



EVALUATION OF C-ITS SERVICES THROUGH SIMULATIONS (FRANCE)

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6th November 2019



Outline

I – The need for a simulation tool for evaluation

II – Presentation of Artery simulation platform

III – Evaluation results of GLOSA

IV – Evaluation results of hybrid communication scenarios: ITS-G5 and LTE

V – Challenges and work in progress

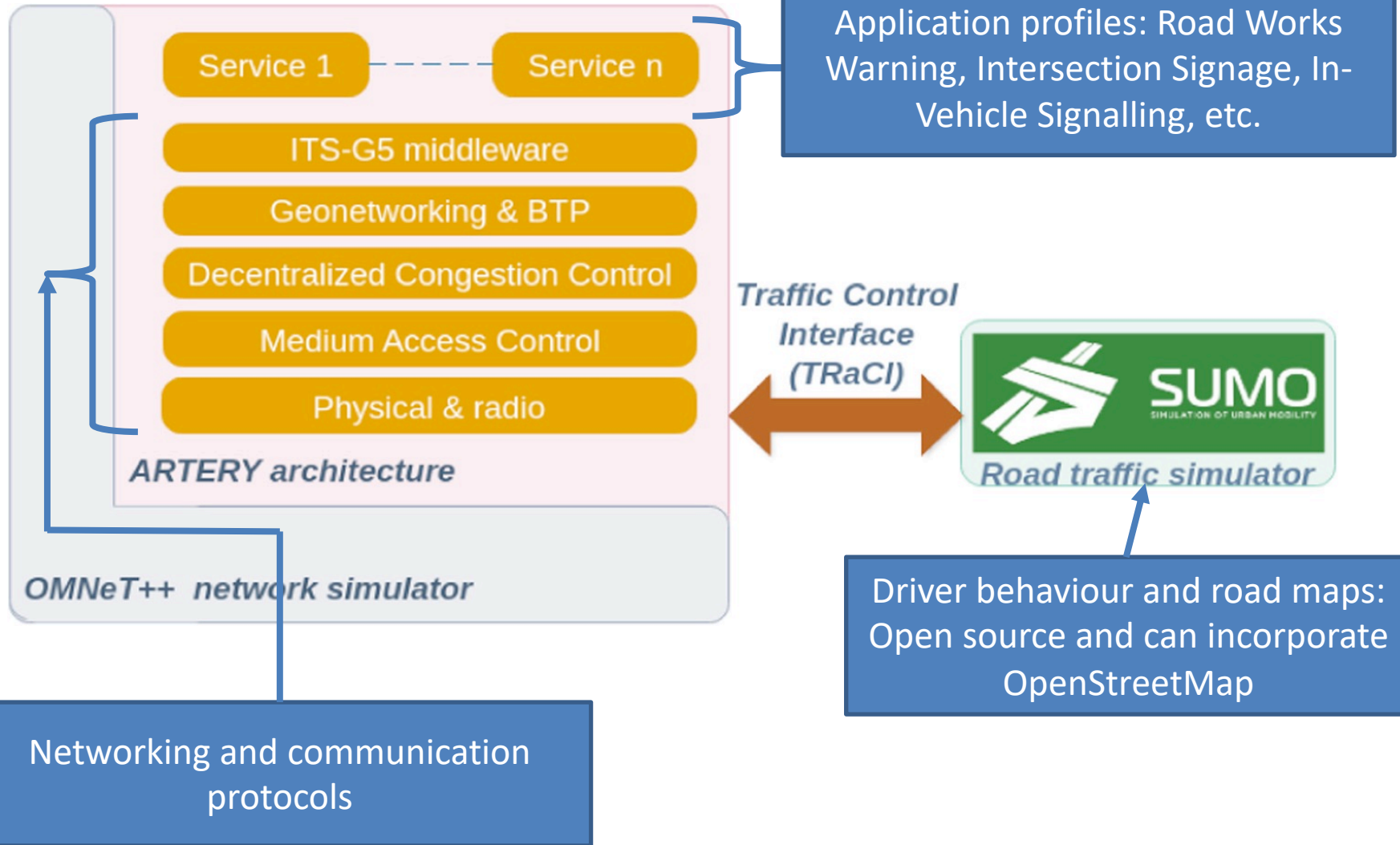
The need for a simulation tool for evaluation

