NDS + ADASIS: Bringing maps to vehicle and driving functions

Roman Dolgov, Project Manager, Elektrobit
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Agenda

1. Map data: Enabling a safe and comfortable automated driving experience

2. Manage complexity by using the NDS standard

3. Providing map data via an electronic horizon
1. Enabling a safe and comfortable automated driving experience

Challenges for safe and comfortable automated cars

**Complexity**

**Unusual situations**

**Hazards**

**Difficult conditions**
# Applications benefitting from map data

<table>
<thead>
<tr>
<th>Full automation</th>
<th>RoboTrucks</th>
<th>Mobility as a Service</th>
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</thead>
<tbody>
<tr>
<td>Partial, conditional, and high automation</td>
<td>Traffic Jam Assist</td>
<td>Highway Pilot</td>
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<td></td>
<td>Platooning</td>
<td>Automated Valet Parking</td>
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<td>Urban Driving</td>
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<td>Active driver assistance systems</td>
<td>Adaptive Cruise Control</td>
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<td>Forward Collision Warning</td>
<td>Lane Keep Assist</td>
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<td>Economic/ecologic assistant systems</td>
<td>Eco Drive Assist</td>
<td>Range Control Assist</td>
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<td>Diesel Particulate Filter Control</td>
<td>Power Train Control</td>
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<td>Passive driver assistant systems</td>
<td>Intersection Warning</td>
<td>Traffic Sign Assistant</td>
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<td>Curve Speed Warning</td>
<td>Predictive Curve Light</td>
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<td>Night Vision</td>
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**past**

**today**

**future**
Evolution of automotive map requirements

1. Enabling a safe and comfortable automated driving experience

**NAVIGATION**
- Standard navigation maps
- Map attributes used for drivers only
- TMC traffic data
- Annual map update
- GNSS positioning

**DRIVER ASSISTANCE**
- Standard navigation maps and ADAS attributes
- Reliability of few ADAS attributes as needed for ADAS functions
- Online traffic, third-party content
- More frequent map updates
- GNSS & dead reckoning positioning

**AUTOMATED DRIVING**
- HD maps: highly precise information about the lanes and objects ahead
- Up-to-date information about speed limits, geometry and curvature, street type (crossroad, motorway, …)
- High reliability of dedicated ADAS attributes
- Online traffic, third-party content
- On-demand daily map updates
- Lane accurate positioning/localization
The need for high-definition maps

- HD maps offer highly accurate geometry of the lanes on the road

- Additional elements like road furniture or point clouds provide reference data for localization using various sensors

- Widespread coverage already available across Europe, America, and Japan through different map suppliers

- Highly accurate dynamic data created through crowd data
2. Manage complexity by using NDS standard

Versatile map attributes managed in one standard: NDS

- Standardized map database format
- Separation of navigation software from navigation data, to enhancing flexibility
- Support of incremental updates, compactness and protection against illegal use

2. Manage complexity by using NDS standard

NDS standard and ADASIS: maps for in-vehicle applications

Standard maps for ADAS applications:
• Maps based on road geometry
• Stored locally
• No automatic map updates

HD maps for HAD applications:
• Maps based on lane geometry
• Stored in backend, cached locally
• Always up-to-date maps
3. Providing map data via an electronic horizon

Generating an electronic horizon

• An electronic horizon translates available map information into usable data for ADAS and automated driving applications

• Distributing map data to other modules (ECUs) on-board of the vehicle, complementing sensor data

• ADAS is the established standard for map data distribution within the E/E system
3. Providing map data via an electronic horizon

Scope of the ADASIS forum

Advancing map-enhanced driver assistance systems

- Group of global vehicle industry and suppliers
- Interfaces for exchanging information between in-vehicle map database and ADAS/AD applications
- Applications to access map sources, build predictive and vehicle environment data based on map/position/georeferenced data
- Defacto standard used worldwide

2012: ADASIS v2 specification release, supporting e.g. Predictive Powertrain Control, relying on SD maps
2014: Start of development of ADASIS v3 with support of HD maps as enabler for automated and autonomous driving
2018: Stable ADASIS v3 specification
2019: EB provides first reference implementation and Eval Kit to the forum
2020: First expected SOP with ADASIS v3
### Comparing ADASIS v2 and v3

