



VIENNA 2018



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Advances in Road Infrastructure, both Physical and Digital, for Mixed Vehicle Traffic Flows

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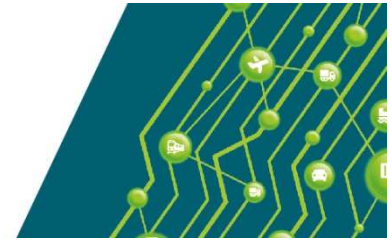


Outline



- INFRAMIX project: Towards a “hybrid” road infrastructure
- Traffic scenarios under investigation
- Physical & Digital road infrastructure advances overview
- Evaluation & optimization
- INFRAMIX Co-Simulation environment overview
- Impact and expected results
- Conclusions

Road INFRAstructure ready for MIXed vehicle traffic flows



www.inframix.eu

prepares road infrastructure for mixed vehicles traffic flows (June 2017-May 2020)



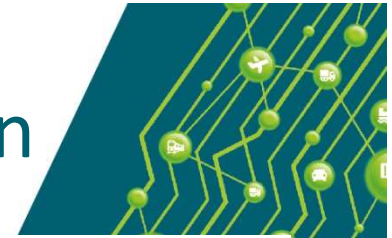
11 partners 2 highway real test sites, towards a “hybrid” road infrastructure:

- Design new and upgrade existing physical & digital road infrastructure elements
- Design novel signaling and visualization elements
- Design and implement novel traffic estimation, monitoring and control strategies
- Develop a co-simulation environment
- Develop hybrid testing system
- Evaluate user’s appreciation and acceptance
- Evaluate traffic safety
- Create a Road Infrastructure Classification Scheme

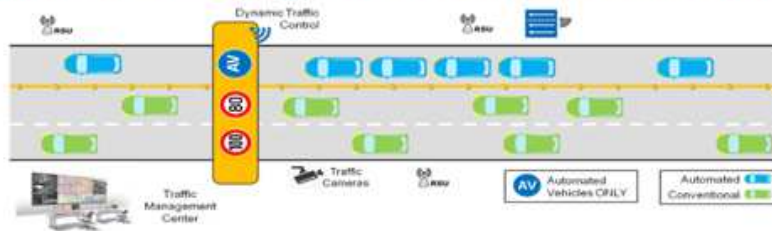
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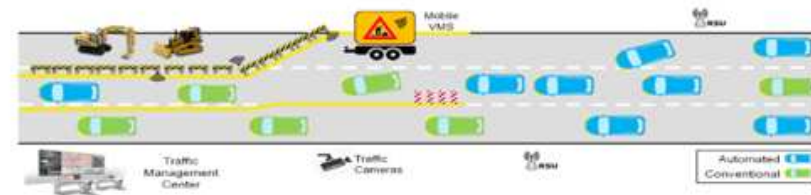
Three traffic scenarios under investigation



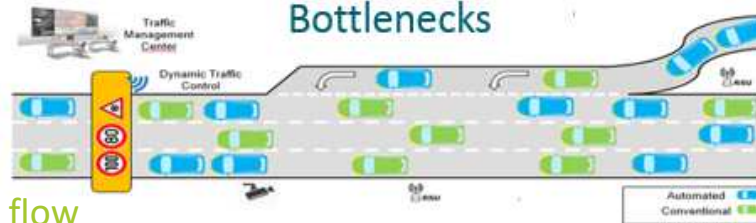
Dynamic lane assignment to automated driving



Roadworks zone



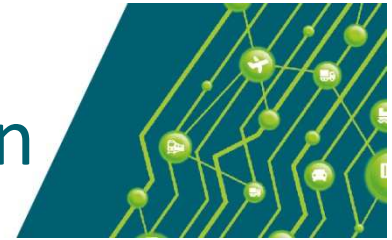
Bottlenecks



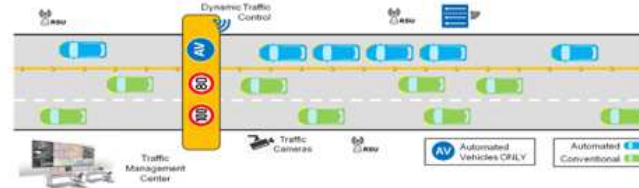
Selection criteria:

- expected impact on traffic flow
- expected impact on traffic safety
- importance of the challenges faced, in the sense that if not handled in a proper and timely way, they will negatively influence the introduction of automated vehicles on the roads
- ability to generalize on the results (applicable in other scenarios and environments)