- Ⓒ How to measure the impact of C-ITS applications on:
 - Ⓒ Traffic
 - Ⓒ Driver behaviour
 - Ⓒ Economy
 - Ⓒ Ecology
 - Ⓒ Etc.
- Ⓒ Real life tests are:
 - Ⓒ Expensive £ €
 - Ⓒ Difficult to do on large scales
 - Ⓒ Almost impossible to do in a controlled environment
 - Ⓒ Difficult to repeat for confirmation or testing the impact of a specific parameter
- Ⓒ Simulation tools can help avoid these obstacles

Simulation tools

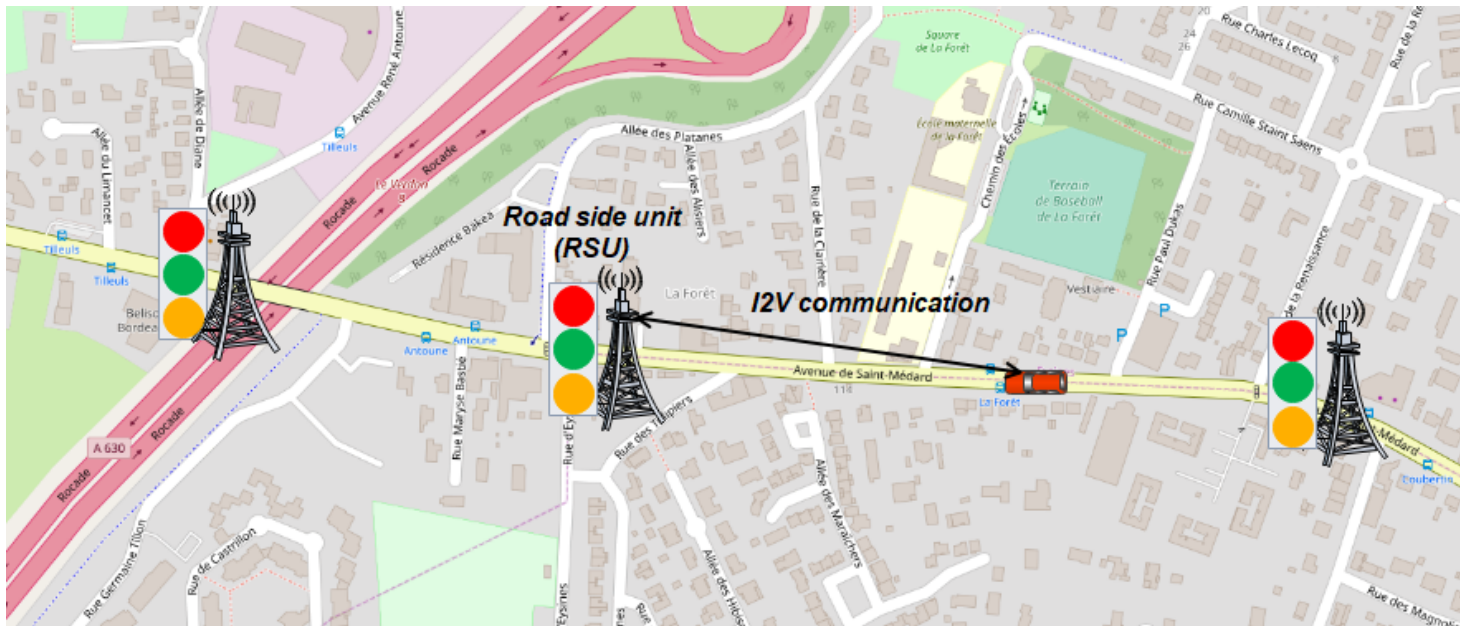
- Ⓒ A simulator is a software that is supposed to emulate a real life system
- Ⓒ When simulating a C-ITS system there are many aspects to emulate:
 - Ⓒ Communication: wireless medium, transmission protocols, networking protocols, etc. **This the most technical part**
 - Ⓒ Vehicles: models, maps, etc. **This the most difficult part to emulate**
 - Ⓒ Applications: scenarios, etc. **This the easiest part**

