Overview of Automated Driving Research in Europe

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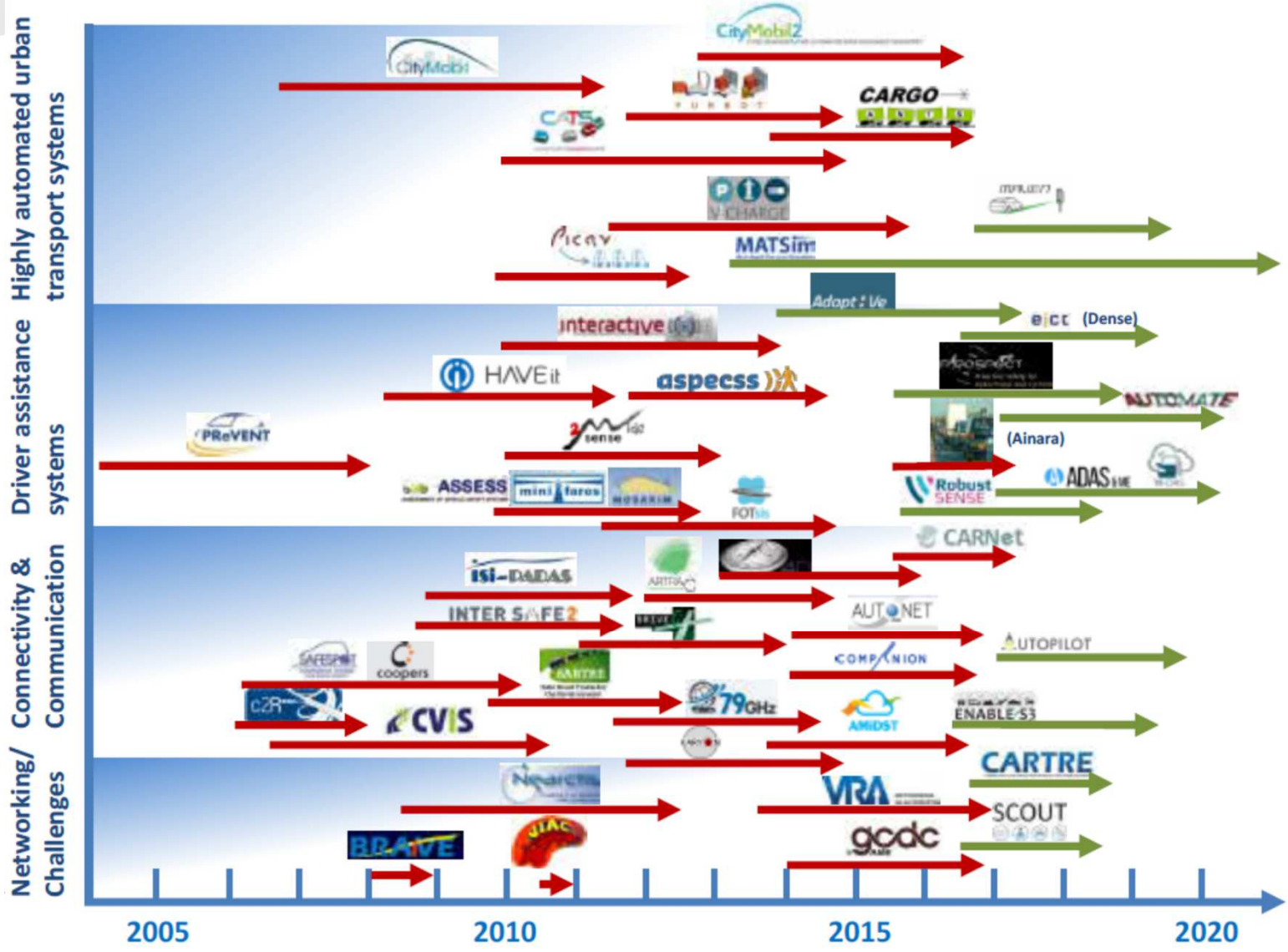
OUTLINE

