Connected Automated Driving Roadmap – 2019 update

ERTRAC Conference April 4th
CAD Roadmap version 8.0 - now available!

- Increased scope to better cover **Connected** Automated Driving, including cooperative and connected vehicles.
- Strengthen the link to the **Infrastructure**, through CEDR.
- Deeper dive into three use cases including requirements on ’connected & infrastructure’:
  - Automated Passenger Cars Path
  - Automated Freight Vehicles Path
  - Urban Mobility Vehicles
- Connect to the CARTRE (CSA) results and the ARCADE (CSA) project and provide **a EU wide overview** (and beyond).
- Incorporate the STRIA CAD actions (2018) via **Key Challenges and Objectives**.
ODD / ISAD / Traffic regulations and Homologation Framework

- Explanation and information on ODD
- Vehicle and Infrastructure Interaction
- Regulatory and standardisation framework for Automation
- Connectivity as a requirement for vehicle-infrastructure interaction
ODD – Operational Design Domain Example #1
Infrastructure Support levels for Automated Driving (ISAD)

Elaborated in cooperation with INFRAMIX, see also ITS World Congress 2018 paper by AAE & ASFINAG

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<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Description</th>
<th>Digital information provided to AVs</th>
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<tr>
<td></td>
<td>Digital infrastructure</td>
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<tr>
<td>A</td>
<td>Cooperative driving</td>
<td>Based on the real-time information on vehicle movements, the infrastructure is able to guide AVs (groups of vehicles or single vehicles) in order to optimize the overall traffic flow.</td>
<td>X  X  X  X</td>
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<td>B</td>
<td>Cooperative perception</td>
<td>Infrastructure is capable of perceiving microscopic traffic situations and providing this data to AVs in real-time.</td>
<td>X  X  X</td>
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<tr>
<td>C</td>
<td>Dynamic digital information</td>
<td>All dynamic and static infrastructure information is available in digital form and can be provided to AVs.</td>
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<td></td>
<td>Conventional infrastructure</td>
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<td>D</td>
<td>Static digital information / Map support</td>
<td>Digital map data is available with static road signs. Map data could be complemented by physical reference points (landmarks signs). Traffic lights, short term road works and VMS need to be recognized by AVs.</td>
<td>X</td>
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<tr>
<td>E</td>
<td>Conventional infrastructure / no AV support</td>
<td>Conventional infrastructure without digital information. AVs need to recognise road geometry and road signs.</td>
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</table>
Infrastructure Support levels for Automated Driving (ISAD) - on schematic road segment

- Based on the ISAD Level of information and services different on-board vehicle decisions can be supported
- CAVs will have to be able to drive on E-level, but the additional possibilities provided by A-level sections enable a much higher customer satisfaction as well as support road safety and capacity management related goals
Connectivity as a requirement for vehicle-infrastructure interaction

Option 1: Metadata & data via NAP

Option 2: only Metadata via NAP
## Automated Passenger Car Development Paths

| Automation Level                      | Established | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 | ...
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<td>Urban and Sub-Urban Pilot</td>
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### Indicative development paths (TRL 7-9)

- Highway Autopilot (Level 4)
- Highway Convoy (Level 4)
- Urban and Suburban Pilot (Level 4)

**Passenger Cars: M1 category**
### Automated Freight Vehicle Development Paths

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<tr>
<th>Automation Level</th>
<th>Established</th>
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- **Fully Automated Freight Vehicles**
- **Highly Automated Vehicles in Confined Areas**
- **Highly Automated Vehicles on Dedicated Roads**
- **Highly Automated Vehicles on Open Roads**

#### Functions:
- **Adaptive Cruise Control**
- **Stop &Go**
- **Lane Keeping Assist**
- **Lane Change Assist**
- **Lane Departure Warning**
- **Blind-spot Warning**
- **Forward Collision Warning**
- **ABS, ESC**
- **Emergency Brake**

#### Pathways:
- **Highway Pilot Platooning**
- **Highway Chauffeur**
- **Traffic Jam Chauffeur**
- **Automated Truck Platooning**
- **Traffic Jam Assist**
- **C-ACC Truck Platooning**

### Unmanned Vehicles
- **Highway Chauffeur, open roads**
- **Unmanned vehicles, confined and hub-to-hub**

**Indicative development paths TRC 7.9**

**Truck:** Freight vehicle > 3.5 tonnes categorie N2 or N3
## Automated Urban Mobility Vehicle Development Paths

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<th>Automation Level</th>
<th>Established</th>
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- **Level 0**: No Driving Automation, support beyond human capability to act
- **Level 1**: Driver Assistance
- **Level 2**: Partial Automation
- **Level 3**: Conditional Automation
- **Level 4**: High Automation
- **Level 5**: Full Automation

PRT (Personal Rapid Transit) incl. Urban Shuttle
City Bus/Coach: M2 < 5 tonnes < M3

© Robert Bosch GmbH
Overview of EU funded projects that support the development of automated driving
Collaboration and Exchange of Key Importance!

