



Transition Areas for Infrastructure-Assisted Driving

Michele Rondinone
(Hyundai Motor Europe Technical Center)

Alejandro Correa (UMH), Miguel Sepulcre (UMH), Javier Gozalvez (UMH),
Julian Schindler (DLR)

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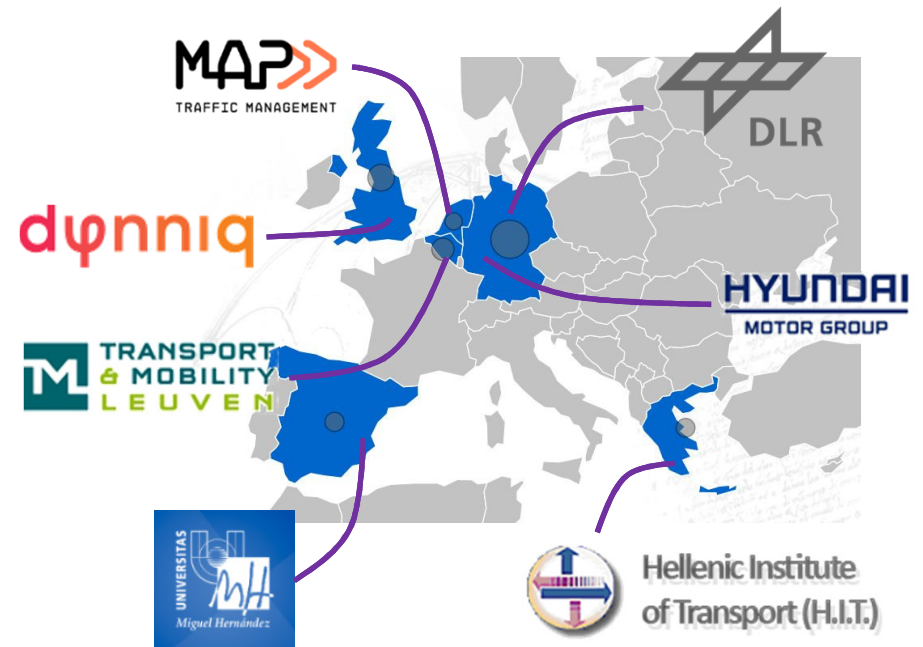


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Project Details

- ❑ 7 partners from 6 European countries (technology providers, automotive industry, academia)
- ❑ 12 associated partners
- ❑ Coordinator: Julian Schindler, DLR (julian.schindler@dlr.de)
- ❑ Start: September 2017 (36M)
- ❑ Budget: 3.8 m€

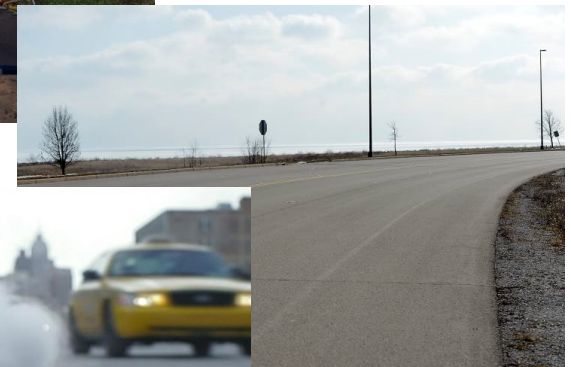


Vehicle automation and Transition of control

- ❑ What should a vehicle do when the **vehicle automation system fails**?
 - ❑ Just drop the control to the driver?
 - ❑ Stop the vehicle where it is?
 - ❑ Perform a more complex **minimum risk maneuver** according to the remaining options?