- Introduction
- **L3Pilot:** Pilot Testing
- **INFRAMIX:** Hybrid Infrastructure
- **SAFERtec:** Cyber-security / Security Assurance
- Conclusions

INTRODUCTION

- **Automation** in Road Transport is a hot topic worldwide
- Several aspects are important and require attention and further research
- There are **several gaps** esp. regarding:
  - Common evaluation framework and testing
  - Road infrastructure
    - Physical
    - Digital
  - Cyber-security
  - …

KEY EUROPEAN INITIATIVES



*ERTRAC Automated Driving Roadmap Version 7.0 29/05/2017

EUROPEAN PROJECTS

L3Pilot

- Testing of L3 automated vehicles functions

INFRAMIX

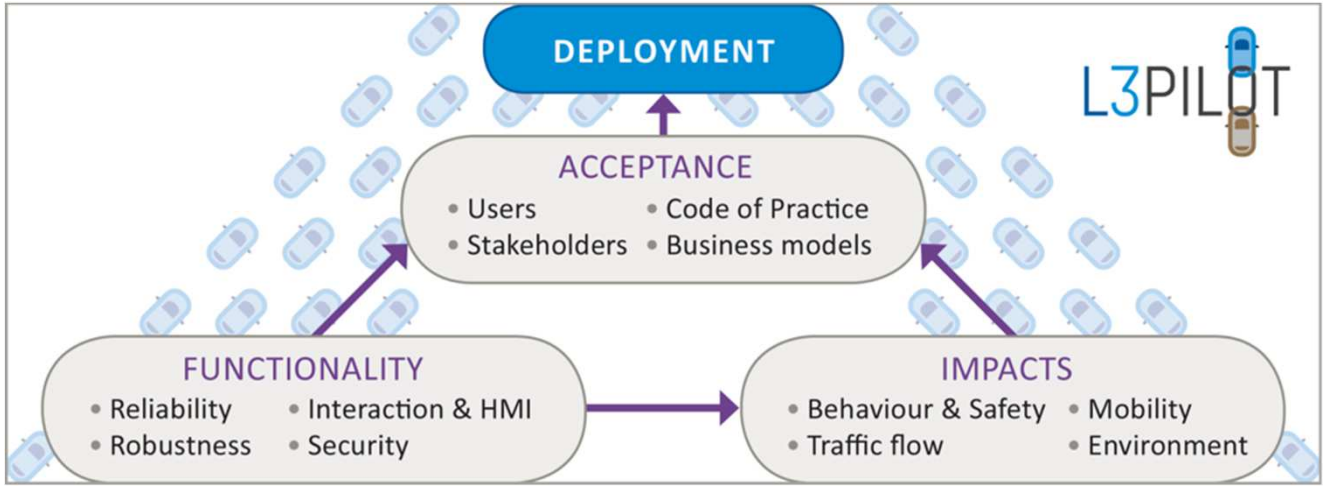
- Hybrid (Physical & Digital) Road Infrastructure

SAFERtec

- Cyber-security / Security Assurance

L3PILOT – OVERVIEW

- Large-scale piloting of AVs, mainly SAE Level 3 and some Level 4 functions (Sep 2017 – Aug 2021)
- 1,000 test drivers and 100 vehicles in 11 European countries