Artery simulation platform



- Ⓒ Most models are based on car following
- Ⓒ Trailing vehicles should adapt their speed according to the leading vehicle
 - Ⓒ Krauss Model
 - Ⓒ IDM (Intelligent Driver Model)
 - Ⓒ Wiedemann
- Ⓒ Please refer to «Evaluation of car-following-models at controlled intersections» by Laura Bieker-Walz, Michael Behrisch, Marek Junghans, Kay Gimm

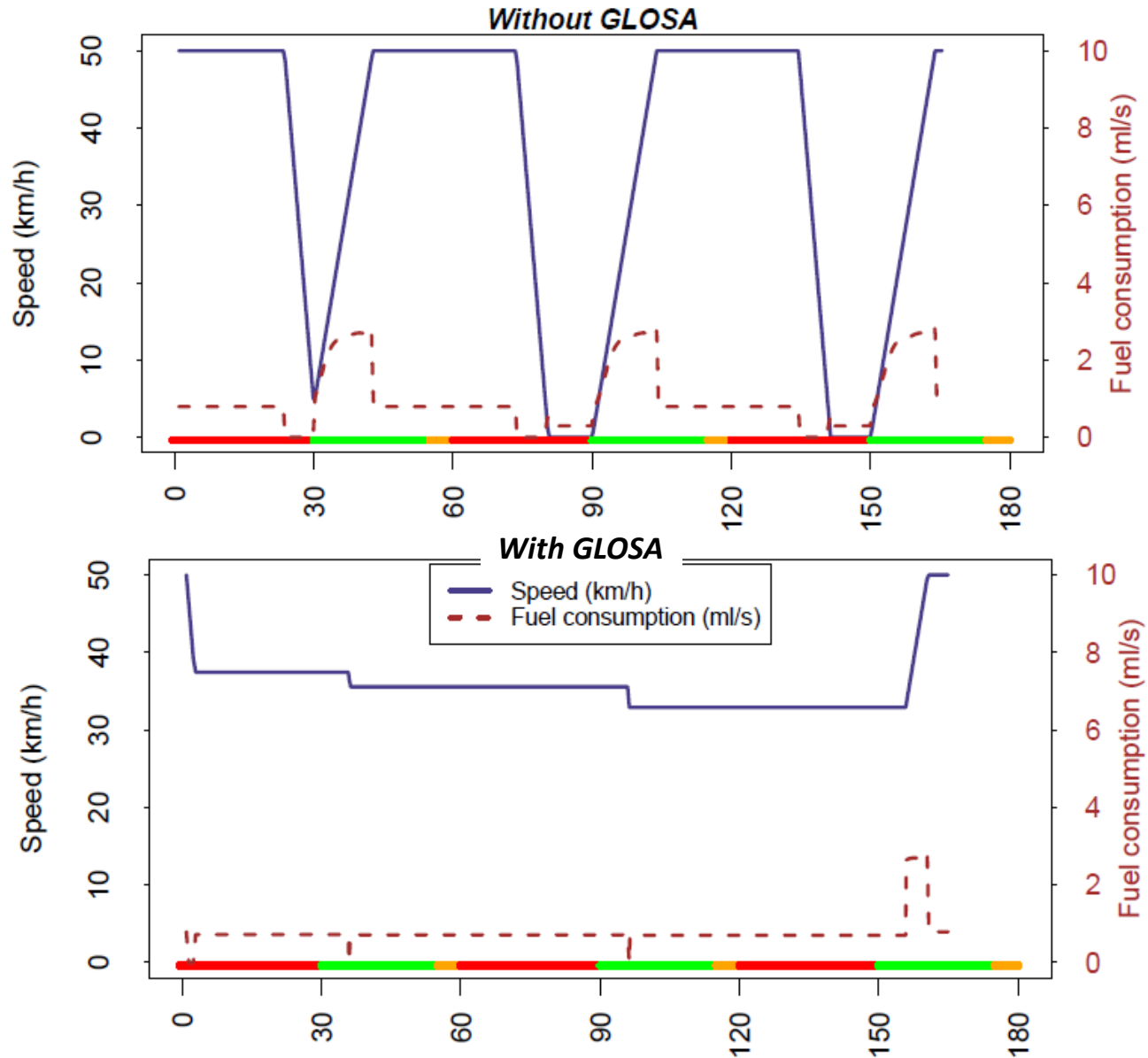
- Ⓒ GLOSA (Green Light Optimal Speed Advisory)
- Ⓒ RSUs will announce the timing of a traffic light so that the approaching vehicle adapts its speed and pass the intersection while the traffic light is green



