INFRAMIX – Overview of main results (so far)

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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.

INFRAMIX – Preparing road infrastructure for mixed vehicle traffic flows

Duration: *1 June 2017-31 May 2020*

EC Funding: *5M €*

Coordinator: *AustriaTech*

Consortium:

AustriaTech, ICCS,

Asfinag, Fraunhofer, Siemens Mobility,

Virtual Vehicle, Autopistas,

Enide, Technical University of Crete,

TomTom, BMW

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Mixed traffic situations will increase

- Several functions for automated driving already available (e.g. Traffic jam pilot, automated parking)
- Dynamic development
  - New functions
  - Extension of ODDs (e.g. to higher speeds, urban environments, worse weather conditions)
- Mixed traffic situations are increasing

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Mixed traffic situations expected to decrease efficiency and safety

- Human drivers and automated vehicles need to interact
- Automated vehicles will differ in functions and technical maturity
- Capabilities of specific automated vehicles are not known to other road users (incl. other automated vehicles)
- Uncertainty about the behaviour of other traffic participants will decrease the quality of interaction
- Efficiency and safety
  - depend on smooth interaction
  - will likely decrease in case of mixed traffic situations, if no measures are set

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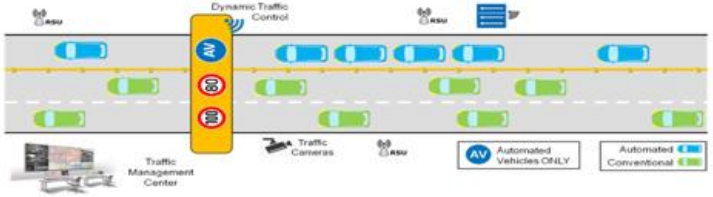
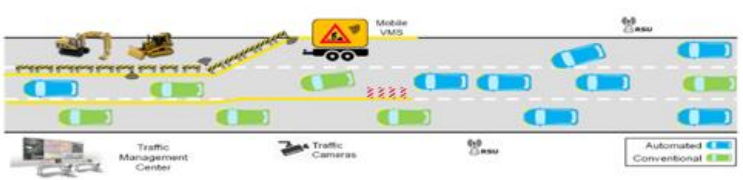
Infrastructure support can increase efficiency and safety in mixed traffic situations

- INFRAMIX expects to improve traffic efficiency, safety and users' appreciation through support by physical and digital infrastructure:
  - By setting up a dedicated lane for automated vehicles in certain traffic conditions
  - By giving automated vehicles additional support for roadworks zones
  - By using appropriate control strategies for bottlenecks

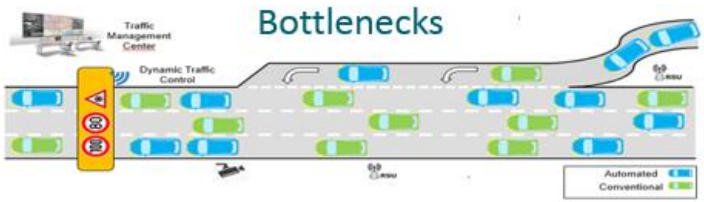
Dynamic lane assignment to automated driving



Roadworks zone



Bottlenecks



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INFRAMIX solutions address different levels

- Support of automated vehicles with information
  - e.g. on weather conditions, road work zones or incidents ahead
  - Vehicles can adapt in advance to conditions ahead
- Direct support for automated vehicles, e.g.
  - Precise maps of road work zones layout
  - Transmitting mandatory traffic signs via electronic messages
- Control strategies for mixed traffic situations
  - at bottlenecks
  - activate and deactivate a dedicated lane for automated vehicles

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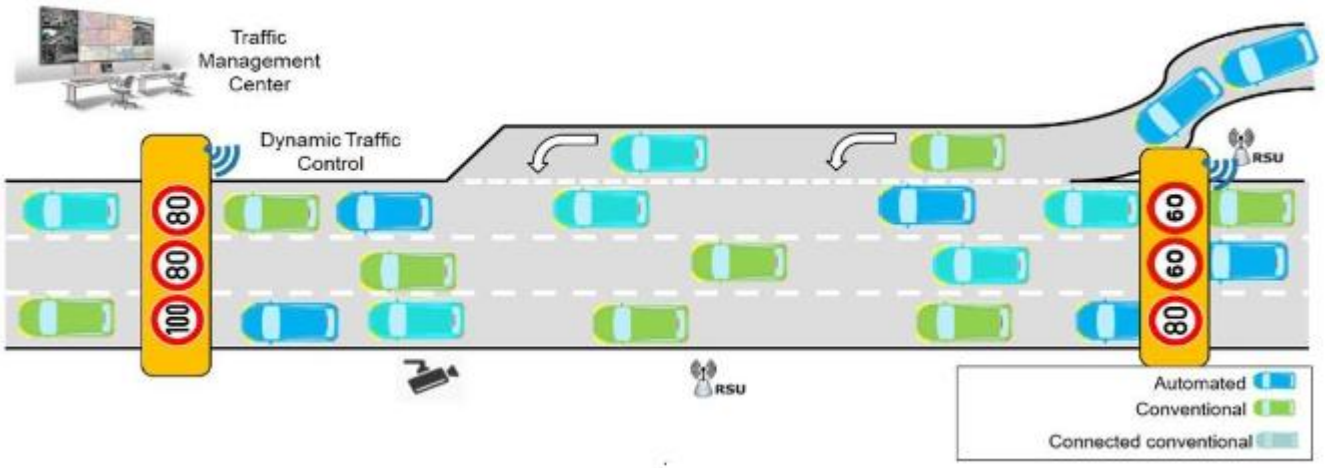
Traffic estimation and control strategies

