Managing automated vehicles at signalized intersections

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mobile.TUM 2017, 4 July 2017, Munich

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Background

Safe and connected automation in road transport – H2020 call MG3.6a - 2015

Specific challenge: Automated and progressively autonomous driving applications in road transport, actively interacting with their intelligent environment could provide an answer to the EU objective of reconciling growing mobility needs with more efficient transport operations, lower environmental impacts and increased road safety.

…

Automation in road transport should make best use of the evolution of Cooperative ITS and the benefits made available by satellite navigation systems, such as the increased accuracy and robustness.

…

Novel transport, service and mobility concepts in real-life situations enabled by automated driving and connectivity. These services and concepts could benefit from cloud computing and data management and data aggregation techniques for road transport big data.

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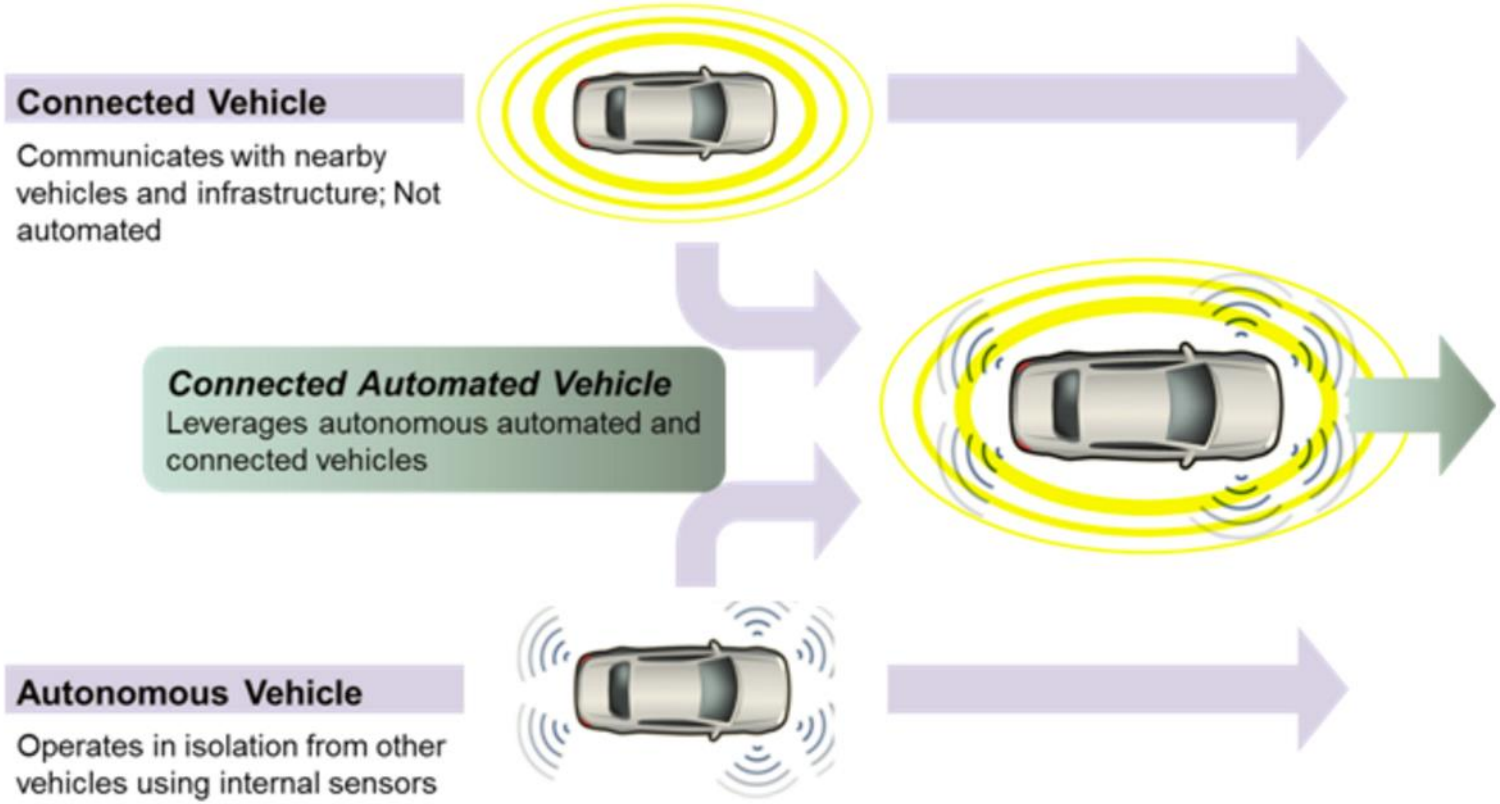
Connected automation



