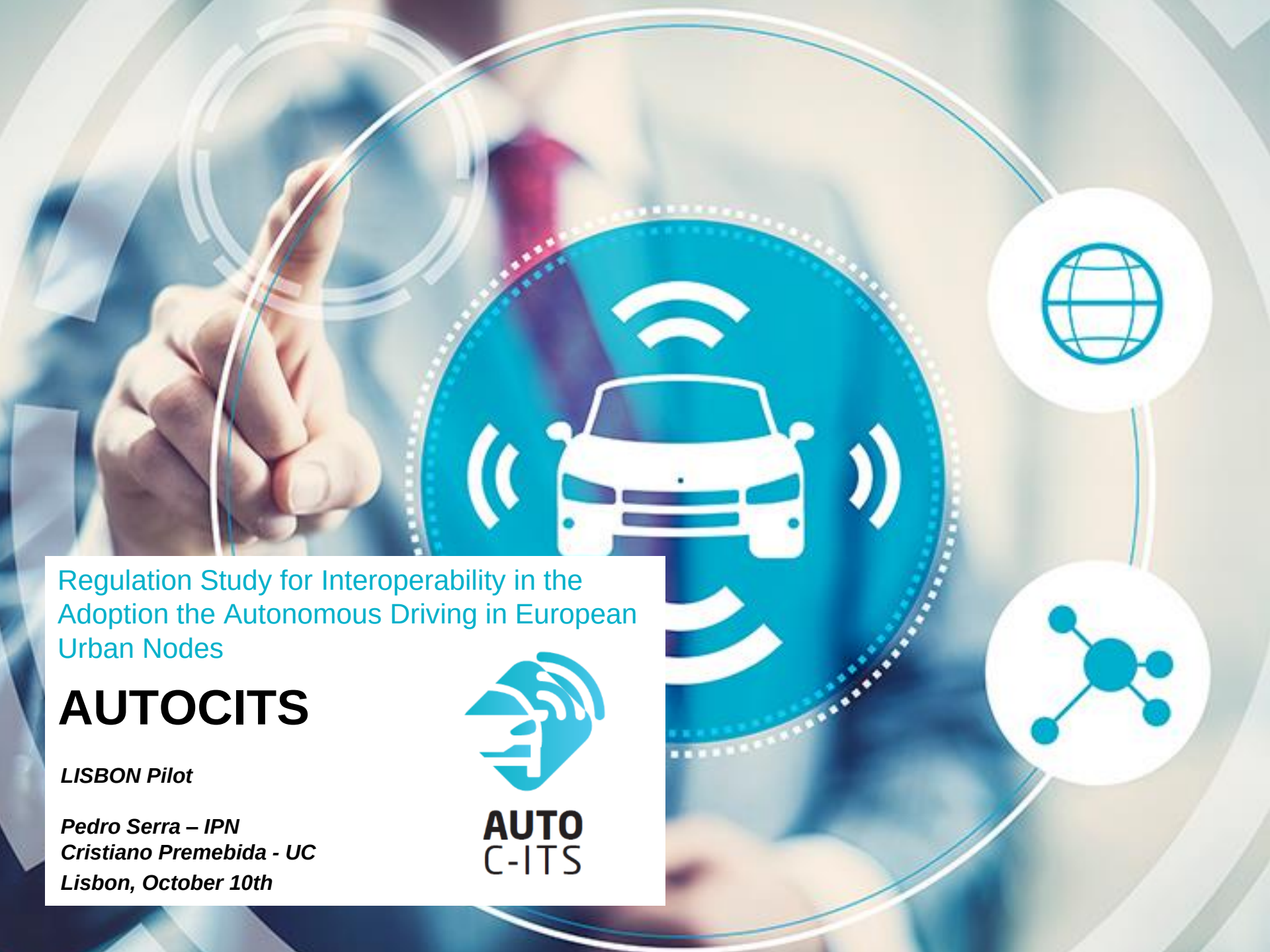

Regulation Study for Interoperability in the Adoption the Autonomous Driving in European Urban Nodes