- Website: http://l3pilot.eu/

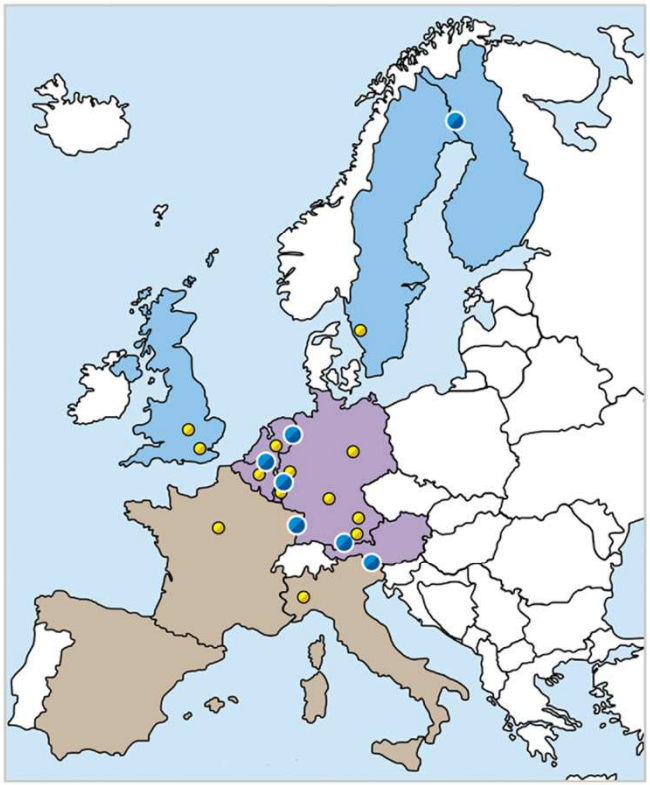
L3PILOT – KEY ACTIVITIES

- Code of Practice (CoP) for Automated Driving
- Methodology for piloting, testing and evaluation (research questions and hypotheses, performance indicators & measures, impact assessment, socio-economic evaluation, etc.)
- Evaluation framework
- Legal aspects / Legislation
- Cybersecurity
- Data logging tools & data management
- Pilots execution

PILOT SITES

Crossborder

Austria	Germany
Austria	Italy
Belgium	Germany
Belgium	Netherlands
Finland	Sweden
France	Germany
Germany	Netherlands



