The Path to Highly Automated Driving
An Evolutionary Development

Brian Droessler, Vice President, Software and Connected Solutions
Continental Automotive, North America
Continental Corporation
Overview 2013

› Since 1871 with headquarters in Hanover, Germany
› Sales of €33.3 billion
› 177,762 employees worldwide
› 300 locations in 49 countries

Sales by division in %

- Chassis & Safety 22%
- Powertrain 19%
- Tires 28%
- Interior 20%
- ContiTech 11%

Status: December 31, 2013
## Continental Corporation
### Five Strong Divisions

<table>
<thead>
<tr>
<th>Chassis &amp; Safety</th>
<th>Powertrain</th>
<th>Interior</th>
<th>Tires</th>
<th>ContiTech</th>
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</thead>
<tbody>
<tr>
<td>Vehicle Dynamics</td>
<td>Engine Systems</td>
<td>Instrumentation &amp; Driver HMI</td>
<td>PLT, Original Equipment</td>
<td>Air Spring Systems</td>
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<td></td>
<td>Fuel Supply</td>
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<td>Commercial Vehicle Tires</td>
<td>Elastomer Coatings</td>
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<td>Fluid Technology</td>
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<td>Power Transmission Group</td>
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<td>Vibration Control</td>
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**PLT** – Passenger and Light Truck Tires
Reshaping Automotive
The Cloud Enables Automated Driving

- Driver Assistance Systems are a good start
- The cloud is the missing element for automated driving
- Cars need to send, receive and act on real-time data insights
- Cars need to communicate with each other
The World of Connectivity
Internet of Things (IoT)

Optimization in closed loop:

Waste

Efficiency

2013: 15 billion connected objects
2020: > 50 billion connected objects
Internet of Things: Business Opportunities
$14.4 Trillion Value At Stake in the upcoming 9 years*

*According to a Cisco White Paper; Value at Stake is the combination of increased revenues and lower costs that is created or will migrate among companies and industries.

ITS (Intelligent Transportation Systems) as major part of Transportation

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Traveling Gradually Becomes Automated

PARTIALLY AUTOMATED

- System monitoring required
- Drivers must be able to take over the task of driving at any time

Example: Stop & go up to 30 km/h
The Legal Framework Has Yet to be Created

Lawmakers have a decisive role to play in determining when and how market introduction will take place.

- **Partial automation**
- **High automation**
- **Full automation**

- **International**
  - Vienna Convention on Road Traffic Art. 8 / § 5:
    - Every driver shall at all times be able to control his vehicle.

- **National**
  - Road Traffic Act (StVO) § 1 (1):
    - Participation in road traffic requires continual caution and respect for others.

2016 2020 >2025
Optimal Solutions Require a Systems Approach

Complex applications
- Parking
- Highway
- Roadwork
- New: Complex scenarios
- Sensor group
- Back-end services

Back-end services
- With the requirement for back-end services
  - New interfaces
  - New optimization options solely from a systems viewpoint

Vehicle

Modules/Functions

Components

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Suppliers Must Prove Their Systems Expertise

In 2013, Continental is investing over €100 million in R&D for driver assistance systems and automated driving. 1,300 employees are working intensively on this topic.

<table>
<thead>
<tr>
<th>Driver</th>
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<tbody>
<tr>
<td>Attention management</td>
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<tr>
<td>Interior camera</td>
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<tr>
<td>Speech recognition</td>
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<tr>
<td>Augmented reality</td>
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<td>Head-up display</td>
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<table>
<thead>
<tr>
<th>Environment</th>
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<tbody>
<tr>
<td>Radar</td>
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<tr>
<td>Camera</td>
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<tr>
<td>Laser</td>
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<td>Ultrasound</td>
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<tr>
<td>Digital maps</td>
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<tr>
<td>Cooperative cars</td>
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<tr>
<td>Back-end</td>
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<tr>
<th>Vehicle</th>
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<tbody>
<tr>
<td>Braking</td>
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<tr>
<td>Sensors</td>
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<tr>
<td>Motor</td>
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<tr>
<td>E/E architecture/bus</td>
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<tr>
<td>Transmissions</td>
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<tr>
<td>Actuators</td>
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</tbody>
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Intelligent Transportation Systems - String of Pearls Consideration of End-to-End Solutions

Focus Safety&Security (SS) (including HAD)

