European collaborative research in connected automated driving since Prometheus ...

The Eureka PROMETHEUS Project (PROgraMme for a European Traffic of Highest Efficiency and Unprecedented Safety, 1987-1995) was the largest R&D project ever in the field of driverless cars.

The project received €749M in funding from the EUREKA member states and defined the state of the art of autonomous vehicles.

**Industrial research**
- PRO-CAR: Driver assistance by computer systems
- PRO-NET: Vehicle-to-vehicle communication
- PRO-ROAD: Vehicle-to-environment communication

**Basic Research**
- PRO-ART: Methods and systems of artificial intelligence
- PRO-CHIP: Custom hardware for intelligent processing in vehicles
- PRO-COM: Methods and standards for communication
- PRO-GEN: Traffic scenario for new assessment and introduction of new systems
EU PROJECT CONTRIBUTIONS EXAMPLES: CONNECTED AUTOMATED DRIVING & ADAS

**Connected Cooperative Automated Driving**
Collaboration, Network, Demonstration, Pilots
Field Operational Tests (FOT), Test verification and validation, Platooning, V2x, Cooperative Driving, …

**Advanced Driver Assistance Systems**
Advanced systems for Lane Change Support, Lane Keeping Support and Adaptive Cruise Control. Drowsiness detection. Driver Interaction. Emergency Brake, Distance Alert, …

Results brought into products e.g. Volvo FH
Reminder:
- ERTRAC is a European Technology Platform (ETP)
- About 60 members, representing all the actors of the Road Transport System: industry, research, academic, European associations, EU Member States, local authorities, European Commission services.

Working groups & Task forces
- Urban Mobility
- Long Distance Freight Transport
- Energy & Environment
- Road Transport Safety & Security
- Global Competitiveness
  - Connectivity and Automated Driving
  - Electrification task force
Connected Automated Driving Roadmap – 2019 update

FFI TSAF Conference September 17, 2019
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**.
1. Scope and Objectives
2. Common Definitions
   2.1 Levels of Automation
   2.2 Operational Design Domain
   2.3 Vehicle and infrastructure interaction
   2.4 Regulatory and standardisation framework for Automation
   2.5 Connectivity as a requirement for vehicle-infrastructure interaction
3. Development paths
   3.1 Automated Passenger Cars Path
   3.2 Automated Freight Vehicles Path
   3.3 Urban Mobility Vehicles
4. EU and International initiatives
   4.1 European research projects
   4.2 European initiatives
   4.3 EU Member States initiatives
   4.4 Initiatives around the world
5. Key Challenges and Objectives
   5.1 User awareness, users and societal acceptance and ethics, driver training
   5.2 Human Factors
   5.3 Policy and regulatory needs, European harmonisation
   5.4 Socio-economic assessment and sustainability
   5.5 Safety validation and roadworthiness testing
   5.6 New mobility services, shared economy and business models
   5.7 Big data, artificial intelligence and their applications
   5.8 Physical and Digital infrastructure (PDI) including Connectivity
   5.9 In-vehicle technology enablers
   5.10 Deployment
6. Annex: definitions of systems – Levels 0 to 2 + Parking
   6.1 Current and future vehicle systems – Level 0
   6.2 Current systems – Level 1
   6.3 Automated Driving Assistance - Level 2
   6.4 Automated Parking Assistance
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

• ODD := A description of the specific operating conditions in which the automated driving system is designed to properly operate, including but not limited to roadway types, speed range, environmental conditions (weather, daytime/nighttime, etc.), prevailing traffic law and regulations, and other domain constraints (SAE J3016 June 2018)

• Long term vision is to align infrastructure data with automotive safety integrity level.
• Visualize automated driving quality and availability, driving/travel experience from a user perspective
• To further provide input from CEDR CAD: what are the prerequisites towards the infrastructure from vehicle side?
ODD – Operational Design Domain Example #1