<table>
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<th>Purpose</th>
<th>ADASIS v2</th>
<th>ADASIS v3</th>
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<tr>
<td><strong>Purpose</strong></td>
<td>Standard and ADAS map with road-level data for advanced driver assistance applications</td>
<td>High-definition map with lane-level data for automated driving</td>
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<td><strong>Vehicle bus</strong></td>
<td>Designed for CAN bus</td>
<td>Broadband connection (Ethernet, TCP/IP)</td>
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| **Communication scheme** | Broadcast communication: 1 provider, n clients | Bi-directional communication mechanisms supported:
- Broadcast for most probable path (MPP)
- Publish-subscribe (P2P) for additional attribute information
- Multiple sub-provider |
| **Electronic horizon road network representation** | Single tree support | Support for multiple independent trees |
| **Most probable path (MPP) and tree length** | Up to 8190m (13 bit) | Ca. up to 43.000 km (32 bit) |
| **No. of possible profile types** | 31 attribute profiles | Room for up to $2^{32}$ bit possible profiles, 45 types currently specified |
| **Profile attribute value range** | Profile short: 10 bit
Profile long: 32 bit | 64 bit for all profile attributes |
| **Attribute resolution** | Meter [m] | Centimeter [cm] |
| **Content** | Standard map attribute profiles on link level
Traffic data | Map attribute profiles on lane level
Extended road lane model | detailed intersection model
Road boundaries / furniture / land marks |
3. Providing map data via an electronic horizon

NDS standard and ADASIS: maps for in-vehicle applications

Standard maps for ADAS applications:
- Maps based on road geometry
- Stored locally
- No automatic map updates
- Electronic horizon protocol: ADASIS v2

HD maps for HAD applications:
- Maps based on lane geometry
- Stored in backend, cached locally
- Always up-to-date maps
- Electronic horizon protocol: ADASIS v3
Evolution of automotive map requirements

**PAST**
- Standard navigation maps
- Map attributes used for drivers only
- TMC traffic data
- Annual map update
- GNSS positioning

**TODAY**
- Standard navigation maps and ADAS attributes
- Reliability of few ADAS attributes as needed for ADAS functions
- Online traffic, third-party content
- More frequent map updates
- GNSS & dead reckoning positioning

**FUTURE**
- HD maps: highly precise information about the lanes and objects ahead
- Up-to-date information about speed limits, geometry and curvature, street type (crossroad, motorway, ...)
- High reliability of dedicated ADAS attributes
- Online traffic, third-party content
- On-demand daily map updates
- Lane accurate positioning/localization
3. Providing map data via an electronic horizon

Electronic horizon – Provider (EHP)

Connectivity

On demand map download
- HAD maps, lane level resolution, live layer

On board maps & connected services
- Dynamic data: traffic, parking, weather, etc.

On board maps
- Manual map updates

Content

Standards maps
- Road topology, speed limits, slopes, curvature, etc.

Highly automated driving (HAD) maps
- Lane boundaries & groups, lane connectivity, polygonal lane description

Scalable basic electronic horizon

- ADASIS \(^2\)

Connected electronic horizon

- ADASIS \(^3\)

HAD electronic horizon

1. Electronic horizon

2. Connected electronic horizon

3. HAD electronic horizon

Addressing...

1. Entry ADAS applications
2. High end ADAS applications
3. SAE Level >=2 applications
EB robinos Predictor Eval Kit: ADASIS v2 and ADASIS v3 Provider

Record test drives and play them back in exact timing behavior at your desk

- Use a robust and series-ready ADASIS Provider for your R&D activities
- ADASIS v2: Use Q3/2018 NDS MapScape maps, EU, and NAR
- ADASIS v3: Use HERE or TomTom online HD maps
- Use GNSS receiver as positioning source
- Record / Replay your tracks of all test drives
- Configure your ADASIS v2 Provider
  - Configure your CAN connection and CAN layout
  - Configure your applied maps (EU / NAR)
  - Configure ADASIS protocol settings
- Connect easily with any mobile device (PC, tablet, mobile phone) via LAN/WIFI (WebApp) for configuring and controlling your Eval Kit

Dont miss the demo!

Give it a try!

Network: EBRaspi
Password: elektrobit
WebApp: 192.168.42.1:5000

Plug in power supply and start!
Let’s conclude

Versatile and high data amount is kept under control by using the NDS standard

ADASIS v3 electronic horizon is a standardized way of providing HD map data to on-board units

We see NDS and ADASIS as a perfect bundle for automated and autonomous driving functions
Thank you! Questions?

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