Comprehensive Roadmap for Level 4/5 Connected and Automated Driving

Gereon Meyer, VDI/VDE-IT

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"This will turn driving these vehicles into a video game except lives are at stake."

California Department of Motor Vehicles, 2018
SCOUT Project

Objectives:

• To identify pathways for an accelerated proliferation of safe and connected high-degree automated driving (SAE 3-5)

• To take into account user needs and expectations, technical and non-technical gaps and risks, viable business models as well as international cooperation and competition.

• To help the automotive, the telecommunication and digital sectors need to join forces and agree on a common roadmap

Contractual Partners:
VDI/VDE-IT, Renault, FCA, BMW, Bosch, NXP, Telecom Italia, NEC, RWTH, Fraunhofer, CLEPA, Sernauto

Duration: 1 July 2016 - 30 June 2018

Funding Agency: European Commission, DG CNECT
Co-Creation of the Vision

Validation exercise at the AMAA 2017 Conference
25 Sept 2017, Berlin
Vision Development
Co-Creation of Roadmap

**Technical**

1) Hurdles:
- Vehicle environment protection and event prediction
- Safety of operation and incident management
- Integration in traffic management and control
- Communication in all-weather conditions
- Privacy and cyber-security
- Georeferenced mapping (e.g. AI systems)
- Management of in-vehicle traffic
- Reliability of functional safety and validation
- Interaction with other road users (ORC; arena)

2) Actions/Links:

- **Function Development**
  - Standardisation
  - Comprehensive & Flexible Concepts for Cyber-Security
  - Future Development of Collective Traffic and Incident Management Systems
  - Validation Method Development & Certification

- **Data Protection**
  - Develop Model Sensor & Control Suite
  - Provide Safe Operations & Safe Vehicle Control Architecture
  - Use Cases
  - Evolution Concept

- **Integration**
  - Update and adapt connectivity infrastructure for appropriate latency and bandwidth
  - Global, open, centralized maps

- **Validation**
  - Certification
  - Simulation
  - Legislation

**SCOUT Expert Workshop 7 Mar 2018**
Co-Creation of Roadmaps

Lessons Learned

• 5-Layer Model appropriate to describe the challenges related to CAD in a comprehensive way.
• Dependencies (“links”) between the layers are manifold, creating a “Gordian knot”, i.e. development and deployment of level 4 and 5 connected and automated driving may be heavily delayed if it is not comprehensively coordinated.
• Relation to time line makes no sense if the use case remains unspecified.
Agile Roadmap Model

Updated Approach:

• Roadmaps need to be distinct for use cases, and focused on goals and milestones.

• Innovation can be accelerated by agile shortcuts anticipating hurdles and roadblocks, e.g. living labs, pilots, sandboxes, hackathons.
Use-Case Specific Roadmaps

ROAD MAP 1

USE CASE:
LEVEL 4/5 AUTOMATION
AUTOMATED ON-DEMAND SHUTTLE

VISION
- Fully integrated
- Part of the transport system
- On-demand

Opportunities
- Easy access
- Cost effective
- Rural lab
- Transfer to freight

STATE OF PLAY
- First tests
- Fixed routes
- Low speed
- Controlled environment
- Stewards

Hurdles
- Safety expectations
- VRU
- Certification
- System integration
Use-Case Specific Roadmaps

**MILESTONES**

- In public on selected lanes
- Mixed traffic: everywhere
- Fully automated traffic

**GOALS**

**PLAN**

- **TECHNICAL LAYER**
  - Development of intelligent vehicles
  - Establish management system for fleet, traffic emergencies

- **LEGAL LAYER**
  - Service regulation
  - Adapt traffic rules and certification

- **HUMAN FACTORS LAYER**
  - Ensure awareness of other drivers and pedestrians

- **ECONOMIC LAYER**
  - Shared mobility business: cars on-demand

- **SOCIAL LAYER**
  - Consider citizens concerns about road safety
  - Adapt city and traffic planning