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An intelligent environment *with infrastructure*

- **Communication a precondition for highly automated driving**
- **'Public' traffic management and control remains necessary**
  - ✓ Safeguard societal interests
  - ✓ Setting constraints and rules
  - ✓ Intervene in case of oversaturated conditions

- **Offers new possibilities for optimisation in traffic management and control**
- **Three operational perspectives:**
  - ✓ Each vehicle individually (autonomous)
  - ✓ Vehicles part of a group process (e.g. platoon)
  - ✓ Vehicles part of a system process (e.g. intersection control)

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Project overview

- **Project title:**
  - ✓ Managing Automated Vehicles Enhances Network
- **Project period:**
  - ✓ 01-09-2016 ~ 31-08-2019
- **Funded by EC Horizon2020**
  - ✓ Budget: € 3.149.661,-
- **Consortium**
  - ✓ Nine partners from five countries: DE, NL, CZ, BE, UK

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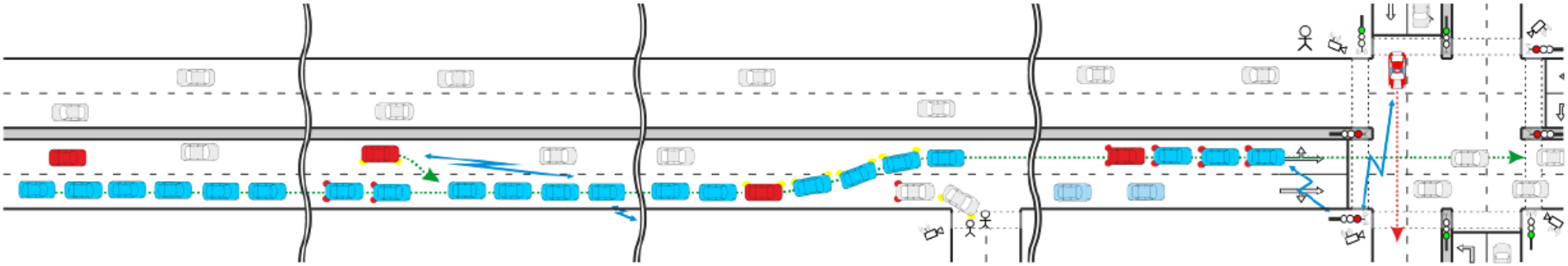
Project summary

- MAVEN will develop **management regimes** for highly automated driving in **urban areas**.
- Road infrastructure will be able to **monitor, support and orchestrate** vehicle and VRU movements to guide vehicles at **signalized intersections** and corridors in urban areas.
- Beyond the state-of-the-art of ADAS and C-ITS services like GLOSA, by adding cooperative **platoon organization** and signal plan negotiation to **adaptive traffic light control**.
- Develop suitable enables technologies, e.g. **communication protocols**, and test and validate via simulation and real-world prototype (ITS-G5 based).