Tom Alkim
2017
ODD – Operational Design Domain Example #2

Everywhere

- Manual driving
  - First mile
  - Highway
  - Last mile

Transition of control

- Automated driving
  - Destination

Origin

Always & all conditions

Tom Alkim
2017
Input - How the infrastructure can (and should) support CAD

- Road infrastructure can provide additional information for on-board decisions of CAVs
- A classification of infrastructure support is needed:
  - Common understanding between OEMs, automotive industry and road operators is to be established
  - More use-cases have to be defined to understand the potential of ISAD in mixed traffic
  - Long transition period with mixed traffic is expected
- The workgroups’ feedback was incorporated in the approach and classification of this infrastructure support levels, please find the related information on the next slides.
# Infrastructure Support levels for Automated Driving (ISAD)

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

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Description</th>
<th>Digital information provided to AVs</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<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>
</tr>
<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>
<td>X X</td>
</tr>
<tr>
<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>
</tr>
<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>
<td></td>
</tr>
</tbody>
</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
The three development path use cases

• One use case per deployment path has been deemed especially beneficial to be researched (-> green boxes), and they align well with the CEDR research project MANTRA’s targeted use cases.

• The use case selection was then further adapted to best fit our current focus points and still align well with other activities.

• All chapters in the roadmap include requirements on ’connected & infrastructure’
# Automated Passenger Car Development Paths

| Automation Level | Established | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 | ...
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5: Full Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4: High Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3: Conditional Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2: Partial Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1: Driver Assistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 0: No Driving Automation, support beyond human capability to act</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Level 5: Full Automation
- Fully Automated Passenger Cars

### Level 4: High Automation
- Highway Autopilot (Level 4)
- Highway Convoy (Level 4)
- Urban and Sub-Urban Pilot (Level 4)

### Level 3: Conditional Automation
- Highway Chauffeur
- Urban and Sub-Urban Pilot

### Level 2: Partial Automation
- Traffic Jam Chauffeur
- Traffic Jam Assist
- Parking Assist

### Level 1: Driver Assistance
- Adaptive Cruise Control
- Stop & Go
- Lane Keeping Assist
- Lane Change Assist
- Parking assist

### Level 0: No Driving Automation, support beyond human capability to act
- Lane Departure Warning
- Blind-spot Warning
- Forward Collision Warning
- ABS, ESC
- Emergency Brake

Passenger Cars: M1 category
Level 4 for passenger cars – what drives technology?
Rollout limited by scenario complexity and driving speed.
### Automated Freight Vehicle Development Paths

<table>
<thead>
<tr>
<th>Automation Level</th>
<th>Established</th>
<th>2018</th>
<th>2020</th>
<th>2022</th>
<th>2024</th>
<th>2026</th>
<th>2028</th>
<th>2030</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5: Full Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4: High Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3: Conditional Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2: Partial Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1: Driver Assistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 0: No Driving Automation, support beyond human capability to act</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0: No Driving Automation, support beyond human capability to act</td>
<td>Lane Departure Warning</td>
</tr>
<tr>
<td></td>
<td>Blind-spot Warning</td>
</tr>
<tr>
<td></td>
<td>Forward Collision Warning</td>
</tr>
<tr>
<td></td>
<td>ABS, ESC</td>
</tr>
<tr>
<td></td>
<td>Emergency Brake</td>
</tr>
<tr>
<td></td>
<td>C-ACC Truck Platooning</td>
</tr>
<tr>
<td></td>
<td>Automated Truck Platooning</td>
</tr>
<tr>
<td></td>
<td>Traffic Jam Assist</td>
</tr>
<tr>
<td></td>
<td>Highway Chauffeur</td>
</tr>
<tr>
<td></td>
<td>Highway Pilot Platooning</td>
</tr>
<tr>
<td></td>
<td>Highly Automated Vehicles on Open Roads</td>
</tr>
<tr>
<td></td>
<td>Highly Automated Vehicles on Dedicated Roads</td>
</tr>
<tr>
<td></td>
<td>Highly Automated Vehicles in Confined Areas</td>
</tr>
<tr>
<td></td>
<td>Fully Automated Freight Vehicles</td>
</tr>
</tbody>
</table>

**Unmanned vehicles, confined and hub-to-hub**

**Highway chauffeur, open roads**

**Truck: Freight vehicle > 3.5 tonnes categorie N2 or N3**
Highway chauffeur for hub2hub and open-roads, Heavy Freight Vehicles - examples

- Highly automated, un-manned connected to control and supply-chain management center
- For repetitive transport between hubs. Slow speed for energy optimized electrified operation
- Dedicated roads/lanes with infrastructure/charging support