**TIME**
Use-Case Specific Roadmaps

**ROAD MAP 2**

**V**ision
- Fully integrated
- Part of the transport system
- logo
- Independence of brand

**STATE OF PLAY**
- First demonstrations
- Supervised vehicles
- Limited length
- Temporary exemptions

**HUMAN FACTORS LAYER**
- Awareness of other road users
- Harmonised regulations
- Mobile communication

**ECONOMIC LAYER**
- Safety concerns
- Job market effects

**SOCIAL LAYER**
- Societal impact
- Job creation

**MILESTONES**
- 6-track-platoon (cross-border, inter-brand)
- Driverless platoon
- Fully automated traffic

**GOALS**
- Optimised vehicle deployment
- Driver training
- Co-creation logistics concepts
- Promote benefits

**PLAN**
- Reliable V2V communication
- Enhanced vehicle intelligence

**Hurdles**
- Reduced emissions
- Increased efficiency

**STORY MAP**

**ROAD MAP 3**

**V**ision
- Fully integrated
- Part of the transport system
- Ubiquitous

**STATE OF PLAY**
- Mature technology
- Solutions with and without V2I communication
- Lack of applications

**HUMAN FACTORS LAYER**
- Common logistics concepts of competitors
- Job market effects

**ECONOMIC LAYER**
- Societal impact
- Job creation

**SOCIAL LAYER**
- Societal impact
- Job creation

**MILESTONES**
- Fully private system
- Public parking off-street
- Self-parking on-street
- Fully automated traffic

**GOALS**
- Optimised vehicle deployment
- Driver training
- Co-creation logistics concepts
- Promote benefits

**PLAN**
- Reliable V2V communication
- Enhanced vehicle intelligence

**Hurdles**
- Reduced emissions
- Increased efficiency

**STORY MAP**
Use-Case Specific Roadmaps

ROAD MAP 4

USE CASE: LEVEL 4/5 AUTOMATION
DELIVERY ROBOT

SCOUT

STORY MAP

Opportunities
- Use independent from employment regulation
- Use on sidewalks, sufficient at low speed
- Large variety of applications
- Automation

Availability
- Service quality
- Trust of user
- Business model

Hurdles
- Operation in public space
- Liability for goods, damage, accidents
- Trust of user
- Misuse and manipulation

VISION
- Fully integrated
- Part of the transport system
- Accepted as logistics services

ECONOMIC LAYER

HUMAN FACTORS LAYER

TECHNICAL LAYER

LEGAL LAYER

SOCIAL LAYER

MILESTONES
- Full service demonstration in public space
- Large scale use in public and private space, long distance
- Full integration in traffic and logistics systems

GOALS
- Reliable, intelligent vehicles, reliable communication
- Clarification of liability
- Harmonization with traffic legislation
- Develop VRU and customer interaction models
- Establish trust in system
- Develop profitable business models
- Ensure responsible usage

PLAN

TIME

ROAD MAP 5

USE CASE: LEVEL 4/5 AUTOMATION
TRAFFIC JAM CHAUFFEUR

SCOUT

STORY MAP

Opportunities
- Less fatalities
- Added value to vehicles
- Less stress
- Well-defined environment
- Safer traffic

LESSONs leamed
- Traffic jam assist available
- Limited us age rate

VISION
- Fully integrated in all vehicles
- Safer traffic
- Routinely used by drivers

ECONOMIC LAYER

HUMAN FACTORS LAYER

TECHNICAL LAYER

LEGAL LAYER

SOCIAL LAYER

MILESTONES
- Majority of vehicles equipped
- All relevant vehicles equipped – traffic jam plataform

GOALS
- System availability
- Spot of cost
- Liability
- Limited trust and experience

PLAN

TIME
General Findings

- There are common technical needs in all level 4/5 use cases, e.g. reliable environment perception, 5G, high-precision digital maps, reliable positioning.
- Safety is of primary concern related to level 4/5 automation, it refers to all five layers.
- Technology oftentimes also is part of the economic equation as it responds to business models, e.g. for shared automated vehicles.
- Connectivity is a necessary condition for a safe and convenient level 4/5 automated road transport.
- Cyber security and safe operation have to be ensured.
- Large scale demonstrations are essential in order to achieve societal acceptance.
General Findings

• A standardization activity on a global data model and/or translation mechanisms between different specific models for the ITS is needed.

• In terms of legal frameworks, in general the Vienna Convention needs to be modified in order to reflect level 4/5 automation; also the passenger transport legislation and liability issues need to be solved.

• The use-case centered approach taken here can’t replace the development of specific roadmaps in the involved industrial sectors, but give inputs to them.

• SCOUT results should be used in the context of building the implementation plan for the EC’s Strategic Transport Research and Innovation Agenda on CAD.