AUTOCITS

LISBON Pilot

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Lisbon, October 10th

AUTO C-ITS

LISBON PILOT

1. Pilot Overview
2. Day 1 C-ITS service
3. Autonomous and Connected Vehicles
4. Autonomous Shuttles – the MOVE
5. Test-cases
6. Assessment/Evaluation
7. Highway scenarios

Pilot Overview

Autonomous and connected vehicles:

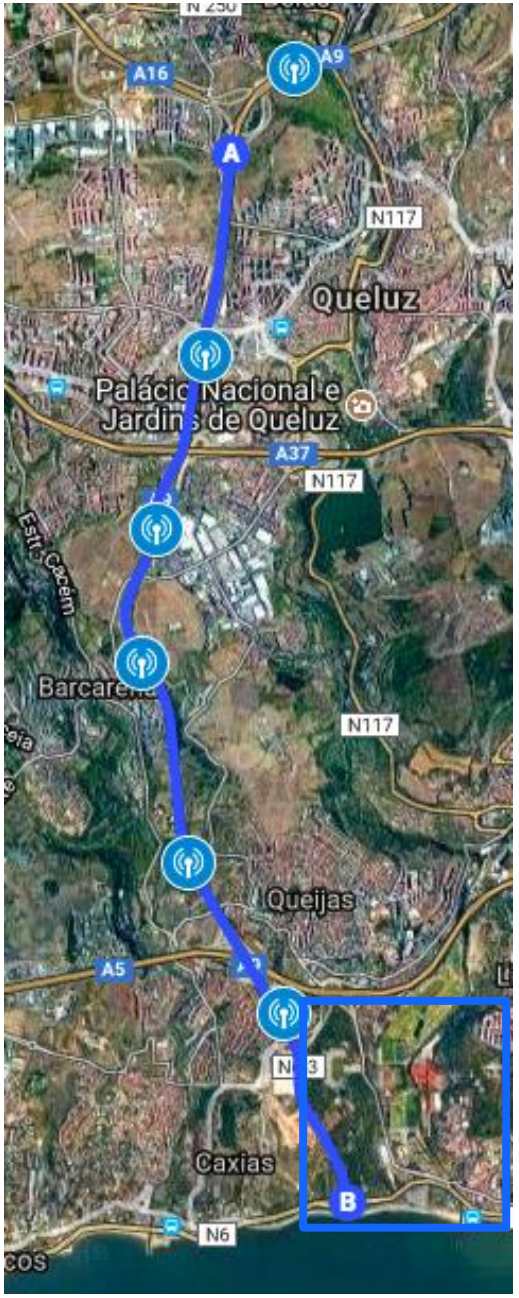
- A9-CREL;
- Between junction with A16 and Avenida Marginal;
- 2 Service Stations for support;
- Distance of 7km (6km of A9 and 1km of N6-1).

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.

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

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.