- New traffic estimation algorithms have been developed
- New traffic control algorithms have been developed
  - Gap and acceleration advice
  - Mainstream traffic flow control
  - Lane change advice
- Tests have been carried out
- Evaluation phase is running currently => Detailed evaluation results will be available in the end of the project



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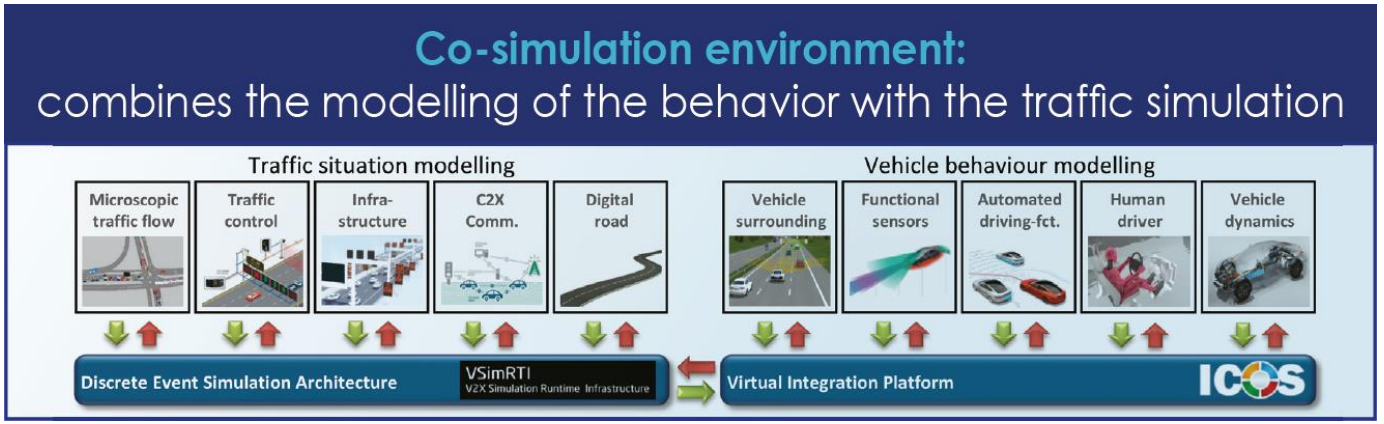
Evaluation of effects on efficiency and safety is a key element (1)



- Simulation tools to address mixed traffic scenarios have been set-up
- Co-Simulation environment has been developed
- Advanced traffic flow modelling has been realized with the INFRAMIX Co-simulation environment
- Used for the evaluation of the three INFRAMIX scenarios for highways.
- The Co-simulation environment consists of
  - VSimRTI for microscopic traffic simulation
  - ICOS for sub microscopic traffic simulation

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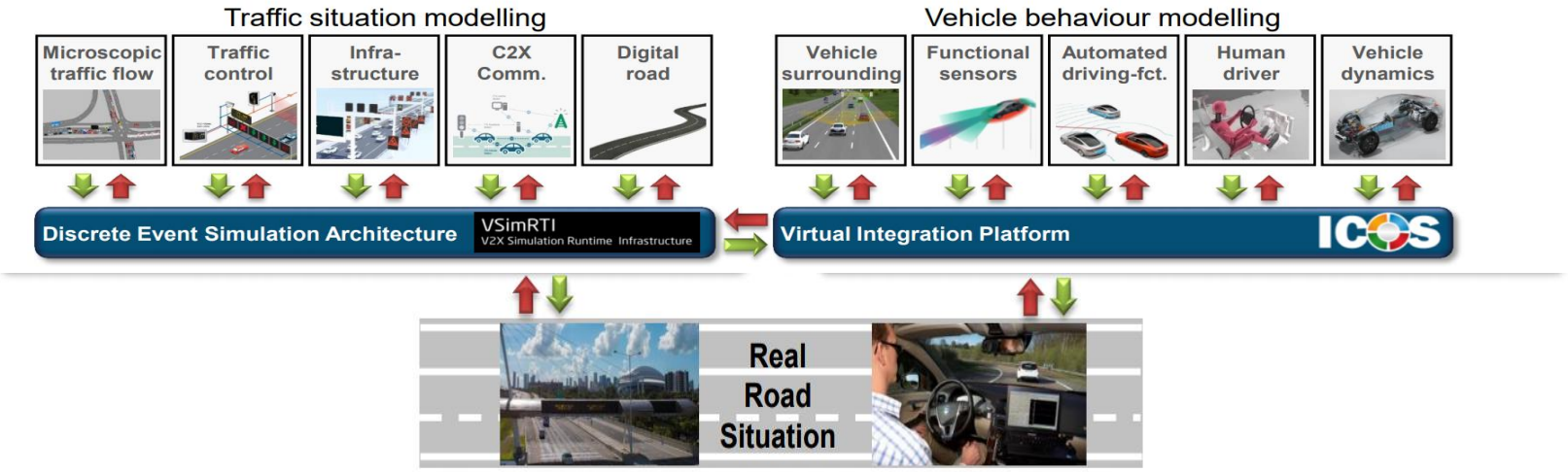
Evaluation of effects on efficiency and safety is a key element (2)