**STRIA**

R&I initiatives and Action Sheets:
- In-vehicle enabler
- Vehicle validation
- Large scale demonstration pilots to enable deployment
- Shared and automated mobility services
- Human factors
- Physical and digital infrastructure
- Big data, Artificial Intelligence and their applications

**ARCADE Project (CSA)**
- Joint-stakeholder Workshops
- Roadmap Consolidation
- EUCAD Conferences and Seminar
- Tri-lateral (Japan, USA, EU) and beyond
- Thematic Areas Clusters;
  - Society & Users
  - Systems & Services
  - Vehicle & Technology

ARCADE is funded by the European Union Horizon 2020 Work Programme
Key Challenge Areas

**VEHICLES & TECHNOLOGIES**
- New mobility services, shared economy and business models
- Big data, artificial intelligence and their applications
- Digital and physical infrastructure, including Connectivity
- In-vehicle technology enablers
- Deployment

**SYSTEM & SERVICES**
- Safety validation and roadworthiness testing
- Policy and regulatory needs, European harmonisation
- Socio-economic assessment and sustainability

**USERS & SOCIETY**
- User awareness, users and societal acceptance and ethics, driver training
- Big data, artificial intelligence and their applications
- Digital and physical infrastructure, including Connectivity
- Safety validation and roadworthiness testing
- Policy and regulatory needs, European harmonisation
- Socio-economic assessment and sustainability
ARCADE WP2: Main Deliverables & Milestones

April 2017 EUCAD 2017 Conference
April 2018 EUCAD2018 Symposium
April 2-3 2019 EUCAD 2019 Conference
April 2020 EUCAD2020 Symposium
April? 2021 EUCAD2021 Conference

2019 - D2.1 CAD consolidated roadmap Year 1 (Volvo)
2020 - D2.2 CAD consolidated roadmap Year 2 (Vedecom)
2021 – D2.3 CAD consolidated roadmap Year 3 (UITP)

Joint stakeholder meetings & Trilateral Working Group meetings

CARTRE
ARCADE activities

• Joint Stakeholder workshop February 2019, in conjunction with ERTRAC WG meetings
  • 5-6 Feb ARCADE joint stakeholder workshop: “Towards the Consolidated CAD Roadmap - 2019”
    • Collecting input from the breakout sessions; Rapporteurs > “Key Challenges, Scenarios and Objectives”

• Finalizing ERTRAC CAD Roadmap, for distribution EUCAD 2019, April
  • Final peer review, editing, printing handled by ERTRAC

• 2-3 April EUCAD 2019, break-out sessions, Rapporteurs consolidation >
  • 4 April joint stakeholder workshop on CAD projects

• Preparation of ARCADE Consolidated Roadmap 2019 D2.1 for M12
ARCADE Consolidated Roadmap (input & links)

Table of Content (tentative)
- Executive summary
- Common definitions
- Scope & Overall Scenarios
- Key Challenges & Scenarios
  - Technology (T3.2)
  - Systems & Services (T3.3)
  - Society (T3.3)
- Development paths
  - Passenger Cars
  - Freight Vehicles & Logistics
  - Urban Mobility & Public Transport
- Key EU and International activities
  - MS / EU
  - International
- Conclusions
- Appendices

Stakeholders
- ARCADE
- ERTRAC; WG CAD
- STRIA CAT 2.0
(+ STRIA Urban Mobility, STRIA Infrastructure, ...)

Projects, activities
- WP3
- WP4

Trilateral+
- (+ STRIA Urban Mobility, STRIA Infrastructure, ...)
- (+ WG Safety & Security, WG Long distance freight transport, WG Urban Mobility)

MS / EU Activities, Projects
- CEDR, ALICE, etc.

International Activities, Projects