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

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

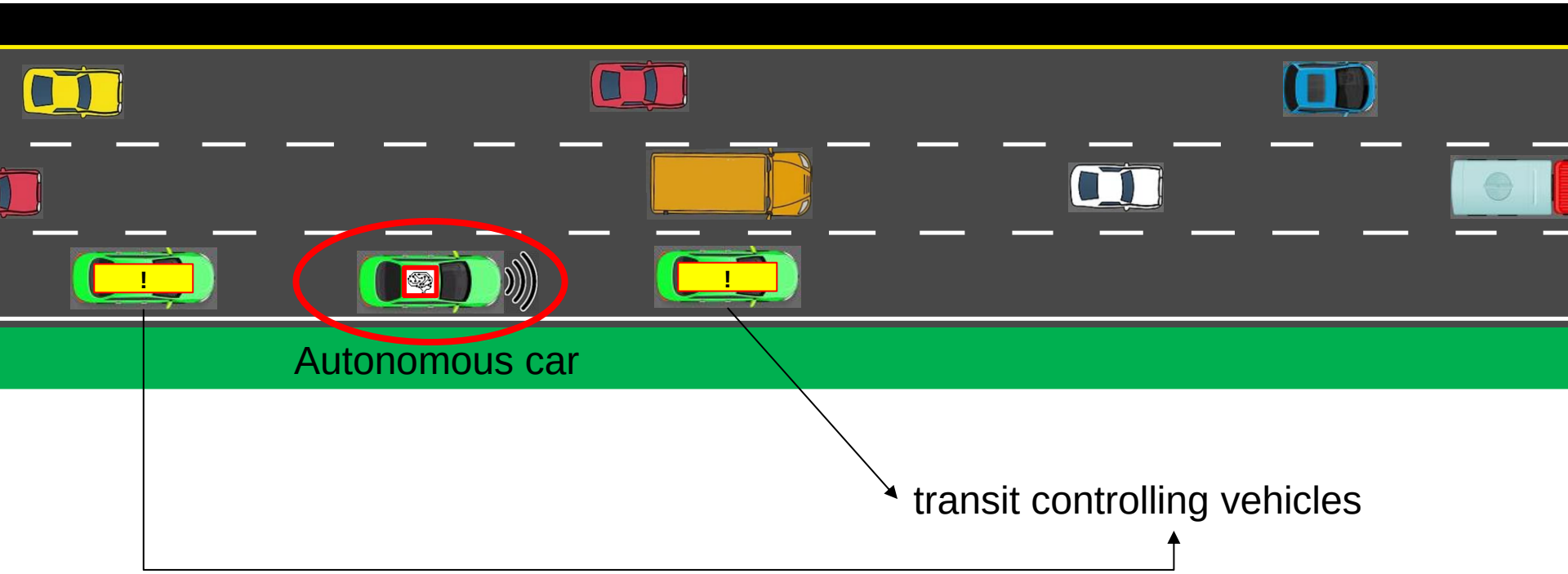
- **On-board**: time of operation; speed profile; position; received messages; actions/commands executed
- **Infrastructure**: received messages and events (from TMC); sent messages
- **External parameters**: weather conditions; obstacles position; number of vehicles; type of vehicles

Actions

- **Change the speed**: autonomous cars; instrumented (connected) cars
- **Change the lane**: eg, to avoid an obstacle (simulated / realistic) on the road