Country, region - OEM

BE, Brussels;
NL - Toyota

DE, Aachen - Ford

DE, Ingolstadt - Audi

DE, Munich - BMW

DE, Offenbach - Honda

DE, Wolfsburg - VW

FR, Paris and other regions - REN, PSA

IT, Turin - CRF

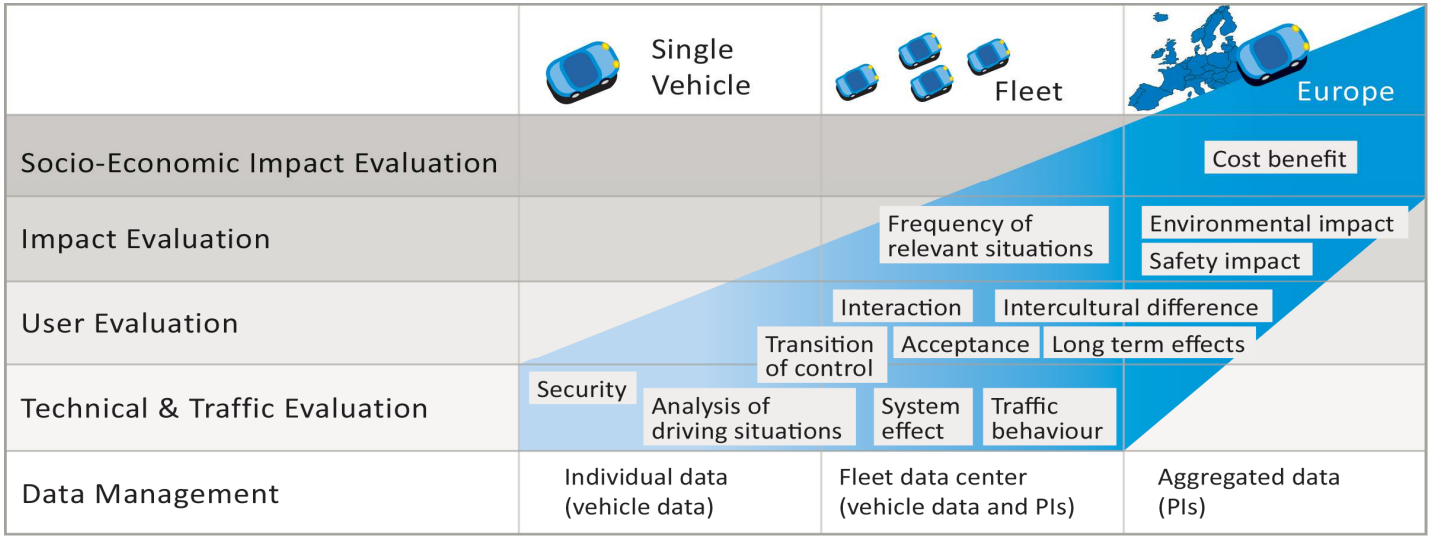
LU; NL - Delphi

SE, Gothenburg;
UK, London - Volvo

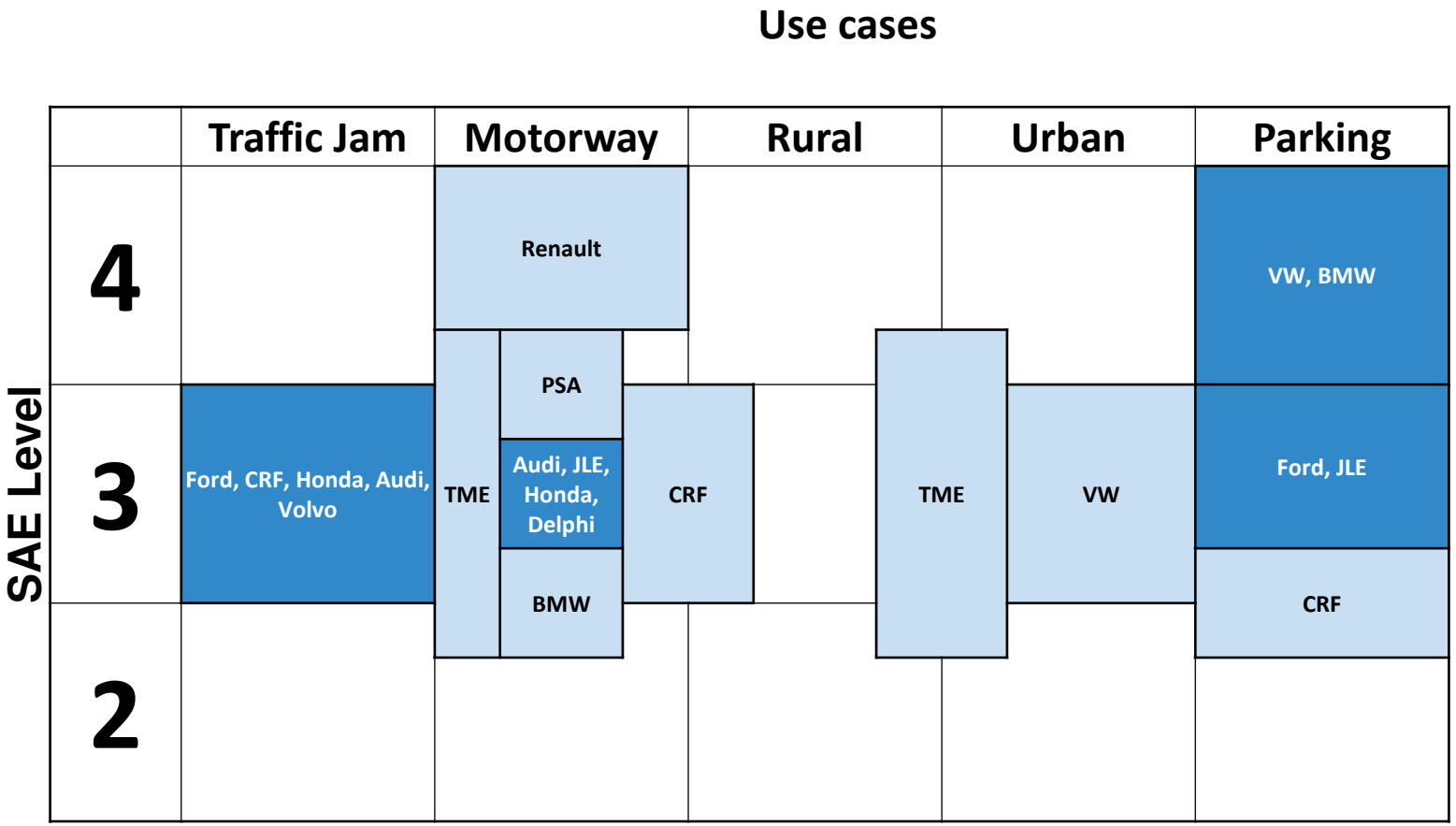
UK, Coventry - JLR

EVALUATION

- Evaluation of AD functions: technical, user acceptance, driving & travel behaviour
- Assessment of long-term effects of AD on user attitudes and acceptance
- Investigation of interactions between different traffic participants in different automation modes
- Assessment of readiness and reliability of AD functions
- Tools for the effective analysis, evaluation and impact assessment



USE CASES OVERVIEW



PREPARING ROAD INFRASTRUCTURE FOR MIXED TRAFFIC

INFRAMIX prepares road infrastructure for mixed vehicles traffic flows (June 2017-May 2020) https://www.inframix.eu/

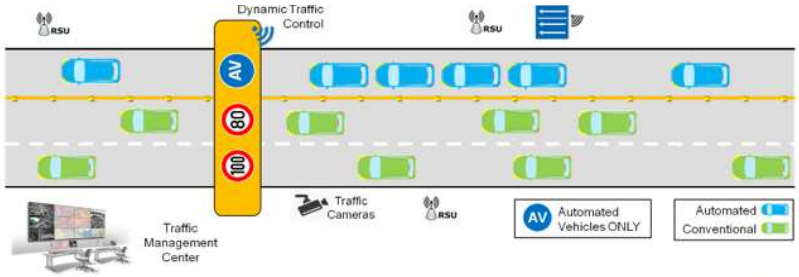
11 partners 2 highway real test sites, towards a “hybrid” road infrastructure:

- 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

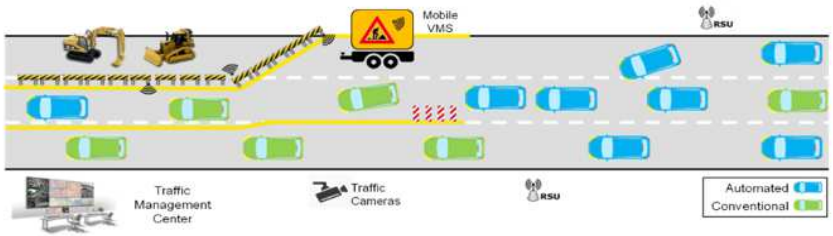