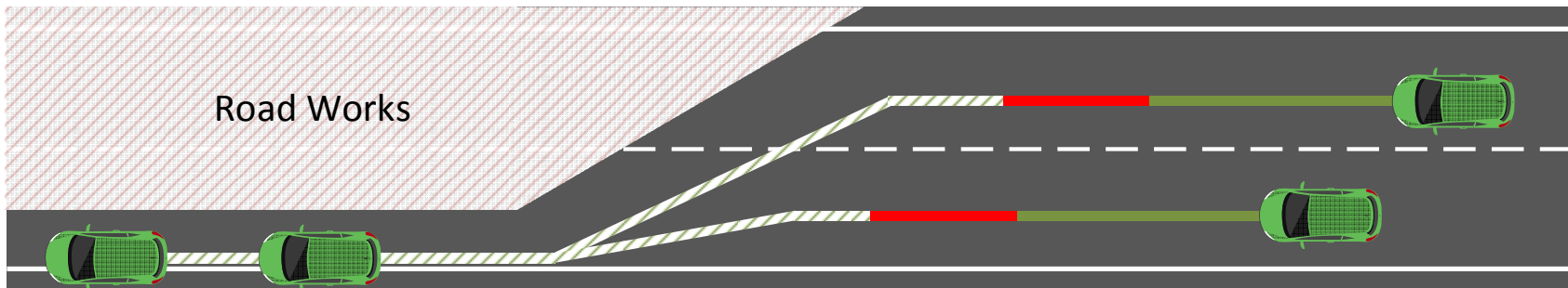
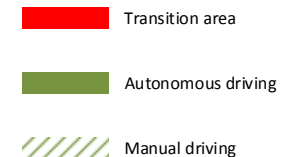
- ❑ What is going to happen when several vehicles have the same problems at the same spot?

- ❑ What is the **impact on traffic safety and efficiency**?
 - ❑ Expected performance degradation



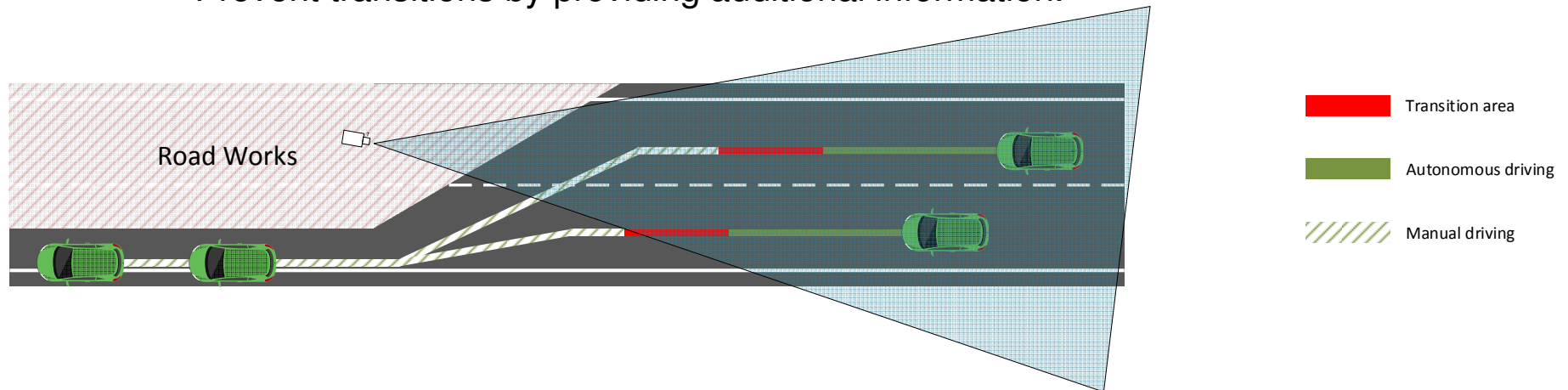
TransAID scope

- ❑ TransAID develops and demonstrates **V2X-based infrastructure-assisted traffic management procedures**, for smooth coexistence between automated, connected and conventional vehicles at **Transition Areas**
- ❑ **Transition area:** area where a **high number of vehicles perform automation level transitions:**
 - Possible reasons: unexpected situation, sensing limitation, external disturbance to automation decisions or executions...



