Transition Areas for Infrastructure-Assisted Driving

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Project Coordinator

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Some general information

● About the EC call:
  – Horizon 2020 ART-05-2016 (Automated Road Transport)
  – Grant Agreement Nr.: 723390

● About the project:
  – Duration: 36 months
  – Start date: September 2017
  – Total budget: 3.8 M€
  – Consortium: 7 partners from 6 European countries
    ● ICT infrastructure providers
    ● Automotive industry
    ● Academia
  – 12 associated partners
What if...

- ...your automated vehicle is not able to solve the situation ahead?
- ...this happens not to single vehicles only, but to several?
- ...it always happens at the same location?
Transition Areas are areas on the road where many highly automated vehicles (blue) are changing their level of automation due to various reasons.
Detailed Analysis

- Severe problem
- Impact on Traffic
- Additional entities help solving the situation
- Solutions for surrounding traffic
Detailed Analysis

- Severe problem
- Impact on Traffic
- Additional entities help solving the situation
- Solutions for surrounding traffic
- abstracted
- Assess by simulation
- V2X RSU, additional hardware, cameras
- Development, simulation and test of measures
- Traffic mixes
- Levels of Service
- Roadmap
- Guideline for stakeholders
**Definition**

**Abbreviations**
- **TOR**: Take Over Request
- **ToC**: Transition of Control
- **MRM**: Minimum Risk Manoeuvre
Scenario definition

- Sense: Prevent
  - Cameras, LIDAR, radar
  - Position of other vehicles
- Plan: Prevent
  - Plan trajectory, predict motion
  - Take Over Request (TOR), ToC
- Act: Manage
  - Steer, brake, accelerate
  - Low level feedback, HMI

Digital map

Turn right via straight lane
Create / use gap

Create way for MRM
Warn other vehicles

+ when a ToC is not preventable, but predictable  → spread the ToCs in time and space
Use Cases & Service Definitions

1. Prevent ToC/MRM by providing vehicle path information.
   - Lane not usable for vehicles strictly following rules
   - Vehicles may stop before obstacle

2. Prevent ToC/MRM by providing speed, headway and/or lane advice.
   - Automated vehicles unable to enter highway
   - Vehicles may stop or issue take over request

Providing path information or temporarily change lane category

Cooperative lane changes Speed & Distance information
Use Cases & Service Definitions

3. Prevent ToC/MRM by traffic separation
   - Risky situations in highway merge areas
   - Vehicles may issue take over request

4. Manage MRM by guidance to safe spot.
   - Automated vehicles unable to pass area
   - Vehicles may stop (e.g. due to failed transitions) and block free lane

   Cooperative lane changes Temporal traffic separation

   Find safe spot for stopping without harming traffic
5. Distribute ToC/MRM by scheduling ToCs.

- Transitions of control in small area
- Higher risk of dangerous situations

Distribute transitions of control to flatten effects
Simulation setup

Traffic mix [%]

<table>
<thead>
<tr>
<th>Mix</th>
<th>AV</th>
<th>LV</th>
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<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>80</td>
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<tr>
<td>2</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>70</td>
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Total demand [Veh/h]

<table>
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<tr>
<th>LoS</th>
<th>Demand</th>
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<tr>
<td>A</td>
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<tr>
<td>B</td>
<td>1000</td>
</tr>
<tr>
<td>C</td>
<td>1500</td>
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</table>

Parameter schemes:

- Safety
- Efficiency

- OS
- PE
- M
- OE
- PS
Preliminary simulation results
Service 5.1

Without traffic management

With traffic management
TransAID interim message set

Approach: standard-compliant, backward compatibility and interoperability.
Real world integration
Trust, Safety and Legal Aspects

- Drive on right?
- Cooperate
- Trust gap
- ‘Illegal’ turn
- Trust MAP + SPAT
- Drive on bus lane
- Trust RW info
- Drive on emergency lane
- Trust advice
- ‘legal’ safe stop?
- Trust about no AD zone
Ways to proceed

Service Providers
OEMs & in-car solutions

Road Authorities
central & decentral
Still many open questions

- Will there be no-automated-driving zones?
- Will there be automated-driving-only zones?
- Are OEMs willing to cooperate to identify transition areas / limitations of their automation?
- What possibilities are provided by OEM backends?
- Can road authorities provide advices which conflict with traffic regulation?
- Which circumstances result in a take-over request?
- What do AVs do when their route is blocked?
- What to do about non-connected/incompatible AVs?
- What kind of minimum-risk manoeuvres can be expected?
- When situations are challenging, will AVs:
  - Behave like everyone else (sometimes egocentric, including breaking traffic laws)?
  - Behave exactly in line with traffic regulation?
  - Behave ‘optimally’?
- What if information from RSI is wrong?
Any questions? Contact us!

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