- Highly automated trucks on open roads in mixed traffic
- For flexible transport assignments with automated/manual operation
- Integrated with logistics supply chain
- Cooperative automation
## Automated Urban Mobility Vehicle Development Paths

<table>
<thead>
<tr>
<th>Automation Level</th>
<th>Established</th>
<th>2018</th>
<th>2020</th>
<th>2022</th>
<th>2024</th>
<th>2026</th>
<th>2028</th>
<th>2030</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5: Full Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 4: High Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3: Conditional Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2: Partial Automation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1: Driver Assistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 0: No Driving Automation, support beyond human capability to act</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Level 5:** Full Automation
  - Fully automated Urban Mobility Vehicles
- **Level 4:** High Automation
  - Automated PRT/Shuttles on Dedicated Roads
  - Automated PRT/Shuttles in Mixed Traffic
- **Level 3:** Conditional Automation
  - Automated Urban Bus Chaffeur
- **Level 2:** Partial Automation
  - Urban Bus Assist
  - Traffic Jam Assist
  - Parking Assist
- **Level 1:** Driver Assistance
  - Adaptive Cruise Control
  - Stop & Go
  - Lane Keeping Assist
  - Lane Change Assist
  - Parking assist
- **Level 0:** No Driving Automation, support beyond human capability to act
  - Lane Departure Warning
  - Blind-spot Warning
  - Forward Collision Warning
  - ABS, ESC
  - Emergency Brake

---

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

© Robert Bosch GmbH
Urban Mobility and Automation

Autonomous vehicles will only help to meet public policy goals if they come as shared fleets integrated with public transport.

**Shared fleet of vehicles**

- Strong reduction in number of cars (and car ownership, effective use of cars as they operate most time of the day)
- Dramatically improved mobility for people that do not own a car

**Privately owned cars**

- No effect on car ownership
- No effect on number of parked cars (cars are used most of the day)
- No effect on costs
- No effect on mobility for people that do not own a car
- Even more car traffic
  - So it is even more uncomfortable and attractive to go by car?

**Fleet cars COMPETING with traditional public transport services**

- Street reclaiming, less parking
- Improved access to public transport
- Improved mobility for people that do not own a car
- More traffic (less congestion in vehicle miles traveled (VMT))
- Inefficiency (small vehicles replacing buses and trains)
- Passenger loss for traditional public transport walking and cycling

**Fleet cars INTEGRATED with traditional public transport services**

- Large scale street reclaiming
- Highly improved access to public transport
- Highly improved mobility for people that do not own a car
- Large decrease in VMT
- High gain of efficiency (large and small vehicles perfectly matched)
- Low costs

Overview of EU funded projects that support the development of automated driving
Overview of EU funded projects that support the development of automated driving

EU projekt med svensk medverkan; https://connectedautodriving.eu/cad-knowledge-base/
### Automated Road Transport Calls 2020

<table>
<thead>
<tr>
<th>Grant</th>
<th><strong>Efficient and safe connected and automated heavy-duty vehicles in real logistics operations</strong> DT-ART-05-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Types of action:</strong> Innovation action</td>
</tr>
<tr>
<td></td>
<td><strong>Forthcoming</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grant</th>
<th><strong>Large-scale, cross-border demonstration of connected and highly automated driving functions for passenger cars</strong> DT-ART-06-2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Types of action:</strong> Innovation action</td>
</tr>
<tr>
<td></td>
<td><strong>Forthcoming</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Key Challenge Areas

**SYSTEM & SERVICES**
- 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
- Human Factors

**VEHICLES & TECHNOLOGIES**
- Safety validation and roadworthiness testing
- Policy and regulatory needs, European harmonisation
- Socio-economic assessment and sustainability
- User awareness, users and societal acceptance and ethics, driver training

**USERS & SOCIETY**
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
Coordination of Automated Road Transport For Europe
Objective: Support faster deployment of connected and automated driving across Europe