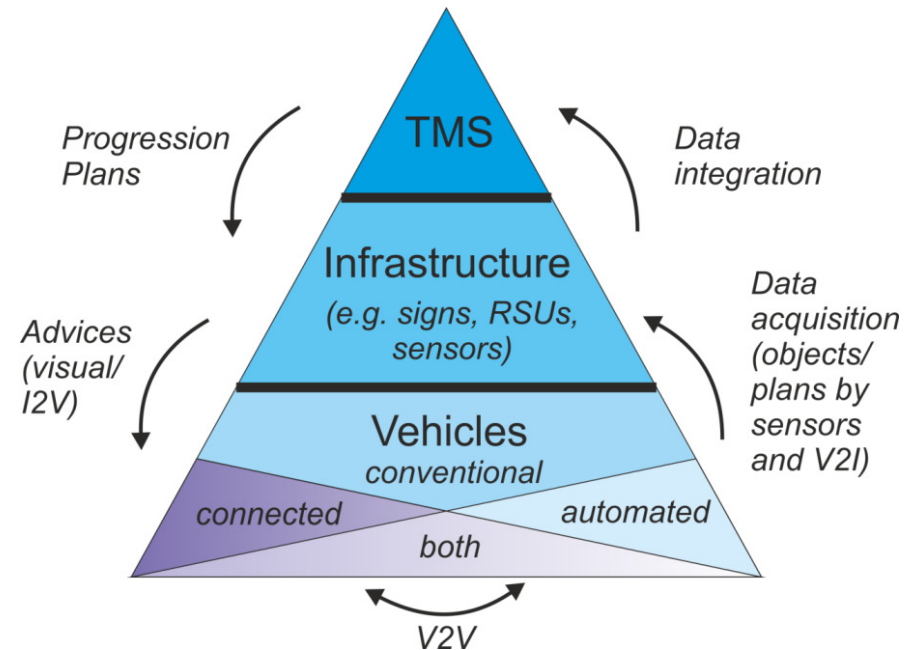
TransAID problem and approach

- ❑ Problem: many uncontrolled transitions can be traffic-inefficient and unsafe (e.g. occurrence of minimum risk maneuvers)
- ❑ Trans AID approach: apply **I2V management procedures** to mitigate possible negative impact of uncoordinated transition of control:
 - Manage transition of vehicles.
 - Distribute transitions of vehicles in time and space (see figure).
 - Prevent transitions by providing additional information.



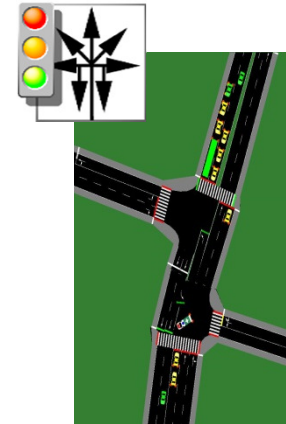
Development targets

- ❑ Traffic management procedures can be applied and provided at different hierarchical level
 - ❑ To find optimal solutions in case of Minimum Risk Maneuvers and transitions of control
 - ❑ To help surrounding vehicles (not necessarily only automated vehicles)
 - ❑ Common functionalities: **situation detection/understanding → policy dissemination**
- ❑ Development of new V2X message sets as well as other signalling methods
 - ❑ Targeting vehicles with different automation and connectivity capabilities (Day1, 2, 3, etc.)
 - ❑ Including warnings, **collective perception**, centralized & distributed **maneuver coordination**



Verification methods & expected results

- ❑ **Simulations** with vehicles in different levels of automation are performed
 - ❑ Baseline simulation to understand problematic situations and system behavior with SoA solutions
 - ❑ Advanced simulation with TransAID solutions



- ❑ **Prototypical field implementations**
 - ❑ To demonstrate the feasibility of the approach at micro-scale

- ❑ **Guidelines** and a **roadmap**
 - ❑ for stakeholders (OEMs, road authorities, cities...) to notify the lessons learned