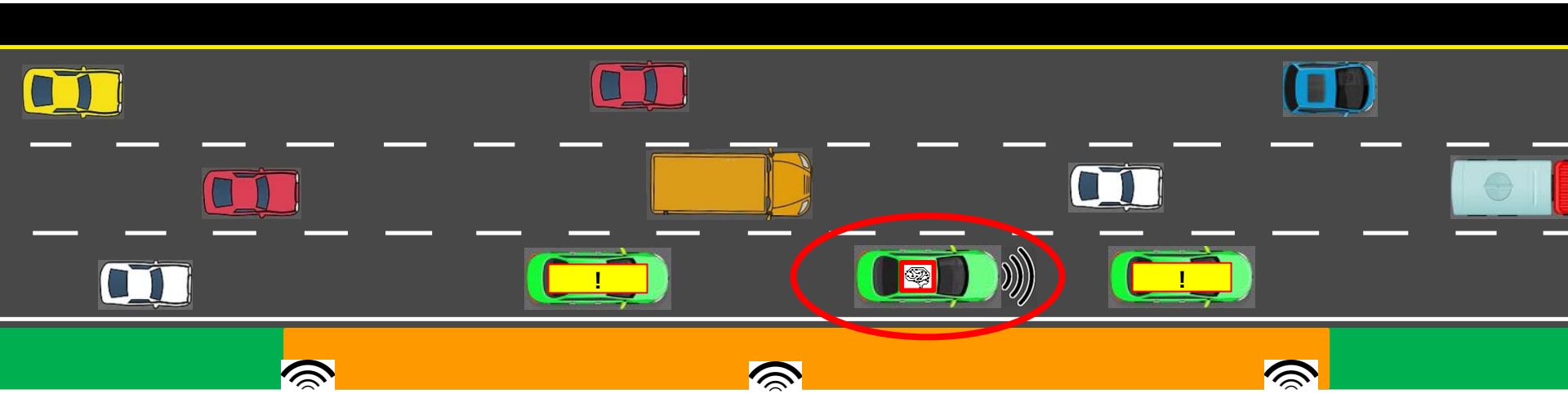
Scenarios in highway: base condition

Scenario: **Dedicated lane (manual and automatic modes)**



Scenarios in highway: I

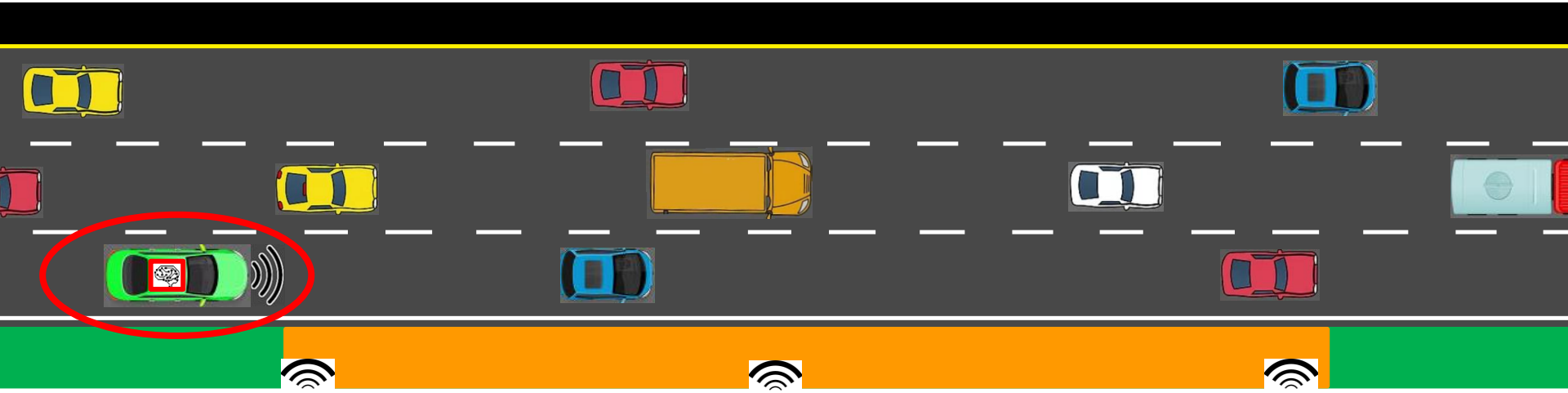
Scenario: **Dedicated lane**



Author: *Cristiano Premebida*

Scenarios in highway: II

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



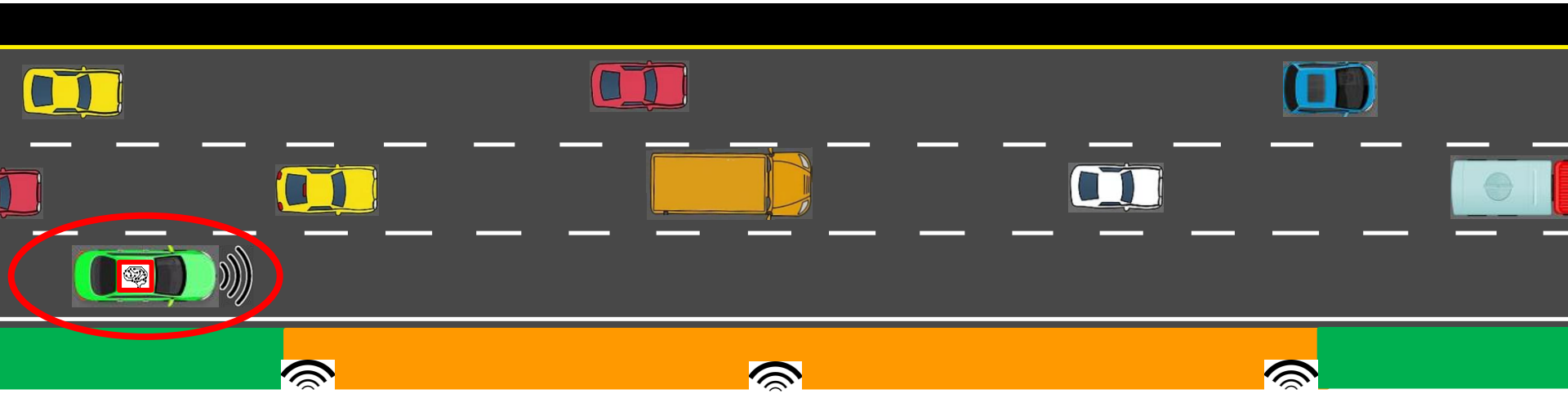
No TCVs: transit controlling vehicles

Scenarios in highway: III