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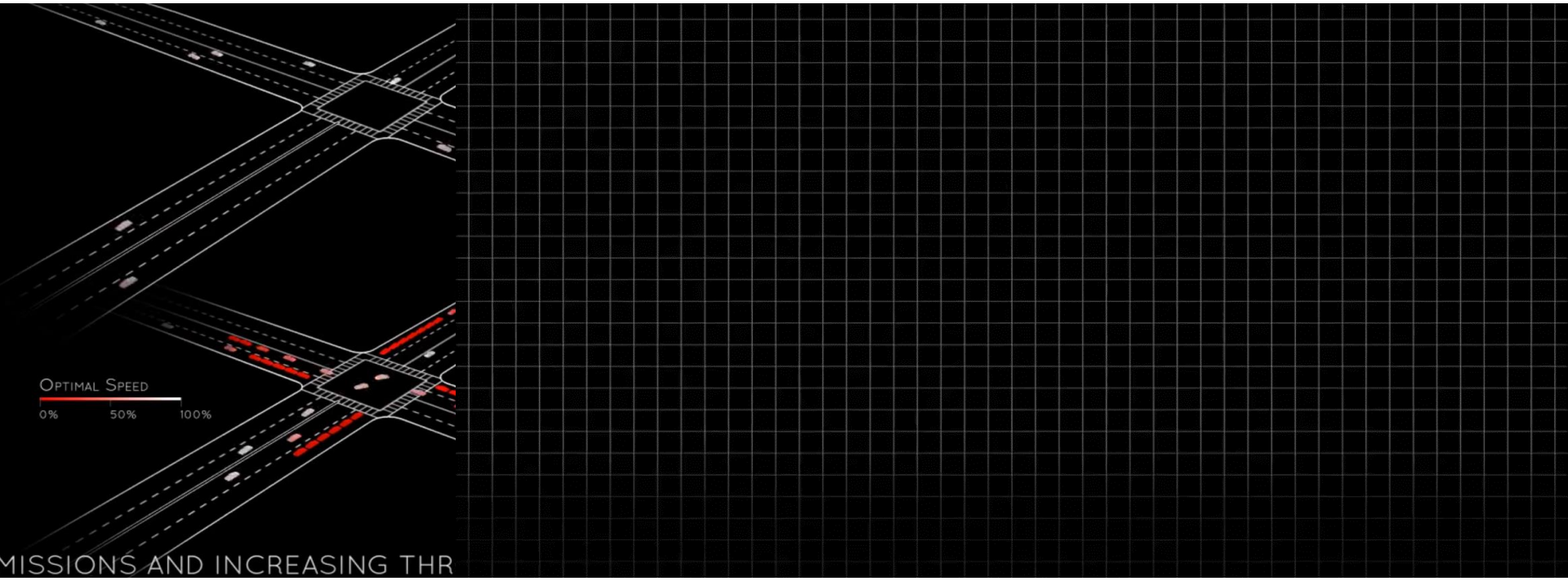
Virtual traffic light controller



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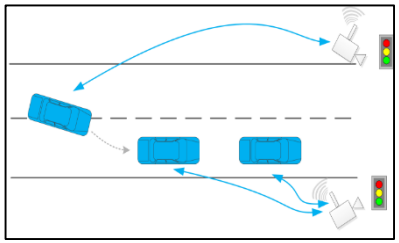
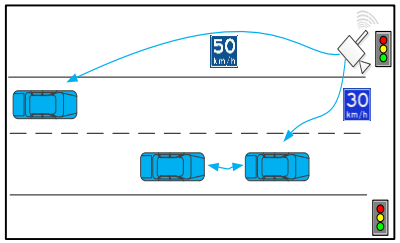
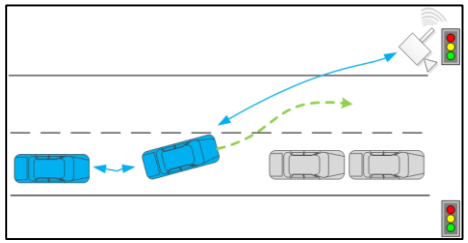
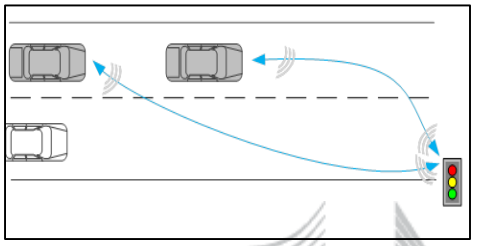
Infra-initiated and/or infra-assisted

- **Infrastructure-to-vehicle interactions (system process)**
  - ✓ Negotiation (signal timing vs. arrival pattern), speed advisory, lane advisory
- **Traffic control optimization (and scheduling)**
  - ✓ Signal optimization, priority management, queue estimation, green wave
- **Platoon management (group process)**
  - ✓ Forming, joining, progression, leaving, breaking a platoon
- **Conventional traffic and vulnerable road users**
  - ✓ Detection of non-cooperative vehicles, VRUs, emergency situations