PREPARING ROAD INFRASTRUCTURE FOR MIXED TRAFFIC

Three traffic scenarios under investigation

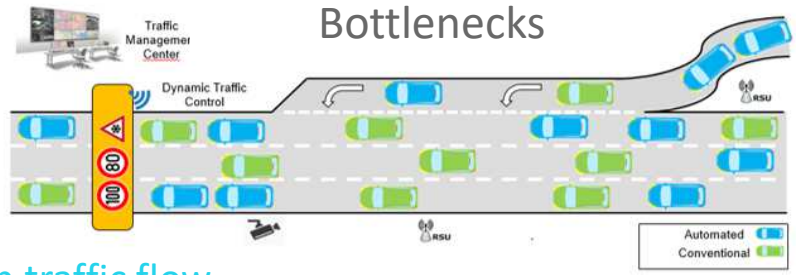
Dynamic lane assignment to automated driving



Roadworks zones



Bottlenecks



Selection criteria:

a) expected impact on traffic flow

b) expected impact on traffic safety

c) 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

d) ability to generalize on the results (applicable in other scenarios and environments)

INFRAMIX 3 SCENARIOS → 8 USE CASES

- *Scenario 1: Dynamic Lane Assignment (incl. speed recommendations)*
  1. Real time lane assignment under Dynamic Penetration Rate of Automated Vehicles (AVs)
  2. Exceptional circumstances e.g. adverse weather conditions
  3. A conventional vehicle drives on a dedicated lane for AVs
- *Scenario 2: Roadworks zones*
  4. Roadworks zone in mixed traffic – Single Lane Closure
  5. Roadworks zone in mixed traffic – New lane Design
- *Scenario 3: Bottlenecks*
  6. AVs Driving Behaviour Adaptation in Real Time at Sags
  7. Lane-Change Advice to connected vehicles at Bottlenecks
  8. Lane-Change Advice combined with Flow Control at Bottlenecks for all vehicles

