1st European Conference on Connected and Automated Driving (CAD)

Session B02  Physical & Digital Infrastructure

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www.continental-automotive.com/interior
Automated Driving
Close the Loop Between Driver, Vehicle & Environment
Visual Range 300m
Is this Really Enough?
Environment Detection
Digital Onboard Maps: Provide Information Beyond the Line of Sight – eHorizon

Driver
Reactions
Perception

Vehicle

Environment

Intentions

Onboard Maps: Provide Information Beyond the Line of Sight – eHorizon
Next Step: Digital Maps and Online Data
Provide real-time Information – dynamic eHorizon
Tomorrow’s Situation: Sensors, Maps and Online Data

The Vehicle Looks beyond 300m and Around the Corner

1. Highly accurate map model provided and updated via the Backend
2. Extended preview information
3. Extension of limited in-vehicle resources
4. Fleet based data collection

Vehicle Sensor range: 0-300m

Close preview: 10 minutes
Automated Driving: “Fresh Data” from the Cloud
Highly Precise Map and Dynamic Data – Crowd Sourced

Digital Map

Functions
› Static Basic Map
› HAD Map Extension (lane, landmark, …)
› Dynamic Events (Speed Limit, …)

Features
› Highly precise (location, time)
› Highly up-to-date (real-time)
› Learning map (via crowd sourcing)

Dynamic Services (Reference List) - based on Traffic Management Information

<table>
<thead>
<tr>
<th>Lanes Closure</th>
<th>Traffic Sign</th>
<th>Traffic Jam ahead</th>
<th>Construction Assistant</th>
</tr>
</thead>
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<tr>
<td><img src="image" alt="Lanes Closure" /></td>
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Digital Infrastructure Requirements for AD
Provision of up-to-date digital map

Key feature: Cloud based digital map – always up-to-date and precise

Always up-to-date

› tile based approach
› learning map (e.g. gantries)
› versioning
› Predictive tile download to the vehicle (based on eHorizon MPP)

precise

› lane accurate information
› precise map matching (lane specific)

CHALLENGE: HD Road Model

› What kind of information? → landmarks, lane info, what else?
› how to get initial model
› how to run updates / maintenance
› how to ensure self localization and precise positioning?
Digital Infrastructure Requirements for AD
Support of Landmark concept

Key feature: precise landmarks along the highway

Absolute Positioning
› based on GNNS technology
› in addition with correction mechanisms

Relative Positioning
› via landmarks
› via Camera based solutions (option: radar based)

CHALLENGE: Life cycle
› Update mechanism of landmarks
Key feature: infrastructure based environmental prediction beyond the local vehicle sensors

Support of speed adjustment:
› Incident prediction (jam, dangerous objects, dangerous weather, …)
› Predictive information about speed limits

Support of lane changing strategy
› Prediction of closed lanes
› Prediction of no-passing areas

Support to evaluate the road features
› Recommendation of AD release (Road/Link Blacklist)

Support of controlled vehicle stop
Digital Infrastructure Requirements for AD
Provision of up-to-date dynamic events / traffic information

Stepwise deployment of AD vehicles require dedicated data fusion strategy

- **Probe Data Vehicles** (including AD vehicles)
- **Dedicated Stream of Traffic Data** e.g. from Road Operators (regional availability)
- **Commercial Stream of Traffic Data** (global availability)

Data Availability as of today

Data Quality as of today (for AD)
Digital Infrastructure Requirements for AD
Data Usage Categories

Position of VDA Germany (communicated to EC)

**Category 1**
Data for improved traffic safety
Traffic safety relevant data
Data for e.g. public traffic management institutions.

Fire Department, Police, 911, ...

**Category 2**
Data for cross brand services
None differentiating vehicle data
Non-discriminatory data access to third parties.*[^2],[^3]*

Product

**Category 3a**
Data for brand specific services
Vehicle data differentiating and IP relevant for OEM

OEM or Partner on OEMs behalf

Dealer, Subsidiary

**Category 3b**
Data for component analysis and product improvement
Vehicle data differentiating and IP relevant for OEM and supplier

OEM or Partner on OEMs behalf

Product

**Category 4**
Personal data
“Right of access” granted only to the parties authorized to process data by law, contract or consent

Customer selected partner

Customer

The customer #1 will be informed of data usage and OEMs will provide the customer with decision options which the customer can reverse at any time, unless the function is required by law
## Digital Infrastructure Requirements for AD Support of Functional Safety Requirements

Five map safety aspects have to be considered:

<table>
<thead>
<tr>
<th>Question</th>
<th>Possible Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the <strong>map content quality</strong> as good as indicated in the metadata?</td>
<td>Map content quality assessment</td>
</tr>
<tr>
<td>Can we rely on the <strong>map provider</strong>?</td>
<td>Map provider audit</td>
</tr>
<tr>
<td>Was the <strong>data transmitted</strong> without falsification of map data or metadata?</td>
<td>End-to-end checksum</td>
</tr>
<tr>
<td><strong>How correct, precise and up-to-date</strong> is the received data set?</td>
<td>Map quality metadata</td>
</tr>
<tr>
<td>Does the <strong>automotive E/E system</strong> work according to the specification?</td>
<td>Functional safety audit / assessment</td>
</tr>
</tbody>
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*Continental*
Digital Infrastructure Requirements for AD
Reliable hybrid telecommunication infrastructure

ITS G5 Communication
Direct vehicle to vehicle

Vehicle-to-vehicle is about proximity, path prediction and collision anticipation/warning:
• Intersection & Lane Change
• Rear end

ITS G5 Communication
Short Range

Vehicle-to-infrastructure is about broader road conditions:
• Incidents
• Alerts

LTE / 5G Communication
Incl. LTE V2X / LTE MEC

V2X via location-cast is about Electronic Horizon far ahead of the vehicle:
• Weather/road/traffic conditions
• Incidents
Digital Infrastructure Requirements for AD
Reliable hybrid telecommunications infrastructure

Option: Mobile Edge Computing to reduce latency

LTE network

Central cloud for connected cars

Distributed „cloudlets“ for connected cars

Section of A9 test bed
Digital Infrastructure Requirements for AD

Security & Privacy
Attack Vector

What can be attacked by hackers?

Vehicle
› Position, Lane Information, GNSS Speed, Road Slope, Road Curvature, AD Status etc.

Connection
› LTE, GSM
› V2X

Backend
› HD Map Data, Dynamic Traffic Data, GNSS Correction Data
Digital Infrastructure Requirements for AD
Follow Standardization
The Change has been Started
Automated Driving in Evolutionary Steps

> 2025
FULLY AUTOMATED
- Monitoring of the system not required
- Driver does not need to be able to take over the driving task

> 2020
HIGHLY AUTOMATED
- Monitoring of the system not required
- Driver needs to be able to take over the driving task with lead time

> 2016
PARTIALLY AUTOMATED
- Monitoring of the system required
- Driver needs to be able to take over the driving task at any moment