"Road infrastructure ready for mixed vehicle traffic flows"

What is INFRAMIX ?

INFRAMIX is an EU funded project in the framework of ART-05-2016 'Road infrastructure to support the transition to automation and the coexistence of conventional and automated vehicles on the same network'. Its full title is 'Road Infrastructure ready for mixed vehicle traffic flows' and its duration is 36 Months (June 2017–May 2010).

Within the project, 11 partners collaborate targeting to design, upgrade, adapt and test both physical and digital elements of the road infrastructure, ensuring an uninterrupted, predictable, safe and efficient traffic.

To meet this high-level objective INFRAMIX is working on different technologies, combining simulation, traffic flow modelling, traffic estimation and control algorithms e.t.c. This work includes ways of informing all types of vehicles about the control commands issued by the road operator and the proposal of new kind of visual and electronic signals for the needs of mixed scenarios.

The outcomes will be assessed via simulation and in real stretches of advanced highways. Key aspects considered throughout the project will be to ensure that the proposed adaptations will not jeopardize safety, quality of service, efficiency and will be appreciated by the users.

To achieve its objectives INFRAMIX selects a bottom-up approach. Instead of working in generic solutions with questionable impact, it builds on three specific high value (in terms of importance for traffic efficiency and safety) traffic scenarios, namely "dynamic lane assignment", "roadworks zones" and "bottlenecks".

INFRAMIX objectives

- Design new and update existing physical & digital road infrastructure elements;
- Develop a co-simulation environment;combining the modelling of the vehicle behaviour with the traffic simulation to examine mixed traffic scenarios under various penetration rates of automated vehicles
- Design and implement novel traffic estimation, monitoring and control strategies;
- Develop hybrid testing system; coupling infrastructure elements and vehicles on real roads with virtual traffic environment including representative mixed traffic situations
- Design novel signaling and visualization elements;
- Evaluate traffic safety and user's appreciation;
- Create a Road Infrastructure Classification Scheme

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 723016.

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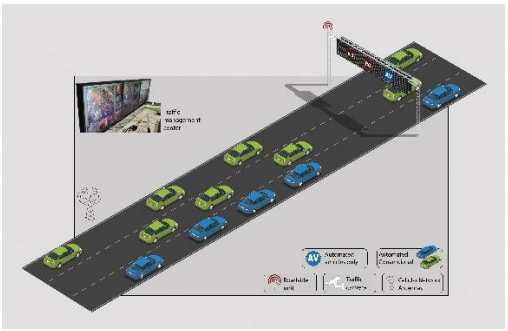
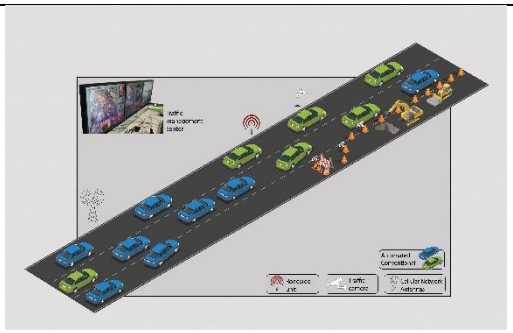


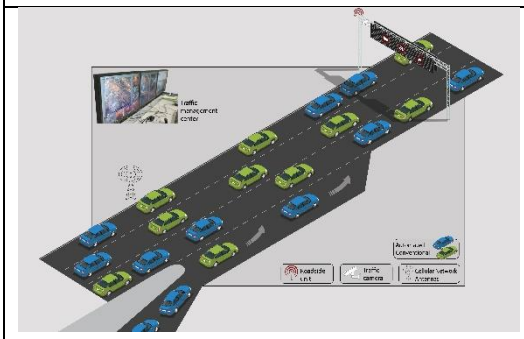
Dynamic lane assignment
(incl. speed recommendations)

- Real-time lane assignment under dynamic penetration rate of automated vehicles
- Exceptional traffic situations-adverse weather conditions
- A conventional vehicle drives on a dedicated lane for automated vehicles

Roadworks zones

- Automated vehicles driving behaviour adaptation in real time at sags
- Lane-Change Advice to connected vehicles at Bottlenecks
- Lane-Change Advice combined with Flow Control at Bottlenecks for all vehicles

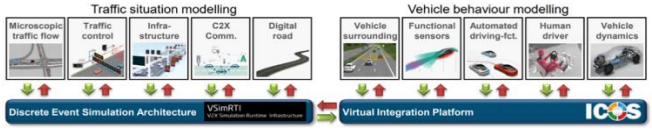




Bottlenecks

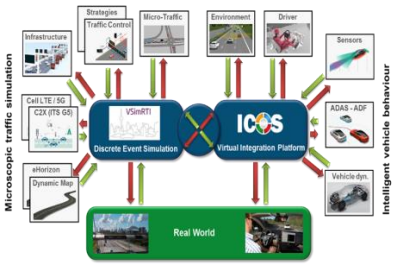
- Single Lane Closure (e.g. short term constructions)
- New Lane Design (e.g. long term constructions)

Real tests in modern highways



Co-simulation environment: combines the modelling of the behavior with the traffic simulation

Hybrid testing: coupling infrastructure elements and vehicles on real roads with virtual traffic environment