European Commission funded Coordination & Support Actions

**VRA**
- July 2013 – Dec 2016

**CARTRE**
- Oct 2016 – Sep 2018
- 36 consortium partners
- 51 associated partners

**ARCADE**
- Oct 2018 – Sep 2021
- 23 partners from 11 States
- 30 associated partners
- 2000 subscribers
Thematic Areas

**Technology**
- In-Vehicle Enablers
- Connectivity
- Human Factors
- Deployment

**System & Services**
- Physical & Digital Infrastructure
- Big Data, AI and applications
- New Mobility Services, shared economy
- Freight & Logistics

**Society & Users**
- Safety Validation Roadworthiness testing
- Policy and regulatory needs
- User awareness, societal acceptance and ethics
- Socio-economic assessment

---

*ARCADE Stakeholder Workshop Brussels 4 April 2019*
<table>
<thead>
<tr>
<th>Development Paths / Use Cases</th>
<th>D3.7 Society Challenges &amp; Scenarios</th>
<th>D3.4 Systems and Service Challenges &amp; Scenarios</th>
<th>D3.3 Technical Challenges &amp; Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>User awareness, users and societal acceptance and ethics, driver training</td>
<td>Safety integration and roadworthiness testing</td>
<td>Policy and regulatory needs, European harmonisation</td>
<td>Socio-economic assessment and sustainability</td>
</tr>
<tr>
<td>New mobility services, shared economy and business models</td>
<td>Big data, artificial intelligence and their applications</td>
<td>New data sharing framework (trust, privacy, liability, data protection, meta-data description, access, etc.)</td>
<td>Need for definitions, standardisation if the interaction of PDI and AVs (e.g. SAD, OOD)</td>
</tr>
<tr>
<td>Digital and physical infrastructure</td>
<td>Human Factors</td>
<td>Connectivity</td>
<td>Definition of connectivity requirements for AD functions (performance, QoS, resilience, etc.)</td>
</tr>
<tr>
<td>Deployment</td>
<td>In-vehicle technology enablers</td>
<td>Tests and Demonstration e.g. Cross-border</td>
<td>Harmonise definition of ODDs and functionalities needed for given ODDs</td>
</tr>
</tbody>
</table>

**Societal Needs Analysis**

- From user and society perspectives
  - Alignment of vehicle regulation (and type approval) and corresponding assessment tools & procedures
  - Working for flexible AD regulation enabling different solutions, within the boundaries of safety.
  - Impact assessment needs both pilots (low TRL) and FOTs (high TRL)
  - Proof of viability only possible when automated fleets is available
  - Consolidate data sharing framework (trust, privacy, liability, data protection, meta-data description, access, etc.) starting from success cases
  - Need for definitions, standardisation if the interaction of PDI and AVs (e.g. SAD, OOD)

**Positive Risk analysis**

- Determine proper combinations of virtual testing, closed test track and open road testing of AVs, connectivity and cyber-security
  - Learn from adaptation of regulation, work towards common approach
  - Development of EU-level databases to allow more reliable scaling up (data on accidents, mileage, etc. including ODD aspects, with sufficient details and granularity)
  - Pilots and FOTs are needed to validate business case, operational models and specifications
  - Validation of AI is a bottleneck
  - Alignment needed for development and validation of AI functionalities for AV
  - Define Classifications of PDI

**Ethics evaluation based on technology understanding**

- Share and harmonise driving/traffic scenarios and best practices, including cyber-security
  - Learn from adaptation of regulation. Build common framework
  - Development of commonly available (validated) AV simulation and other evaluation tools
  - Raise authorities awareness of new role of services, system, integration and operation
  - Standards and solutions (HW/SW) for data management and data quality (e.g. L3Pilot)
  - AV-ready road planning and self-explaining roads. (e.g. traffic signs and lane marking for AVs)
  - New role of remote operators (sustain attention, control environments, etc.)
  - Standardisation and further deployment of V2X technologies
  - L3 FOT (L4 FOT unclear when possible)

**Impact on drivers/users and operator training**

- Consensus building with respect to validation of methodologies, including Data-labeling standards
  - Make cross-border testing easy
  - Commitment to use common impact assessment methodologies (like FESTA, Trilateral framework)
  - Integration of new services with existing services (e.g. public transport) from start
  - New AI-concepts for cyber-physical road traffic systems
  - Promote the use of common definitions (e.g. ISAD), create Living lab with PDI
  - Behavioral change, Social inclusion
  - Cybersecurity and safe communications respecting privacy and various levels of trust
  - Interoperability of communication technologies / Hybrid connectivity solutions
  - Promote deployment through simulations of scenarios, road transport & traffic management
  - Reach efficient integration of system in fail-operational architectures (costs, energy, redundancy)