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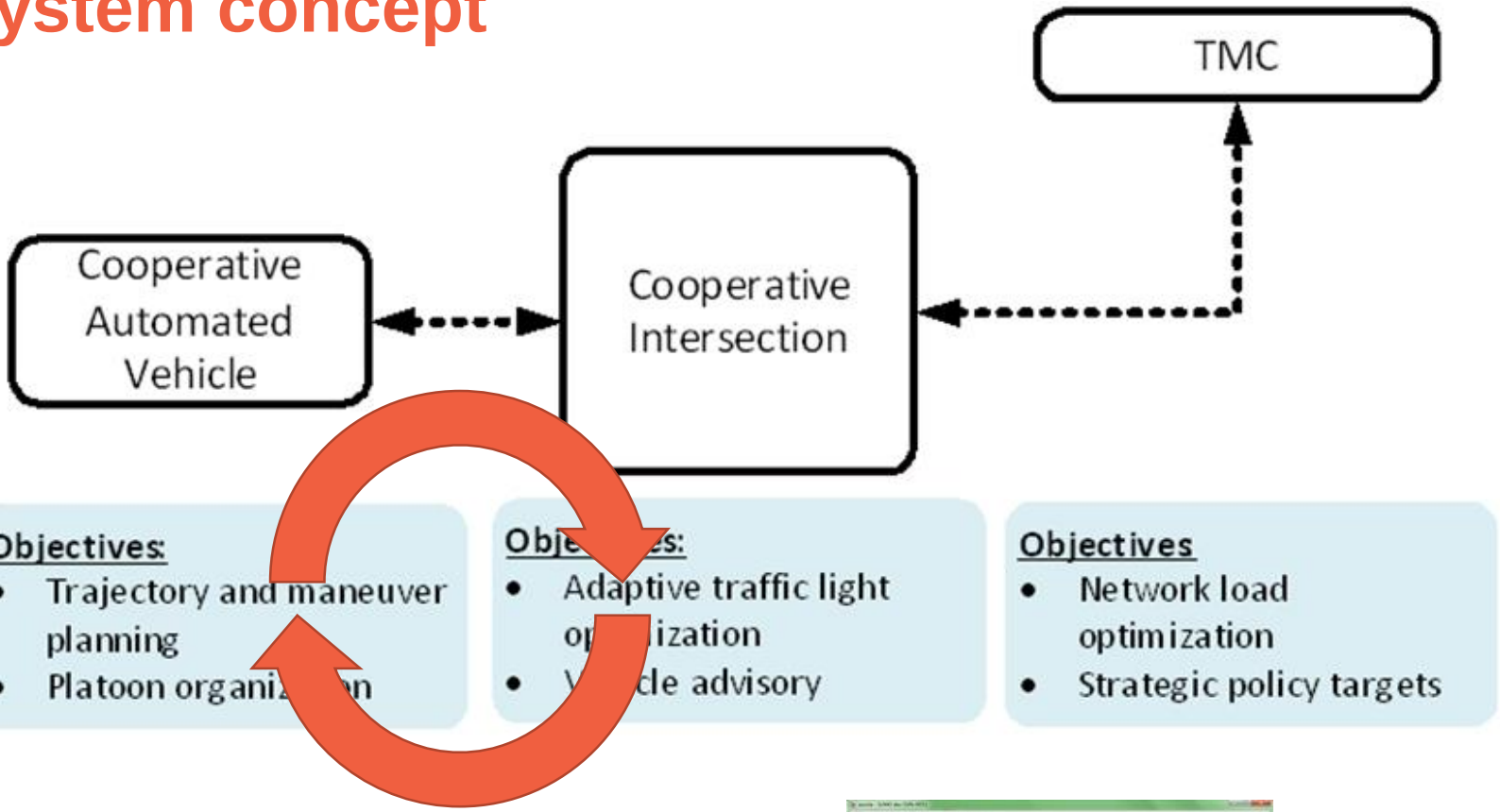
System concept