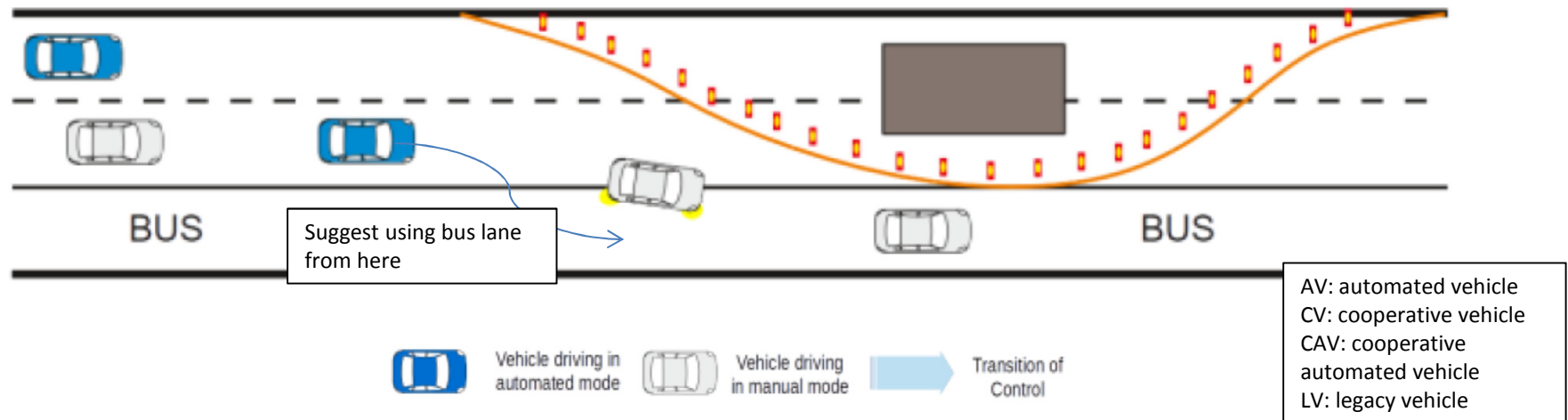


TransAID services (1)

□ Prevent Transition of Control or Minimum Risk Maneuver

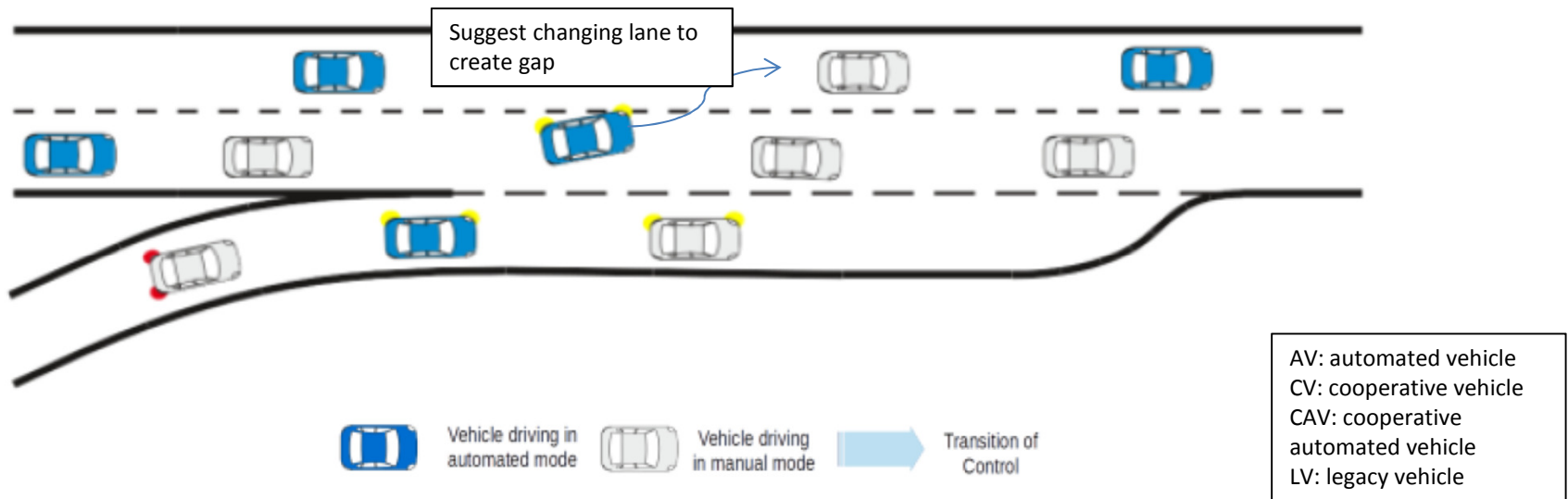
– by providing vehicle path information

- E.g. To drive through zone that would not initially be allowed for driving (e.g bus lane)
- Detect traffic load & stream composition (% of AVs, CVs, CAVs, LVs) to adjust service parameters (e.g. Point to cross the bus lane)