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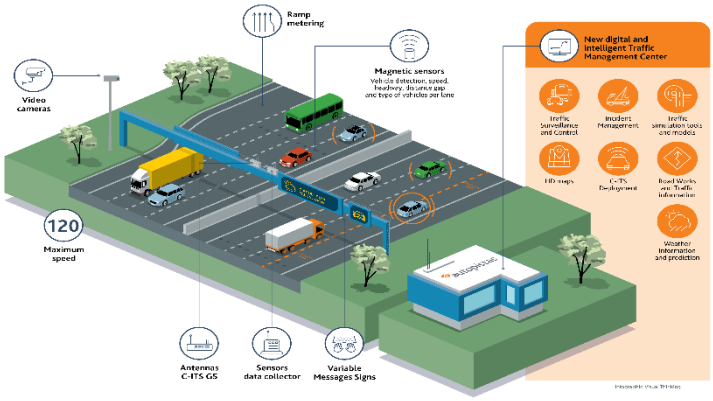
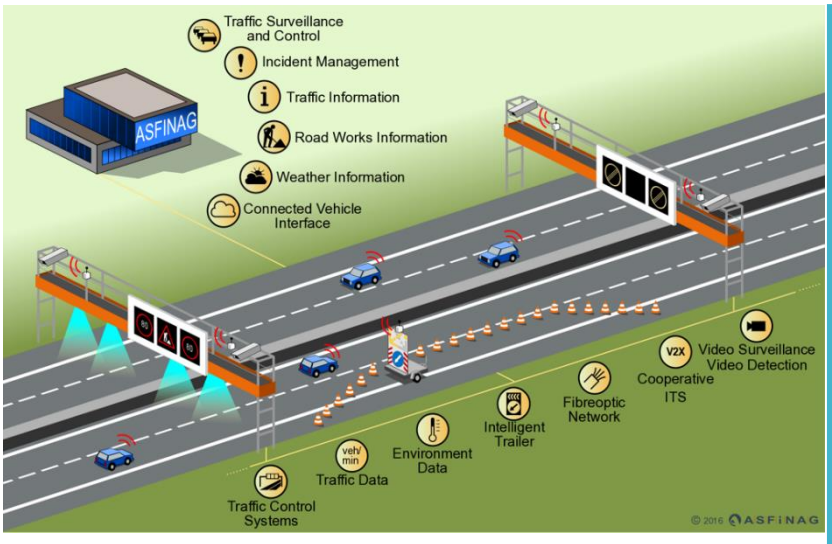
The Spanish test site is located within the Mediterranean Corridor between Barcelona and the French border. The specific highway segment is over 20km of four-lane carriageway. Each lane is 3,5m wide. The internal hard shoulder is 1m and the external hard shoulder is 2,5m. The highway median is 5m wide (in average). The test site includes four intersections and a 180m tunnel. The Average Daily Traffic (ADT) in this section was around 30.000 vehicles per day in 2016, and the speed limit is 120km/h.

The currently available ITS equipment includes different types of VMSs, video cameras, Bluetooth antennas, and magnetic sensors for measuring occupancy and 1 Weather station. ITS-G5 short range communication and cellular communication are available at the test-site, and a proprietary Fibre Optic ring network with 10 Gb Bandwidth connects all the equipment from the test-site to the TMC in real-time.





The Austrian Test Site includes 20km of A2 motorway between Laßnitzhöhe and City of Graz. The test site is equipped with gantries, mobile VMS, roadworks warning equipment, ITS-G5 RSUs, video cameras (traffic management, single vehicle detection), single-vehicle counters, environmental sensors and radar detection. It enables testing of newly developed visual information, ITS-G5 short-range communication, cellular communication and real-time communication with the traffic control center. The infrastructure is based on a fibre-optic network that provides IP-based network connectivity to gantries.

The additional intention of the Austrian test site is to provide for each test run the complete precise trajectories of the tested vehicle as well as all vehicles in the surrounding traffic for the testing party to analyse. The data can be played back via a 3-D simulation tool.

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INFRAMIX expected impact

As the construction of new roads is an expensive and time consuming project while Europe has already a quite mature road network, and considering the fact that roads have a quite long lifecycle (especially compared with vehicles), the only way to prepare our existing road network for automation is through targeted interventions both physical and digital. This is even more important for the long transition period where we expect a step by step introduction of automation and mixed traffic on roads with different capabilities and installed equipment. In this respect, INFRAMIX is expected to have an important impact as it will deliver specific solutions with tangible integrated interventions, both physical and digital. These will be tested and validated beforehand through the use of innovative modelling technologies (new traffic flow models and advanced simulation tools) guaranteeing this way their efficiency, traffic safety but also users' appreciation and acceptance.

This set of interventions will be adaptable and incremental to cope with a variety of existing infrastructure (old, new, etc.) and diverse traffic scenarios (percentage of automated vehicles, of connected vehicles etc.). The fact that they will also be tested in quite demanding scenarios on the actual road networks of the consortium partners will ensure that the proposed scenarios will be realistic and aligned with modern road design and engineering principles.

Moreover, INFRAMIX will propose a scheme for classifying road infrastructure into "automation-appropriate" levels by listing connectivity and automation capabilities of each road segment, while informing road users about its capability to host automated vehicles of different levels of automation and connectivity.

At the same time provide a roadmap and guidelines both for the short and for the long term (towards automated transport systems) to support infrastructure owners, road operators and relevant authorities.

Key expected results

Road infrastructure for mixed traffic	• New traffic signs for mixed traffic • Novel traffic monitoring recommendations (wireless messages extensions)
Infrastructure Classification Scheme	• Indication of the infrastructure connectivity, automation capabilities, capability to host vehicles of different levels of automation and connectivity • A guide of how to incrementally upgrade levels of infrastructure to avoid stranded investments

Simulation platform: combines the modelling of the vehicle behavior with the traffic simulation	• Investigation of several cases with safety critical impact
	• Testing of innovative traffic control algorithms
	  ➢ With increased traffic densities in exceptional conditions
	  ➢ With different rates of conventional and automated vehicles

Hybrid testing system: coupling infrastructure elements and vehicles on real roads with virtual traffic environment	• Testing of new developments of connected and automated driving • Emulation of critical traffic situation in a safe artificial environment

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