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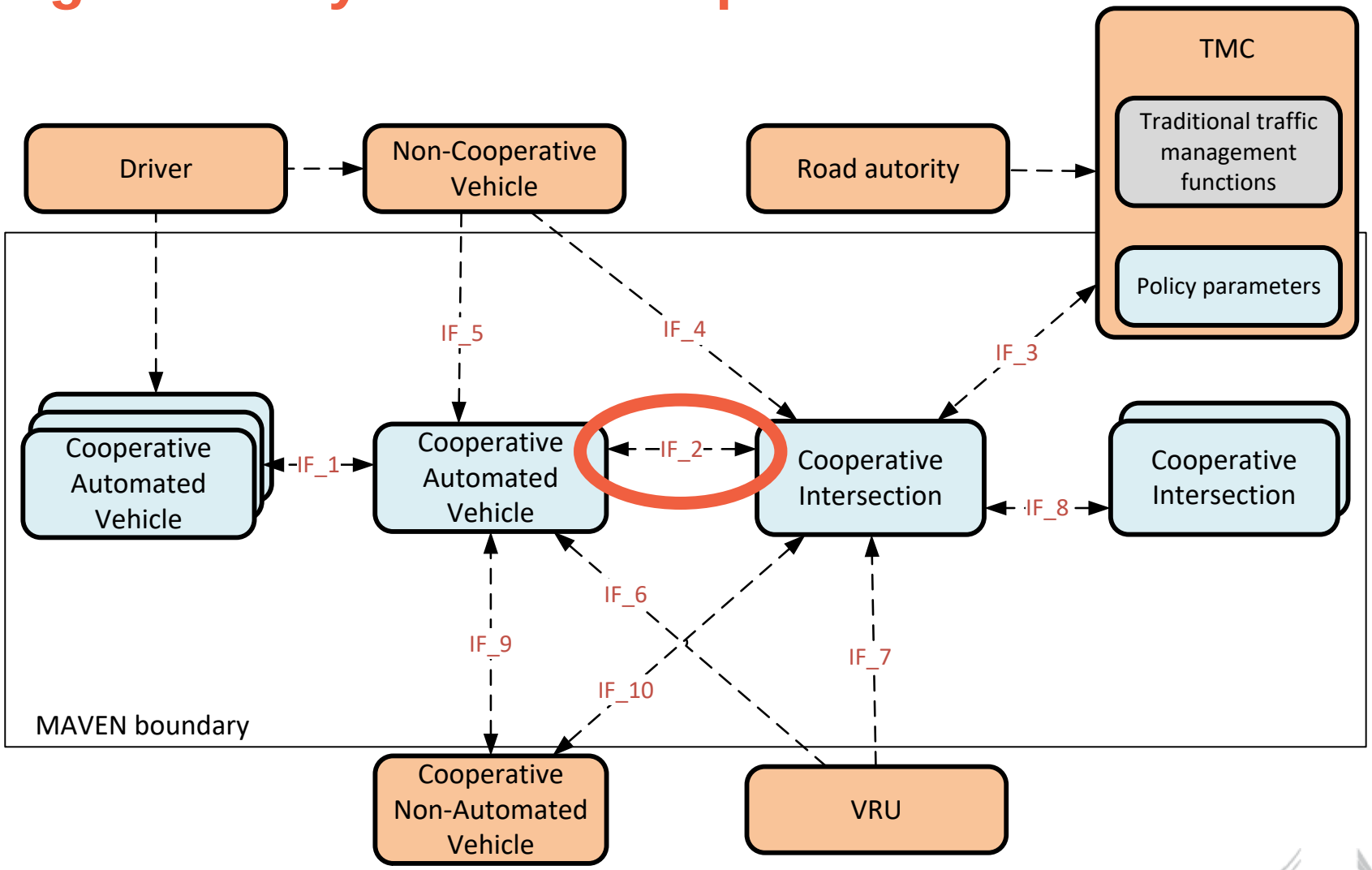
High-level system decomposition



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Necessary V2X extensions

- **Cooperative Awareness Message (CAM)**
  - ✓ Planned manoeuvre at intersection;
  - ✓ Desired speed range;
  - ✓ Platoon properties (size, length, roles, speed, headway, composition, etc.);
  - ✓ Acknowledgments of intentions and compliance.
- **Signal Phase and Timing Message (SPAT)**
  - ✓ Differentiated speed advisory;
  - ✓ Lane advisory;
  - ✓ Desired headway;
  - ✓ Maximum platoon length;
  - ✓ Prohibitions such as platooning or level of automated driving.
- **Cooperative sensing**
  - ✓ Detected (non-cooperative) road users, vulnerable road user in particular