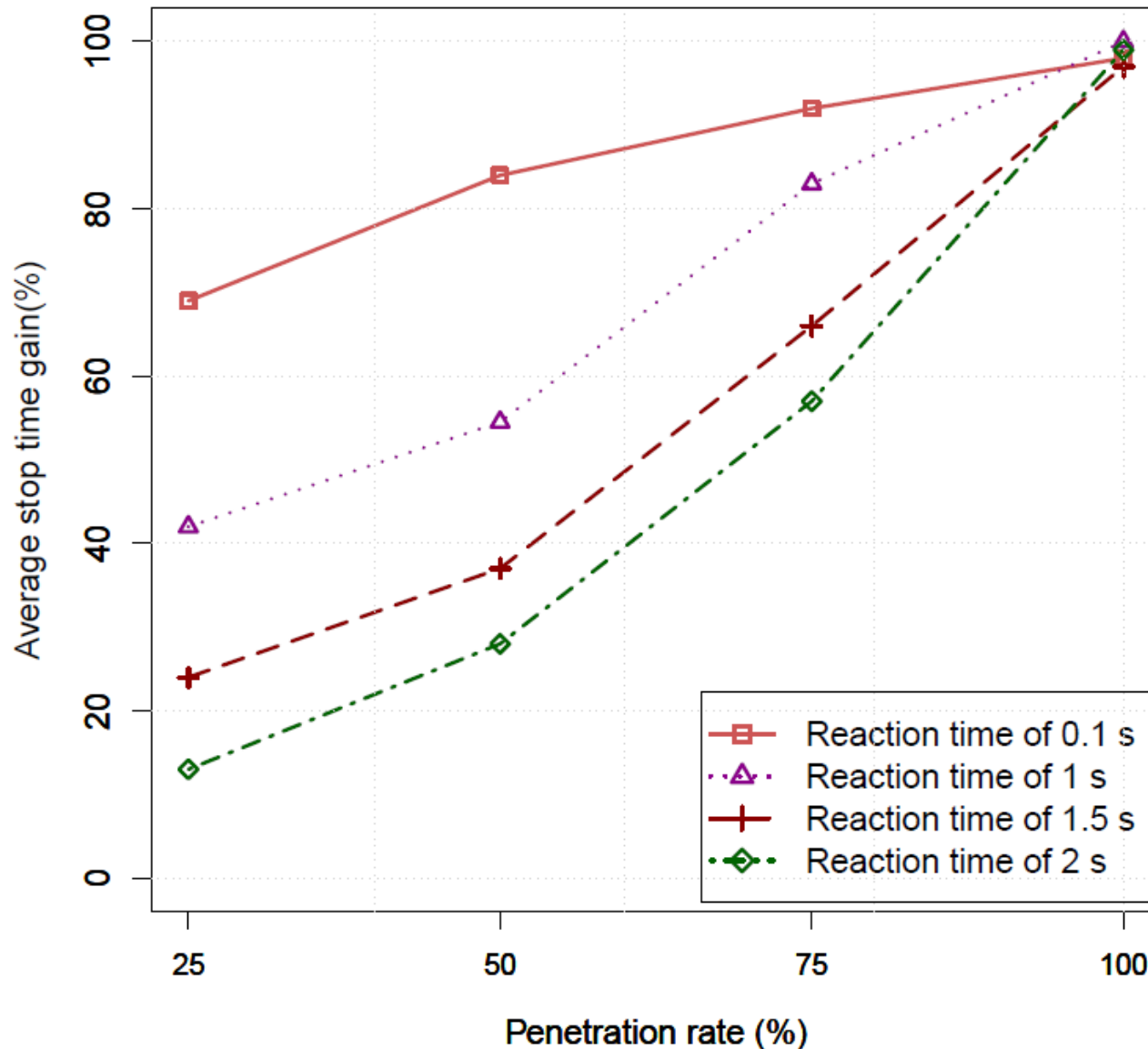
Simulation parameters

- Ⓒ Activation distance 900 m
- Ⓒ Max speed 50 Km/h, min speed 20 Km/h
- Ⓒ Acceleration 1 m/s², deceleration 2 m/s²
- Ⓒ Traffic light cycle: red 30 s, green 25 s, yellow 5 s
- Ⓒ Broadcast period: 0.5 s