Three traffic scenarios under investigation



Dynamic lane assignment to automated driving



- How to balance mixed traffic for maintaining the traffic throughput at the same level, as in case of today's traffic?
- Which are the proper indicators for activation and deactivation of lanes assigned to automated vehicles ?
 - Parameters under consideration:
 - penetration rate of automated vehicles
 - prevailing traffic conditions
 - Dynamic adaptation of the speed limits per lane
 - Lane recommendations for all vehicles
 - Visual and electronic ways for informing all vehicles/drivers
 - usage of physical segregation elements?
 - also considering adverse weather conditions

Three traffic scenarios under investigation



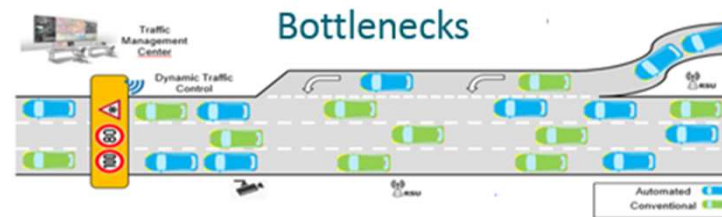
Roadworks are major safety hotspots with many accidents both for vehicles and for the staff on site

- Efficient and safe guidance of mixed traffic through roadworks zones :
 - updated maps
 - additional traffic signs
 - reference points on the spot for accurate localization for automated vehicles
 - new traffic control measures in the particular region

Information in real-time to both automated and conventional vehicles:

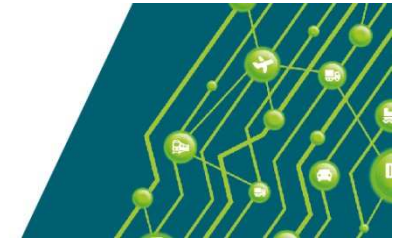
- To automated vehicles through electronic signals and up-to-date digital maps (electronic horizon)
- To conventional vehicles through guidance to their nomadic devices, visual signs and other physical elements (e.g. cones).

Three traffic scenarios under investigation



- Investigate real-time controllers to manage mixed traffic situations:
 - Different types of bottlenecks, with different penetration rates of automated vehicles
 - Innovative control strategies:
 - suggesting (real-time) time-gap and vehicle acceleration behaviour
 - distribution of the vehicles across lanes depending on traffic

“Hybrid” Road Infrastructure



○ Physical road infrastructure

- Visual and electronic signalling to inform and guide both conventional and automated vehicles
- Road side elements and related upgrades of today Traffic Management Centers (TMCs).

○ Digital road infrastructure

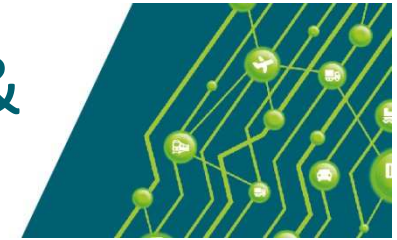
- Highly accurate digital maps
- Individualized speed and lane recommendations
- Traffic flow estimation methods for mixed traffic
- Investigation of different novel traffic management architectures (vehicle-based, cluster of V2V connected vehicles, V2I-based traffic control) and combinations
- Usage of short range (e.g. ITS-G5, WiFi) and long range (cellular) communication
- Definition of dedicated ITS specific messages



Today

Tomorrow

“Hybrid” road infrastructure evaluation & optimization



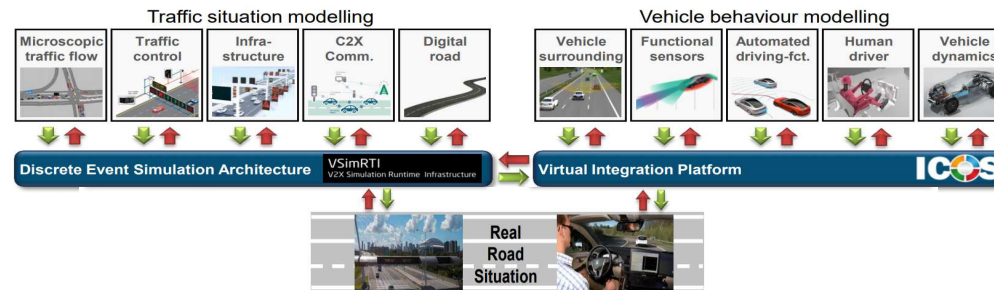
- Real tests in modern highways:

Girona (Spain)



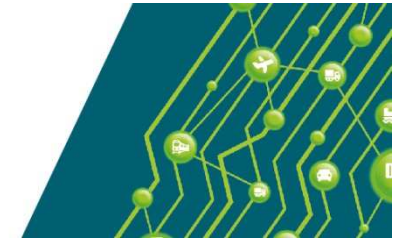
Gratz (Austria)

- Co-simulation environment: combines the modelling of the vehicle behaviour with the traffic simulation