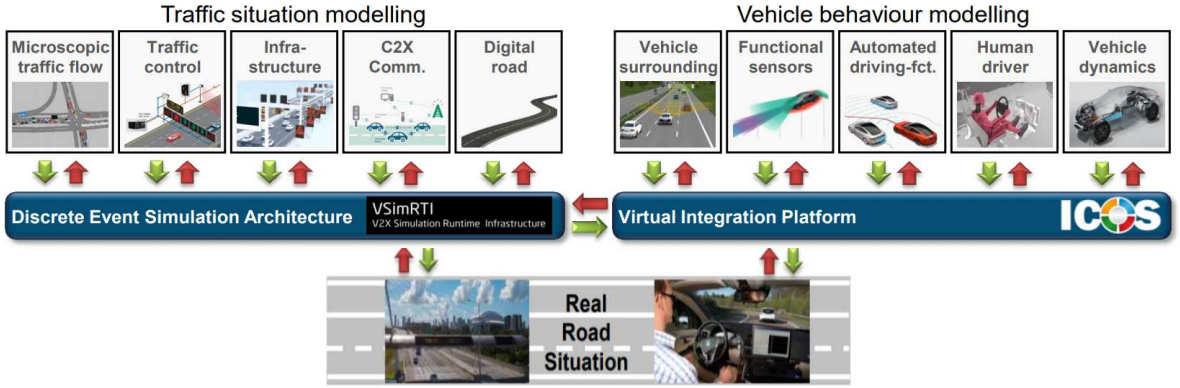
INFRASTRUCTURE EVALUATION & OPTIMIZATION

- Real tests in modern highways:

Girona (Spain)

Graz (Austria)

- Co-simulation environment



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

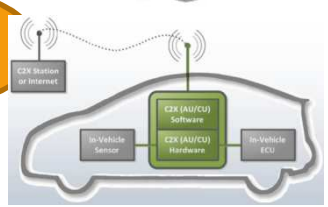
INFRAMIX IMPACT IN AUTOMATED ROAD TRANSPORT

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
Road infrastructure for mixed traffic	• New pictogram code for 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. • Boost discussion at stakeholder's workshop

INFRASTRUCTURE-CONNECTED VEHICLES AND SECURITY ASSURANCE

- Today's vehicles integrate a large set of 3rd party components and applications
  - Numerous interfaces and an increased attack surface are exposed

Focus on V2I



To what extent are we 'sure' that the involved technology meets the requirements for

SECURITY | PRIVACY | RELIABILITY | SAFETY

- Quantification of assurance is complex and costly!
  - Typically relies on generic frameworks
  - Connected-vehicle-ecosystem details: not considered

EU SAFERtec to **design** and **experimentally evaluate** an agile assurance framework tailor-made for V2I settings

Industry

AIRBUS DEFENCE & SPACE, CRF, swarco, TOMTOM

SMEs

Autotalks, OPPIDA, commsignia

Research Institutes

ICCS, UNIVERSITY OF PIRAEUS

Project facts

Start date: January 2017
Duration: 36 months
Budget: 3.8 MEuros

WORK OVERVIEW & USE-CASES SCOPE

Now

January 2017 | March 2017 | June 2017 | September 2017 | December 2017 | March 2018 | ....