Speed and fuel consumption

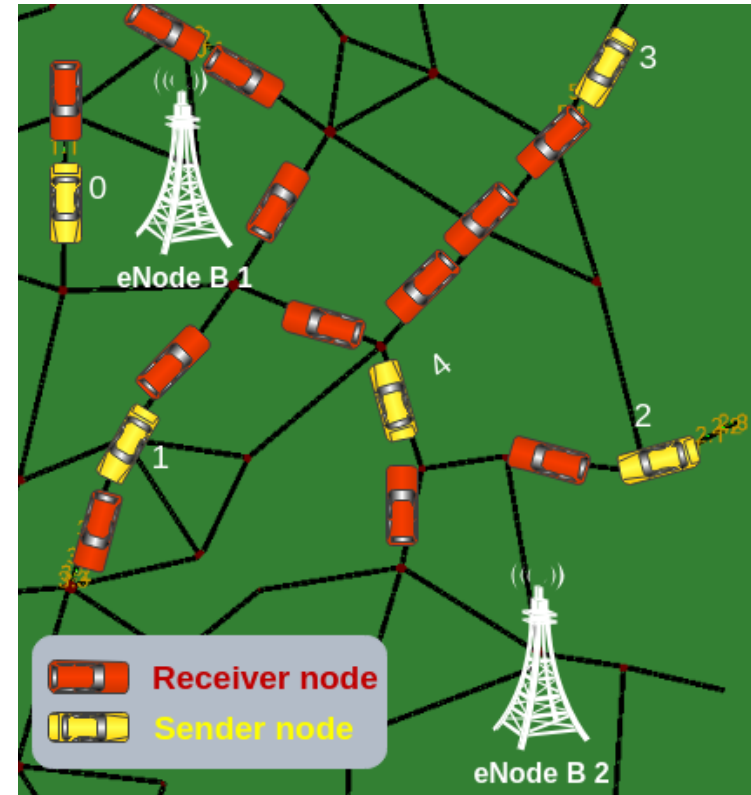


Reaction time impact

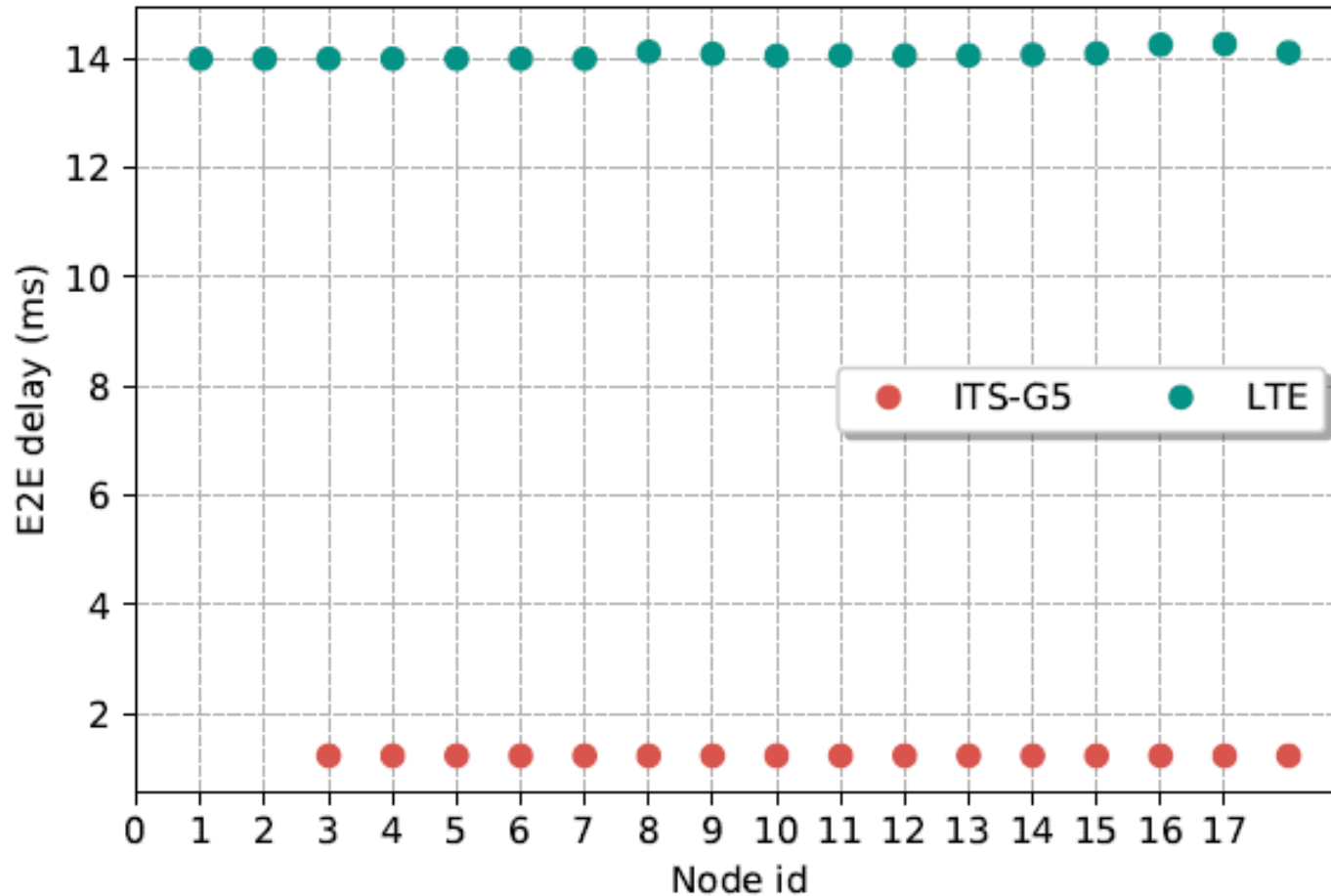


LTE-V2X vs ITS-G5

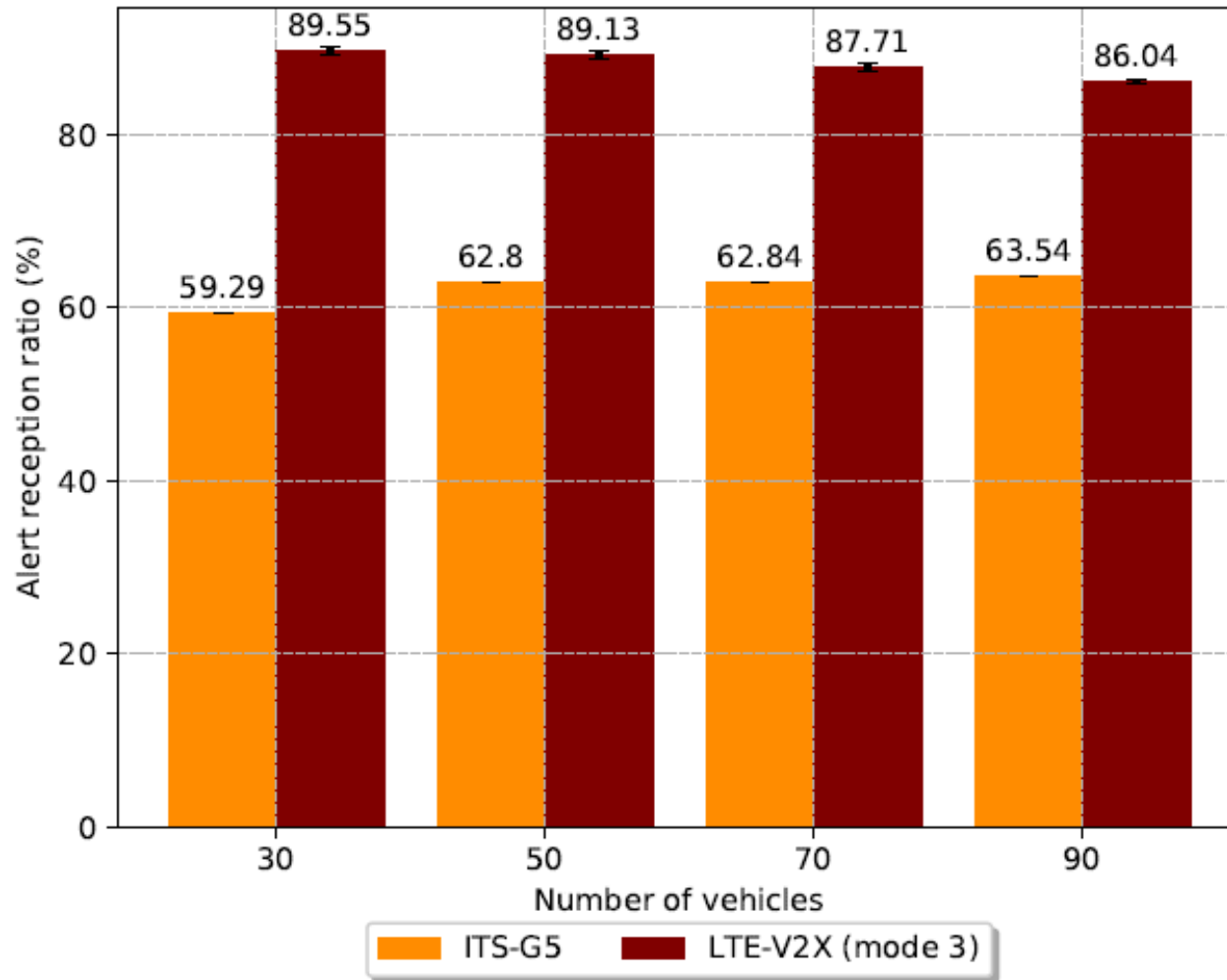
- C-ITS traffic will coexist with other user traffic on LTE network
- We considered typical data traffic usage per day based on L. korowajczuk, “How to dimension user traffic 4G networks,” CelPlan international, inc, 2014.
- We only measured the radio part of the network (no core network)
- Scenario: alert notification sent by yellow vehicles



Delay performance



Reception efficiency



Challenges and work in progress