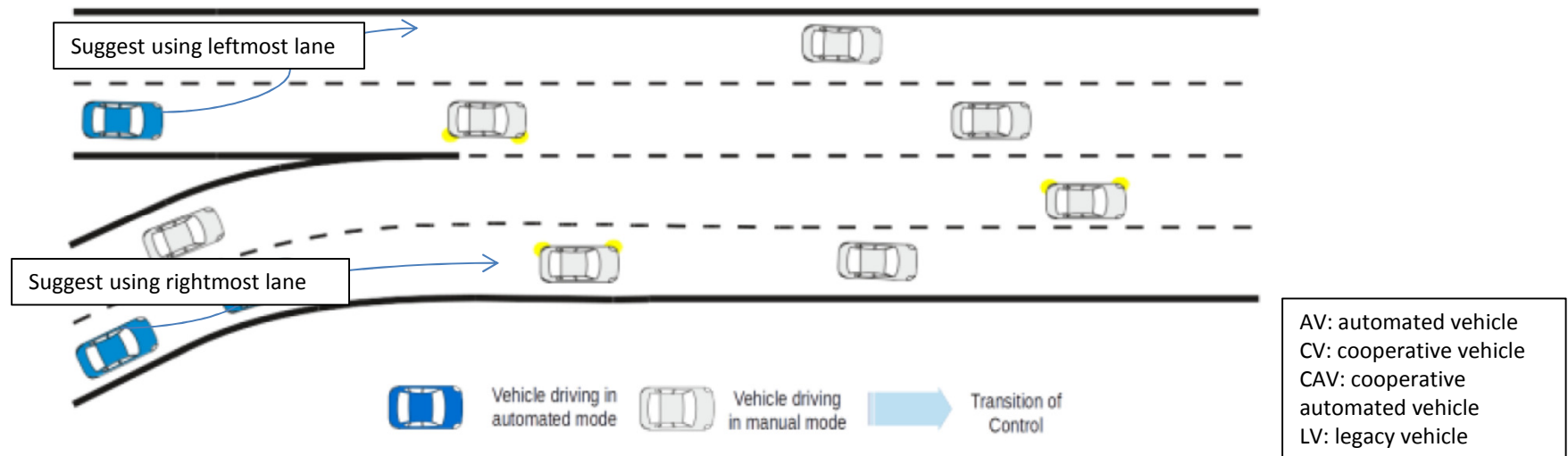
TransAID services (2)

- Prevent Transition of Control or Minimum Risk Maneuver
 - **by providing speed, headway and/or lane advice**
 - E.g. To regulate interactions among CAVs & avoid turbulences/shockwaves (e.g providing gaps at merging points)
 - Detect traffic load & stream composition (% of AVs, CVs, CAVs, LVs) to adjust service parameters (e.g. Available and required gaps for merging)



TransAID services (3)

- Prevent Transition of Control or Minimum Risk Maneuver
 - **by traffic separation**
 - To minimize interactions among (C)AVs & manually driven vehicles in critical scenarios (e.g at highway mergings)
 - E.g. All (C)AVs on sidemost (left/right), all manually driven cars on innermost lanes
 - Detect traffic load & stream composition (% of AVs, CVs, CAVs, LVs) to adjust service parameters (e.g. Upstream points for starting separation)