Initial Focus Areas

- Remote Diagnostics/Predictive Maintenance
- Virtual Key
- UBI
- OTA
- TruckYa
- ETA Plus
- TIS Web
- Fully AD
- Intelligent Parking
- Assistent for Highway
- Assistent for City Traffic
- Platooning
- Vehicle Life Cycle Management / CRM
- City Toll Solution
- Safety Map
- Dynamic Data Services
- Trust Center
- Assistent for City Traffic
- Initial Focus Areas

Hardness:
- Idea
- Concept
- Innovation
- Demonstrator
- SOP

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The Benefit for the Driver:
Connectivity Increases the “Visual Range”

Vehicle Sensor
Visual range: 100-300m*

Cloud-based
Information

Local vehicle data

Road data along the route
Example Use Case
Why you need an eHorizon system

Imagine you are driving to O’hare airport. Shortly before arrival you pass an area that is usually is very foggy. Wouldn’t it be great to be warned ahead to be able to adapt your driving style and optimize the ADAS functions of your car?

Your Challenge

Imagine you are driving to O’hare airport. Shortly before arrival you pass an area that is usually is very foggy. Wouldn’t it be great to be warned ahead to be able to adapt your driving style and optimize the ADAS functions of your car?

Our Solution

If one driver is using the fog lights it might be an user error. If 20 cars use fog lights at the same position and drive slower afterwards, it is very likely that there is heavy fog in this area. With Connected eHorizon, drivers entering the area can be warned to adapt their speed accordingly. Less accidents happen.
Vehicle Networking and Partnerships
Strong Partners in the IT Industry

- Network Connectivity
- Data compression and data security
- Big Data processing
- Stream computing
- Analytics
- Infrastructure
- Platform as a service
- Highly precise digital map data
- Map based cloud services
- System Integrator
- ITS Applications and ITS services
- In-car systems
- In-car components

Connected Vehicle
Technical Solution
Connected eHorizon System Concept

In-Vehicle
- Application
- SW Platform
- OS Kernel
- Hardware
- Sensors

Cloud Services
- Stream Computing
- Analytics
- Big Data
- Infrastructure
- Platform-as-a-Service

Maps
- Fresh Map data
- Location Based Services
- Parking Spaces
- Real time traffic
- ADAS attributes

Connected Car Cloud

Secure Mobile IP Network
eHorizon at a Glance
System Architecture

**eHorizon Provider / eHorizon Box**

- Navigation Core
  - Positioning
  - Map Database
  - ADAS Application (optional)

**eHorizon Provider**
- Sends information to CAN
  - Position and meta data
  - Path Profile
  - Segment information

**Reconstructor**
- Decodes eHorizon messages
  - Position and meta data
  - Path Profile
  - Segment information

**ECU**
- Converts information for applications
  - Fuel and energy management
  - Comfort
  - Safety

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**eHorizon supplies**
- ADAS map data
- Positioning and map matching
- eHorizon provider

**eHorizon provider send information to CAN**
- Position and meta data
- Path Profile
- Segment information

**Reconstructor decodes eHorizon messages**
- Position and meta data
- Path Profile
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**ECU converts information for applications**
- Fuel and energy management
- Comfort
- Safety
eHorizon at a Glance
How your vehicle knows what you are up to

› Current most probable path (MPP) implementation has a look ahead length of up to 8 km (configurable)

› Along this stretch (i.e. for all road segments), required ADAS data are put onto the CAN

› Those ADAS data are provided also for connected road segments (e.g. at intersections) to ensure that the ADAS data are available in case the vehicle leaves the MPP

› In future, a self-learning MPP will be supported (locally in the vehicle)
Connected eHorizon
Three Update Cycles ensure Data Availability and Reliability

Cycle 1
Vehicle-internal Attribute Update

Cycle 2
Server-based Attribute Update

Cycle 3
Map Update (Yearly)

Continental Merging Algorithm

Dynamic Attribute Update

New Map Release
We fit your needs…
and increase Comfort, Safety and Efficiency!

<table>
<thead>
<tr>
<th>Comfort</th>
<th>Safety</th>
<th>Efficiency</th>
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<tbody>
<tr>
<td><strong>Maximized comfort</strong></td>
<td><strong>Increased safety</strong></td>
<td><strong>Improved cost efficiency</strong></td>
</tr>
<tr>
<td>by adjusted routes</td>
<td>by providing latest road</td>
<td>by reduction of fuel</td>
</tr>
<tr>
<td>based on real time traffic</td>
<td>and weather conditions</td>
<td>consumption up to 4%</td>
</tr>
</tbody>
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The Future Starts Earlier With Continental