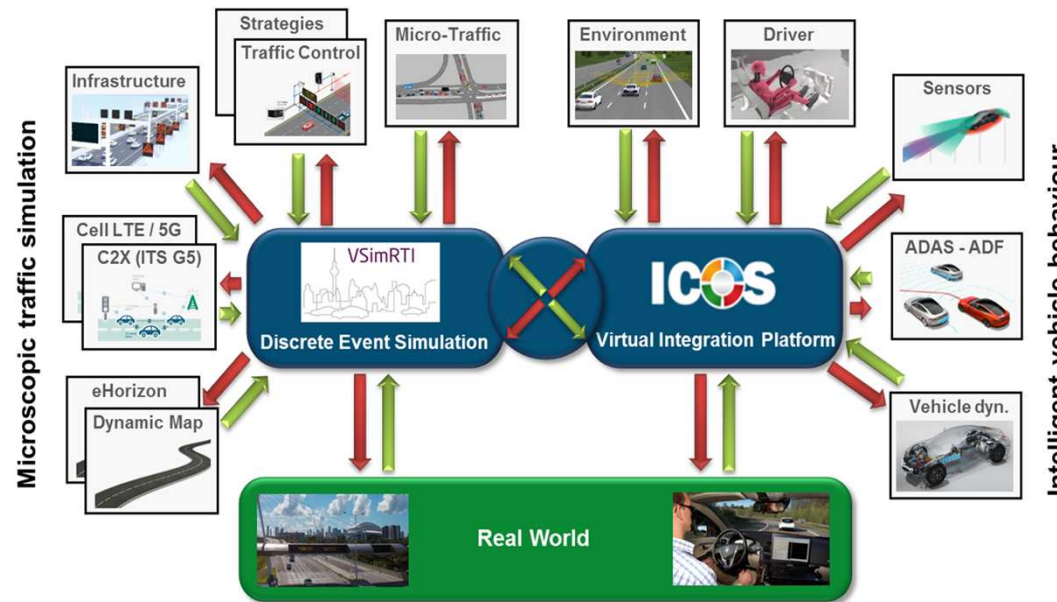
- Hybrid testing: coupling infrastructure elements and vehicles on real roads with virtual traffic environment

INFRAMIX Co-Simulation environment



Microscopic traffic simulation

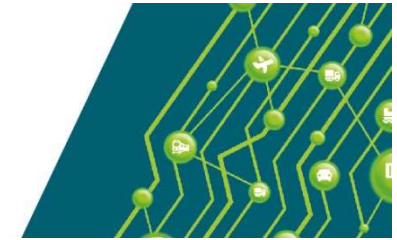
- realistic mobility pattern for a multitude of vehicles
- overall traffic flow
- Infrastructure sensor models
- Modelling the functionality of Informing vehicles with VMS
- Cellular (LTE or 5G) & WLAN based ad hoc communication (ETSI ITS) (OMNeT or ns-3)



Submicroscopic simulation

- Vehicle sensors models
- Detailed trajectory for the single vehicle : conventional vehicle (incl. human driving behaviour) & automated vehicle
- Simulation of the vehicle physical properties: engine acceleration , brakes, suspension

INFRAMIX Co-Simulation environment



The INFRAMIX Co-simulation environment combines the modelling of the vehicle behaviour with the traffic simulation enabling the :

- Investigation of several cases with safety critical impact (e.g. for the *roadworks zones* scenario).
- Testing of the developed traffic control algorithms (e.g. for the *bottlenecks* scenario)
 - with increased traffic densities in exceptional conditions
 - with different rates of the targeted vehicle types (conventional, automated).
- Scenarios testing (e.g. *the dynamic lane assignment* scenario) under adverse weather conditions.

Impact and expected results



Road infrastructure for mixed traffic

- New traffic signs for mixed traffic
- Novel traffic monitoring recommendations (wireless messages extensions)

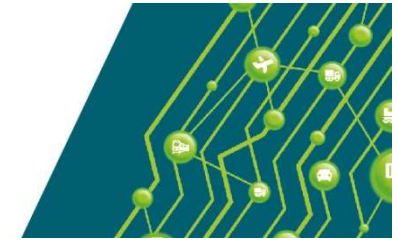
Hybrid testing system

- Testing of new developments of connected and automated driving
- Emulation of critical traffic situation in a safe artificial environment
- Real-time communication with real-world vehicles

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.

Conclusions



- INFRAMIX (H2020 project) prepares road infrastructure for mixed traffic and aims to influence community and stakeholders through Infrastructure classification scheme
- Provides a simulation platform and hybrid system testing of high value for future research
- Implements novel traffic monitoring and control
- Evaluates users appreciation and traffic safety in mixed traffic through *dynamic lane assignment*, *roadworks zones* and *bottlenecks* traffic scenarios.
- Propose new traffic signaling for the needs of mixed traffic
- Propose extensions to V2X communication standardization bodies



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