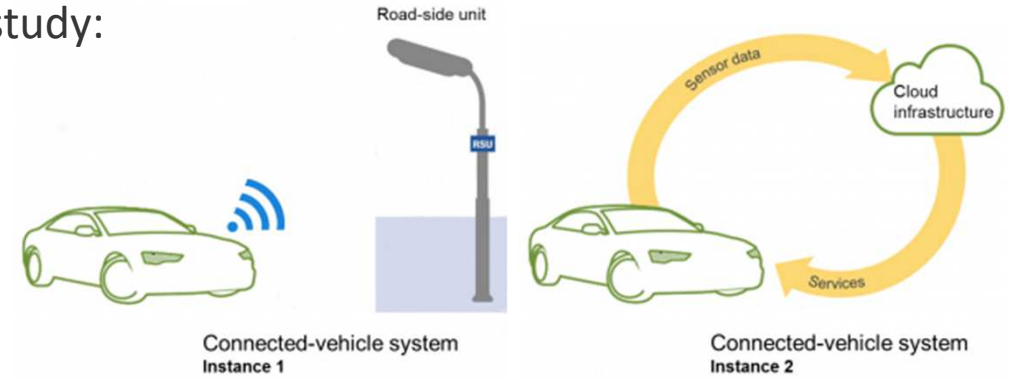
Modeling of V2I use-cases
Use-cases, attack modeling, risk analysis

To test the proposed framework

Development of the connected-vehicle system
Prototype vehicle with 3rd party HW/SW connected to infrastructure

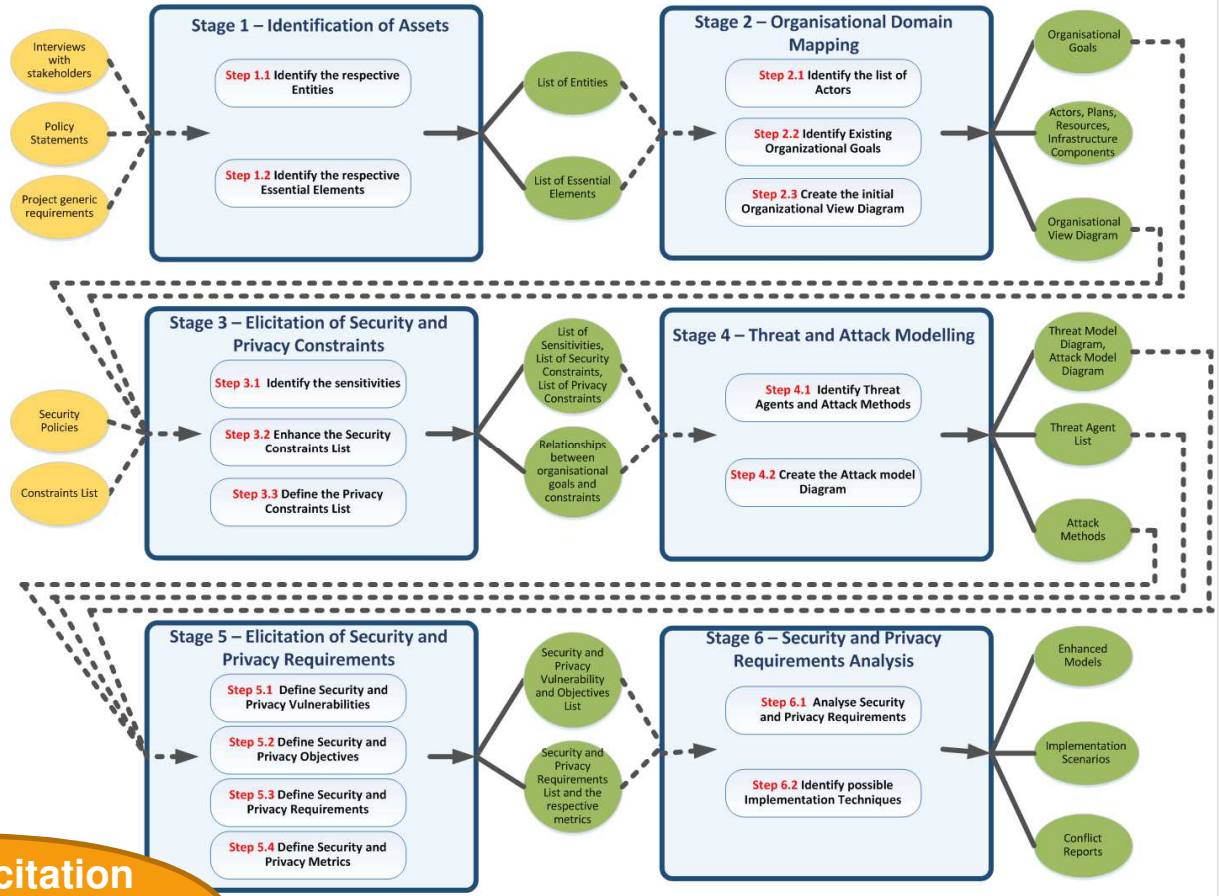
Design of a Security Assurance Framework
Innovative methodology to quantify V2I security/privacy assurance