- Ⓒ Concerning communications:
 - Ⓒ Make sure that communication protocols are correctly implemented
 - Ⓒ Make sure that the right functionalities are implemented
- Ⓒ Concerning driver behaviour:
 - Ⓒ We do not have enough real life input to model the reaction of drivers
 - Ⓒ Different drivers behaviours
- Ⓒ Current efforts:
 - Ⓒ Hybrid communication system
 - Ⓒ Simulate large scale scenarios: cities, or parts of a city
 - Ⓒ Lack of realistic traffic light systems

Published results

- © Mouna Karoui, Antonio Freitas, Gerard Chalhoub, **Comparative evaluation study of GLOSA approaches under realistic scenario conditions**, Ad Hoc NOW, Oct 2019
- © Mouna Karoui, Antonio Freitas, Gerard Chalhoub, **Impact of driver reaction and penetration rate on GLOSA**, Nets4Cars Nets4Train Nets4Aircraft Workshop, May 2019
- © Mahdi Sharara, Marc Ibrahim, Gerard Chalhoub, **Impact of Network Performance on GLOSA**, IEEE Consumer Communications and Networking Conference, January 2019
- © Mouna Karoui, Antonio Freitas, Gerard Chalhoub, **Efficiency of Speed Advisory Boundary fINder (SABIN) strategy for GLOSA using ITS-G5**, Performance Evaluation and Modeling in Wired and Wireless Networks, September 2018



THANK YOU!

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