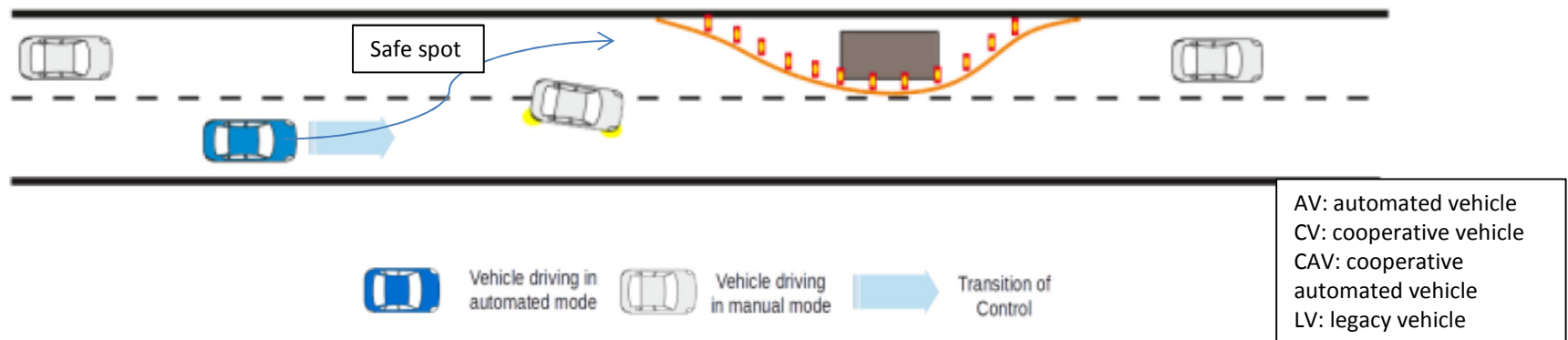


TransAID services (4)

□ Manage Minimum Risk Maneuver

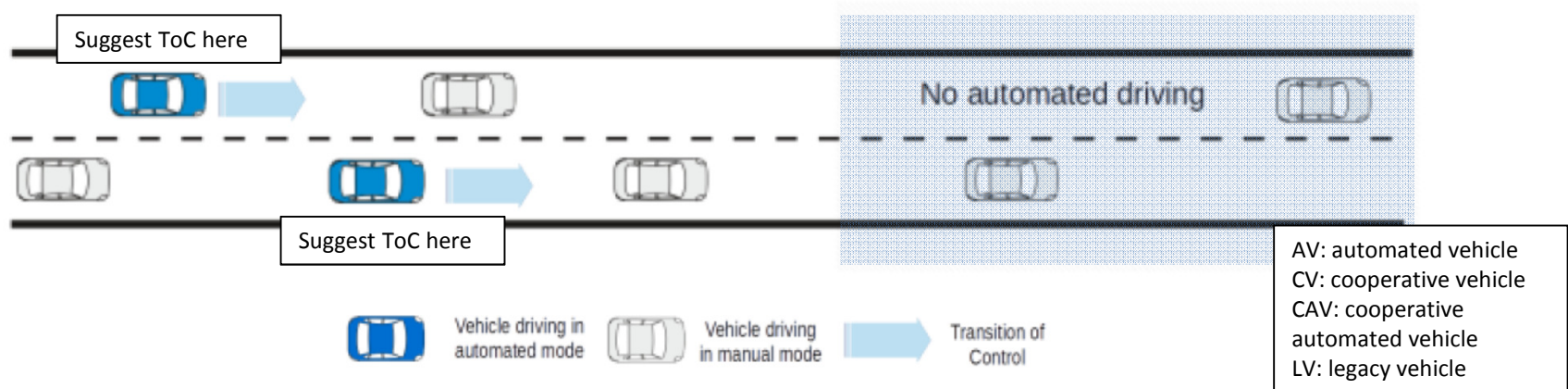
– by guidance to safe spot

- To minimize risks & inefficiency in case a minimum risk maneuver cannot be avoided
- E.g. Driver is not taking over, then infra suggests optimal spot to stop a CAV
- Detect traffic situation and failed transition to adjust service parameters (e.g. Safe spot)



TransAID services (5)

- Distribute Transition of Control or Minimum Risk Maneuver
 - by **scheduling Transition of Control in time and space** on different CAVs
 - To minimize risks & inefficiency in case of many simultaneous transitions
 - E.g. Preventively suggest transitions upstream
 - Detect traffic load & stream composition (% of AVs, CVs, CAVs, LVs) to adjust service parameters (e.g. Upstream points for triggering transitions)



Current & future work

- ❑ Extend micro-modelling for mixed traffic simulations
 - Including cooperative & automated driving models: (C-)ACC, (C-) Automated lane change
 - Including transitions and minimum risk maneuvers

- ❑ Define suitable V2X message sets for communication modelling
 - Extensions/profiling of Day1 messages (CAMs, SPAT/MAPs, IVIs)
 - Day2+ messages: CPM extensions, centralized and distributed maneuver coordination

- ❑ Evaluation via simulations

- ❑ Proof of concept via small prototypes implementation



Thanks for your attention!

Any questions?

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