Electronic Horizon
How the Cloud improves the connected vehicle

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The change in individual mobility
Automated Driving for more comfort, safety and efficiency

**Comfort**
- Germans spend on average 36 hours p.a. in traffic jams

**Safety**
- 90% of all accidents depend on human error

**Efficiency**
- The manner of driving has an impact on the fuel consumption up to 20%
Internet of Everything
Transformation of Products, Markets and Enterprises
$14.4 Trillion total value at stake in the upcoming 9 years
Transport. Business Covers Only a LTD Share of Total Market
The Connected Vehicle
Part of the Internet of Everything

Connected new vehicles (k units) with embedded connectivity NAD / year

Source: IHS, July 2014
The Connected Vehicle
Additional Value to the Vehicle and beyond

“Visible” services
→ Attractive car

Intelligent Transportation Systems
→ Better traffic

Invisible services
→ Better car
The Connected Vehicle
Additional Value to the Vehicle and beyond

“Visible” services

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Intelligent Transportation Systems

→ Better traffic

→ Attractive car

Invisible services

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“Invisible Services”
Reference Use Cases

Technology Base: electronic Horizon

- Vehicle Lifecycle Management
- Predictive Maintenance
- Advanced Shifting
- 48V Eco Drive System
- Cooling Strategy
- Preview ESC
- Emergency Steer Assist
- Damping Control
- Speed Advisor
- Curve Speed Warning
- High Beam Assist
- Emergency Steer Assist
- Advanced Retarder Control
- Bumper Warning
- Remote Diagnostics
- AFFP
- Platooning
- EV Comfort Range Balancer
- Connected Energy Management
- Traffic Light Assist
- Green Wave Assist
- Connected ESC
- Connected Energy Management
- Green Wave Assist

Precise Positioning

Non eHorizon Use Cases
- Infrastructure
- Maintenance
- Comfort

eHorizon Use Cases
- Efficiency Package
- Safety Package
- AD Package
## Digital Map

<table>
<thead>
<tr>
<th>Functions</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Basic Map</td>
<td>Highly precise (location, time)</td>
</tr>
<tr>
<td>HAD Map Extension (lane, landmark, …)</td>
<td>Highly up-to-date (real-time)</td>
</tr>
<tr>
<td>Dynamic Events (Speed Limit …)</td>
<td>Learning map (via Crowd Sourcing)</td>
</tr>
</tbody>
</table>

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

- **Lanes Closure**
- **Traffic Sign**
- **Traffic Jam ahead**
- **Construction assistant**
Electronic Horizon Based Use Cases
Why Cloud / Backend for “Fresh Data”

1. **Highly accurate & up-to-date digital map model**: for self-localization & environment interpretation

2. **Extended preview information**: physical limitations of in-car sensors extended through backend

3. **Extended Real-Time Data**: to support a smoother driving strategy
   - (1) **Highly accurate map model**
   - (2) **Extended preview information**

4. **Fleet based data coll.**: highly accurate & validated data via crowd sourcing approach

**BUT**: Final decision on driving strategy remains with the car
Connected Vehicle
The eHorizon Allows to Have a Look around the Corner and more …

(1) Map models provided and updated via the backend

(2) Extended preview information

(3) Extension of limited in-vehicle resources

(4) Fleet-based data collection

Car sensor range
100–300 m

Prompt preview: 10 minutes

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Electronic Horizon
The Technological Basis for Connected Vehicle Applications

Definition: eHorizon (Electronic Horizon)

› **eHorizon** is a technology for transmitting *map data* and *dynamic / environmental* data to other *in-car units* in order to increase and improve vehicle functionalities

› **Connected / dynamic eHorizon** is collecting vehicle data in the Cloud (Backend), improving the content via *crowd sourcing* and providing *improved data quality to the vehicle*

› Through the use of eHorizon, driving is going to be more
  › economical,
  › secure and
  › predictive
Electronic Horizon
System Concept

In-Vehicle Platform

Cloud Services

Maps

Highly precise and up-to-date digital map

Secure Mobile IP Network

Scalable and highly available Backend platform with data analytics capabilities

Content

Traffic and Event Services

3rd Party Data

eHorizon based Applications

In-Vehicle Platform

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Electronic Horizon Layering (Reference Model)

Extension of Data Planes

- **Dynamic Data**
  - Information on **Dynamic Events** along the road (e.g. construction area, traffic jam, potholes, average speed)

- **HD Map and Localization**
  - **Self Localization and High Definition (HD) Map**
    - Landmarks and camera based data, high precision updates of landmarks on the map; describes road including all lanes, occupied/non-occupied areas; Highly precise lane information

- **ADAS**
  - Semantics and Rules, e.g. Speed Limits, Non-Overtaking areas, conditional signs, slope info, curvature info

- **Topology and Basic Layer like Routing**
  - Enables referencing of information and further layering in relationship to a frame of reference
Evolution of the Electronic Horizon
System Architecture: Integration of Cloud based “Fresh Data”
Dynamic Services via Cloud / Backend
Value Add to Automated Driving (AD)

Support and improvement of predictive driving strategy
Improvement of driving comfort of AD vehicles

Key feature: Backend based environmental prediction beyond the local vehicle sensors

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

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)
Dynamic Services via Cloud / Backend

Use Case Examples:
Same Application - Different Sources and Different Means of Communication

- C2C via short range communication (ITS-G5)
- C2I via short range communication (ITS G5)
- C2B2C via cellular communication

Backend Server with Highly precise Map, Dynamic Services

Use Case Examples:
Same Application - Different Sources and Different Means of Communication

Backend Server with Highly precise Map, Dynamic Services
Dynamic Service via Cloud / Backend
Data Sources and Fusion Strategy

Stepwise deployment of Fleet vehicles require dedicated data fusion strategy

- Probe Data Vehicles – Crowd Sourced (Fleet/Sensor vehicles)
- 3rd Parties – specific (regional availability)
- Commercial Stream (global availability)

Data Availability

Data Quality

Crowd Sourcing requires stepwise increase of fleet vehicles; data provision via Collector Service

Safe Baseline: Dynamic Event Services start with the provision of the commercial stream
Dynamic Services for Automated Driving
Implications for Dynamic Traffic Management Tasks

- TODAY: Traffic Management Data are finally consumed by the Driver (via HMI)
- TOMORROW: Traffic Management Data are finally utilized for machine based driving

Implications to Road Operators

- Highly accurate dynamic data provision
  - Precise lane based data
  - Precise location referencing
  - Near real-time data provisioning

- Extended and precise source of data
  - E.g. Speed Limit Info, Gantry Info, Incidents, Tunnels, Road works, Tolling, Shoulder Information,
  - Predictive information: e.g. upcoming roadworks (incl. impacts on lane closure)

- Interface harmonization
  - E.g. based on DATEX II and/or TPEG

Continental and ASFINAG agreed on a joint project approach in order to address the current Traffic Management Challenges for Automated Driving
The Change Has Started
Automated Driving in Evolutionary Steps – Based on eHorizon
Thank you!