evaluation of each Pilot; conclusions on all the Pilots (analysis and comparison between the Pilots); recommendations for future (large-scale) deployments; review of Regulations; review/update of test-cases

**Key Prerequisites**
- **Human driver**: it is mandatory to have drivers in all the vehicles (ie, including Autonomous)
- **Safety**: this is of major importance
- **Connected technology**: the vehicles should be equipped with on-board units (OBUs) and should be programed to take actions based on received messages
- **Levels of Automation**: from level 3 to 4 (maximum)

**Locations**
- **Highway**: autonomous cars; instrumented cars; conventional cars
- **Urban-node**: autonomous “shuttle” cars
Evaluation and analysis of the test-cases and Pilots

AUTOCITS has an Activity devoted to the evaluation and analysis of the Pilots:
- Activity 4 “Pilot assessment” (lead by UC)

Data and info obtained from the test-cases and Pilots will be relevant to Activity 4 and its reports (deliverables)

Objectives:

• Create an assessment/evaluation guidance-document for the tests and Pilots;
• Have a common methodology for the test-cases and evaluation;
• Extend the results, assessment and conclusions for large scale deployment and further regulations.

Tasks (sub-activity):

• Sub-activity 4.1 - Assessment methodology
• Sub-activity 4.2 - Test and validation
• Sub-activity 4.3 - Analysis of the legal framework & large-scale deployment

Reports:
1) Initial report regarding the Pilots
2) Final report on the Pilots
3) Review of the National regulations and recommendations of A.V. circulation
4) Guide of deployment and good practices for C-Autonomous Driving

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Scenarios and test-cases

Types of scenarios (highway)
- **Dedicated lane**: right-most lane with physical barriers
- **Shared lane**: as before but without physical barriers
- **“No-restrictions” scenarios**: connected cars (autonomous and/or instrumented) can use all highway lanes with minimal (but some) restrictions

Test-cases (no exhaustive ...)
- **Single event**: eg, traffic jam ahead
- **Multiple events**: eg, low visibility + obstacle on the road
- **Speed changes**: average speed – min. speed – max. speed
- **Lane changes**: under restricted and controlled conditions
- **Simulated and real-world events**

Data logging
- **On-board**: time of operation; speed profile; position; received messages; actions/executed commands
- **Infrastructure**: received messages and events (from TMC); sent messages
- **External parameters**: weather conditions; obstacles position; number of vehicles; type of vehicles

Actions
- **Change the speed**: autonomous cars; instrumented (connected) cars
- **Change the lane**: eg, to avoid an obstacle (simulated / realistic) on the road
Scenario: **Dedicated lane (manual and automatic modes)**

Autonomous car

Transaction controlling vehicles
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Scenarios in highway: I

Scenario: Dedicated lane
Scenario: **Shared lane (C-ITS)**

No TCVs: transit controlling vehicles
Scenario: No-restriction (C-ITS)
Example of a test-case

**Test-case:** Dedicated lane (C-ITS enabled)

**RSUs:** sending messages; simulated events

**Action:** acknowledgement of all the messages

Author: Cristiano Premebida
Example of a test-case

**Test-case:** Dedicated lane (C-ITS enabled) & *simulated event*

Action: reduce the speed

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**Example of a test-case**

**Test-case:** Dedicated lane (C-ITS enabled) & *simulated event* (obstacle/object on the roadside)

**Action:** reduce the speed + change the lane (there is a time-window)
**Test-case:** Dedicated lane (C-ITS enabled) & real-world event (can on the roadside)

**Action:** reduce speed + change the lane (there is a time-window)
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