Scenario: **No-restriction (C-ITS)**

Example of a test-case

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

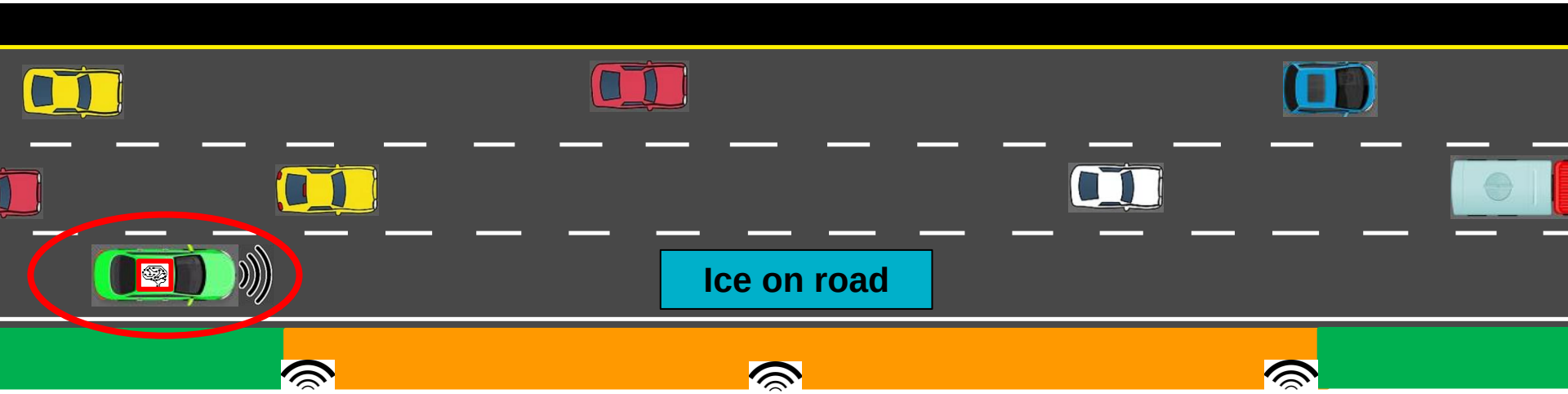


RSUs: sending messages; simulated events

Action: acknowledgement of all the messages

Example of a test-case

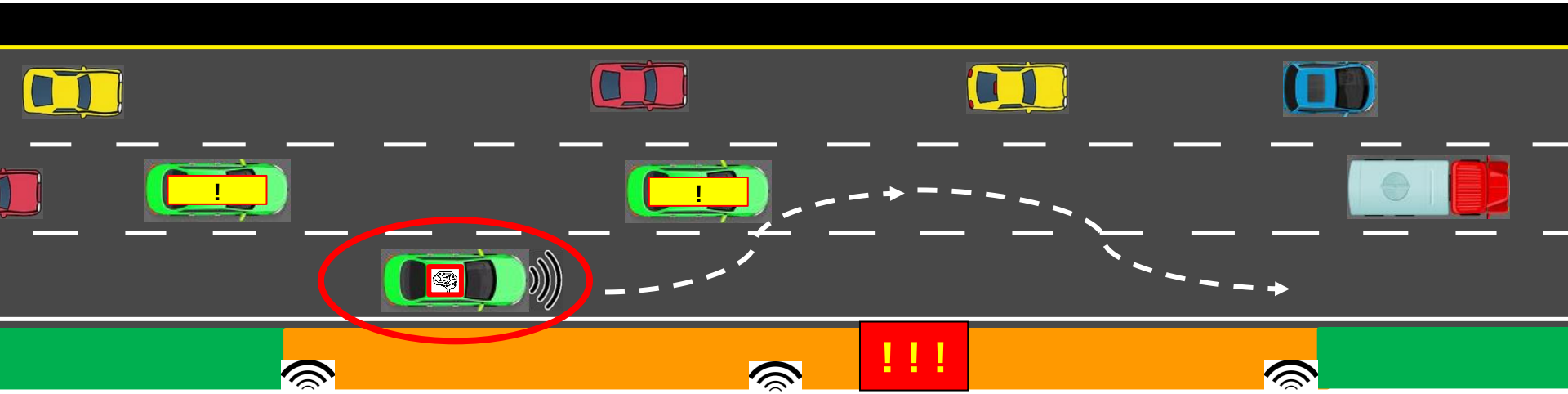
Test-case: Dedicated lane (C-ITS enabled) & **simulated event**



Action: reduce the speed

Example of a test-case

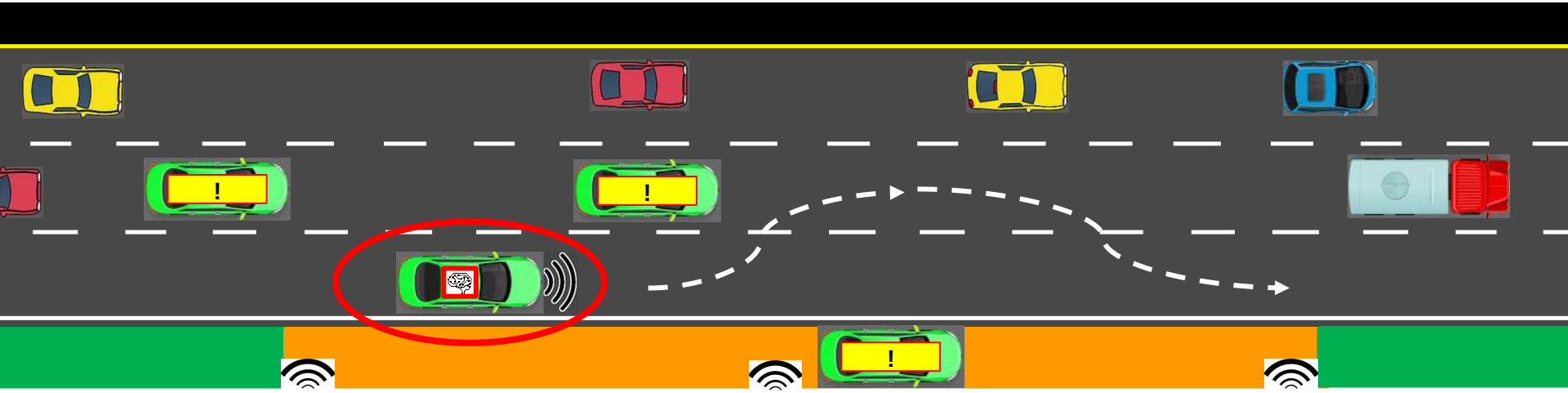
Test-case: Dedicated lane (C-ITS enabled) & **simulated event** (obstacle/object on the roadside)



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

Example of a test-case

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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Project **AutoC-ITS** is co-financed by the European Union's Connecting Europe Facility (CEF)

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