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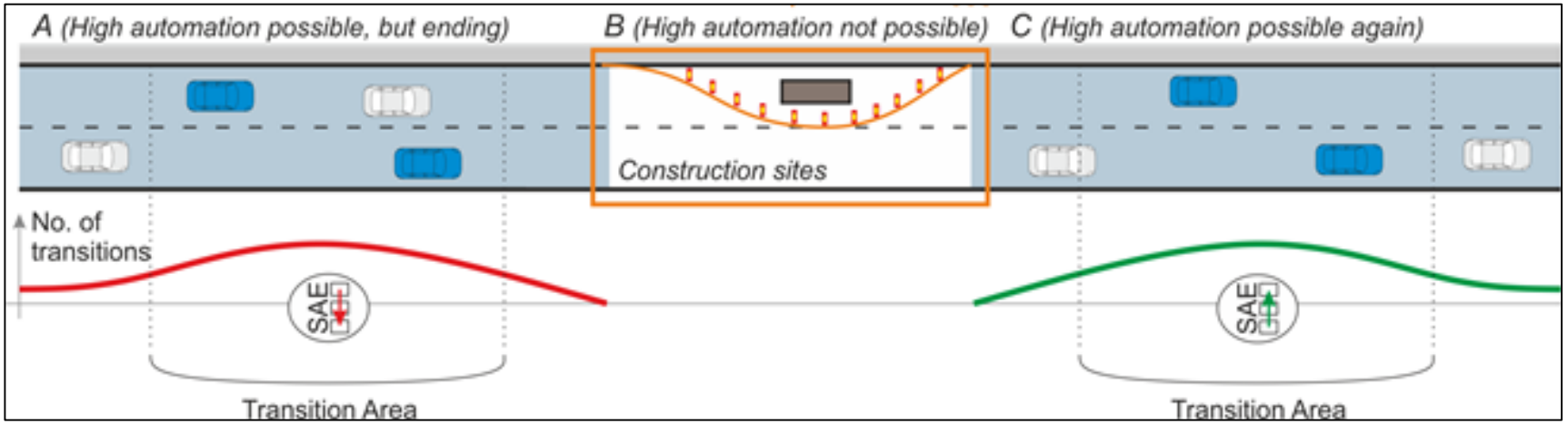
Transferability of I2V intervention and planning principles



TransAID (H2020)

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To conclude

- Infra-assistance for highly automated driving
  - ✓ Managing Automated Vehicles Enhances Network (MAVEN)
  - ✓ Transition Areas for Infrastructure-Assisted Driving (TransAID)
  - ✓ Truck Platooning Challenge

- A necessity but also a new dimension of Traffic Management and Control
  - ✓ Explicit intervention (control)
  - ✓ Implicit response (inform)

- Many ideas and concepts, equal amount of questions: much research!

- Great interest (local) road authorities, in particular broader city mobility context

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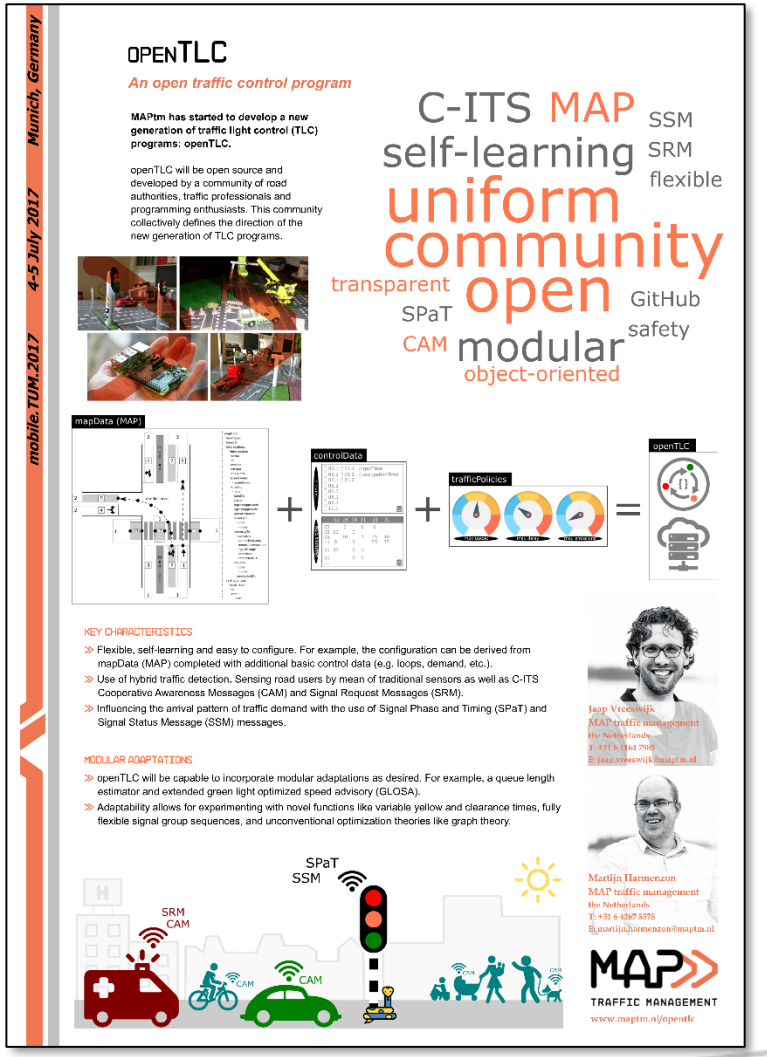

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