**Secure privacy for mobility users**

- Developing procedures to manage validation of vehicle updates (e.g., over the air software updates) monitoring during the whole lifecycle of the vehicle.
  - Harmonisation of the interpretation of traffic rules, digitalization of traffic sign information
  - Research on the long-term indirect impacts of automation, equity etc.
  - Further develop urban delivery AD solutions
  - Clarify the new roles and responsibilities of AD
  - Learning, education
  - Interoperability of communication technologies / Hybrid connectivity solutions
  - Maintain system integrity and well-functioning once in the field, monitor for updates

**Passenger Cars**

- Homologation framework and simulations, self-certification
  - Impacts on safety and travel behaviour
  - Peer-to-peer sharing
  - New robust AI-passenger-car solutions
  - Customer pilots with non-homologated vehicles

**Freight Vehicles**

- New fleet operation seems for AV
  - Homologation framework Hub-to-hub, semi-confined ODDS
  - Business case for platooning need to be clarified depending on regulation scenario
  - Impacts on transport network efficiency and environment
  - Logistics services Business need for AD (TCO)
  - New AI freight and logistics solutions
  - Hub-to-truck corridors and freight trips management
  - Truck parking safe-zones for AD trucks
  - The role of professional truck drivers
  - Correctness and latency for multi-brand configuration
  - Commercial pilots

**Urban Mobility Vehicles**

- City authority perspectives
  - VRU scenarios for unmanned buses and shuttles
  - Support early introduction through exemptions
  - Impacts on transport mode choice and social inclusion
  - Further develop urban delivery AD solutions
  - New AI urban mobility solutions
  - Traffic management complementing public transport
  - The role of professional bus drivers
  - Identify needs
  - Specific requirements for remote operation “control-tower”
  - Low-speed, low-tech AVs
The EC has launched a “Single platform for open road testing and pre-deployment of cooperative, connected, automated and autonomous mobility (CCAM)”. For details see: https://ec.europa.eu/digital-single-market/en/news/call-applications-selection-members-single-platform-open-road-testing-and-pre-deployment

Working Groups established

- WG1 Develop an EU agenda for testing
- WG2 Coordination and Cooperation of R&I
- WG3 Physical and Digital road infrastructure
- WG4 Road Safety
- WG5 Access to and exchange of data & Cybersecurity
- WG6 Connectivity and digital infrastructure
Horizon Europe – Important to provide Swedish input

- **4.2 Cross-sectoral solutions for decarbonisation**
  - 4.2.1 Establish a competitive and sustainable European battery value chain
  - 4.2.2 Strengthen the European value chain for low-carbon hydrogen and fuel cells
  - 4.2.3 Develop sustainable infrastructure, services and systems for smart and sustainable communities and cities
- **4.5 Develop low-carbon and competitive transport solutions across all modes**
  - 4.5.1 Achieve zero-emission road transport
  - 4.5.4 Enable low-carbon, clean and competitive waterborne transport
- **4.6 Develop seamless, smart, safe and accessible mobility systems**
  - 4.6.1 Make automated and connected road transport safe and competitive
  - 4.6.2 Develop efficient and innovative transport infrastructure
  - 4.6.3 Develop the future transport network and integrated traffic management
  - 4.6.4 Enable multimodal freight logistics and passenger mobility services
  - 4.6.5 Increase transport safety across all modes
Conclusions

- ERTRAC CAD Roadmap, an important common reference for European R&I and provides recommendations for the European Commission
- Two remaining calls related to Automated Road Transport 2020
- ARCADE CSA project maintains the Network, Knowledge Base, Thematic Areas towards further development of a Consolidated Roadmap
- CCAM Single Platform is important for common tests, R&I, Safety, data sharing, cyber-security, infrastructure etc.
- Co-Design for Horizon Europe is ongoing – Important to provide Swedish input and align with FFI strategies.
- **Use FFI projects to build Swedish capacity towards European exploitation of results!**