- Coupling of infrastructure elements with vehicles on real roads with virtual traffic environment has been realized
  - Enables detailed and realistic investigations of real driving behaviour in a complex but safe virtual traffic to demonstrate the potential of INFRAMIX.
  - Testing of new developments of connected and automated driving
  - Emulation of critical traffic situation in a safe artificial environment
- Tests have been carried out. The evaluation report will be available end of May.

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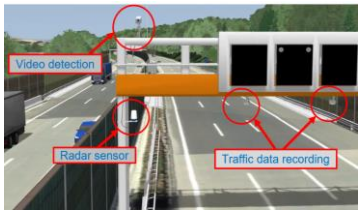
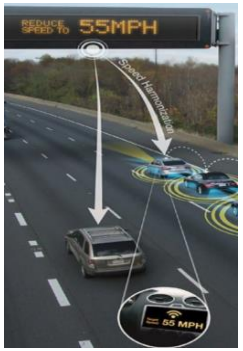
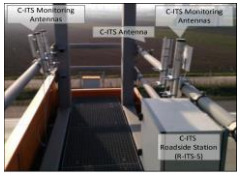
Infrastructure to address both automated and conventional vehicles







- A system architecture to be able to address both conventional and automated vehicles has been designed and developed
- Vehicles are addressed by ITS-G5 and cellular communication
- INFRAMIX system was implemented and tested in the test-sites in Spain and Austria
- Demonstration and Workshop events have been carried out. The users' appreciation evaluation report will be available officially the end of May, but the first results are very encouraging
- Detailed description of physical and digital elements is available (including functionalities, interfaces and messages)
- Visual signs required to realise the INFRAMIX use cases have been analysed and developed and implemented (digitally as well as directly on the road)

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Road Infrastructure Classification Scheme

- Infrastructure classification scheme for automated driving (ISAD) has been developed
- Classification of the level of support for automated vehicles provided by the infrastructure
- Could allow to keep up ODDs for longer time and reduce number of handovers
- Support timely deployment of automation-appropriate infrastructure networks
- Has been presented and discussed (amongst others in workshops) with a lot of stakeholders
- A detailed description is available on the INFRAMIX website

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Infrastructure Support levels for Automated Driving (ISAD)

	Level	Name	Description	Digital information provided to AVs			
				Digital map with static road signs	VMS, warnings, incidents, weather	Microscopic traffic situation	Guidance: speed, gap, lane advice
Conventional infrastructure	E	Conventional infrastructure / no AV support	Conventional infrastructure without digital information. AVs need to recognise road geometry and road signs.				
	D	Static digital information / Map support	Digital map data is available with static road signs. Map data could be complemented by physical reference points (landmarks signs). Traffic lights, short term road works and VMS need to be recognized by AVs.	X			
Digital infrastructure	C	Dynamic digital information	All dynamic and static infrastructure information is available in digital form and can be provided to AVs.	X	X		
	B	Cooperative perception	Infrastructure is capable of perceiving microscopic traffic situations and providing this data to AVs in real-time.	X	X	X	
	A	Cooperative driving	Based on the real-time information on vehicle movements, the infrastructure is able to guide AVs (groups of vehicles or single vehicles) in order to optimize the overall traffic flow.	X	X	X	X

Road infrastructure support levels for automated driving, Anna Carreras, Xavier Daura, Jacqueline Erhart,Stefan Ruehrup, 25thITS World Congress, Copenhagen, Denmark, 17-21 September 2018

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INFRAMIX Summary

Focus	• Mixed traffic: Automated & connected, connected, conventional vehicles (different levels of penetration) • Road infrastructure (high level road network)
3 Key Scenarios	• Dynamic lane assignment • Roadworks zone • Bottlenecks
Solutions	• Comprising new traffic management and control strategies, new physical and digital road infrastructure elements (define, specify, develop, implement)
Evaluation Tools	• Development of co-simulation framework • Real world implementation • Combination of real world and simulation (=Hybrid testing)
Recommendations	• Infrastructure classification scheme • Safety performance criteria • Roadmap towards a fully automated transport system

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