- Under two general V2I instances we study:
  - Optimal driving-speed advice
  - Real-time traffic-hazard information
  - Priority request in intersection-crossing



A BIT OF TECHNICALITIES: REQUIREMENTS ELICITATION & MODELLING

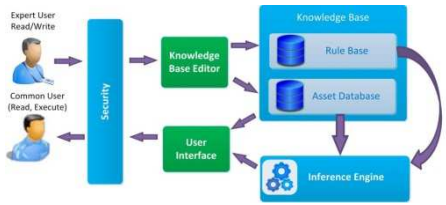
- A novel 6-stages approach integrating 3 methodologies (EBIOS, SecureTropos and PriS)
- **Input**: the high level description of the V2I considered use-cases
- **Output**: identified security and privacy requirements and countermeasures



Threat elicitation is based on ETSI standards

EXPECTED ACHIEVEMENTS AND IMPACT

- Innovative modeling work for the emerging risks/vulnerability
- Introduction of an agile security assurance framework tailored for V2I
- Experimental validation of the framework using a prototype vehicle and dedicated SW and HW
- Contribution to relevant standards
- Toolkit to enable (semi-)automated generation of assurance levels for Connected Vehicles



Assurance Framework Toolkit

Higher Level of Assurance (and trust) for Connected Vehicles and services

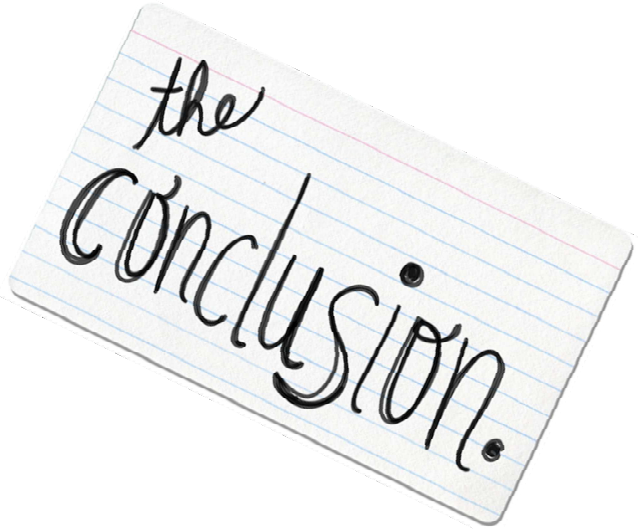
CONCLUSIONS (1)

- A **common evaluation framework** for AD functions (technical, user acceptance, driving & travel behaviour) is necessary
- **Assessment** of the long-term **effects**, **readiness** and **reliability** of AD functions is needed for proper deployment
- **Tools** for the effective analysis, evaluation and impact assessment are missing

- Road infrastructure must be **upgraded** for mixed traffic
- An **Infrastructure Classification** Scheme is needed
- **Simulation** and **hybrid testing** is of high value for future research
- Real implementation of **novel traffic monitoring** and **control strategies** for mixed traffic is necessary

CONCLUSIONS (2)

- Establishing vehicular connectivity comes with further **cyber-security, privacy and safety concerns**
- An under-explored area: **Automotive Security Assurance**
  - Degree of confidence that the realized automotive (cyber-)security controls will reduce anticipated risks
- EU SAFERtec advances the V2I security assurance research aiming to **increase trust** in connected vehicles/ITS



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