CCC workshop “Traffic Management and Autonomous Vehicles”

Towards a Common Vision for Automated Driving – Integrating Automated Vehicles with Advanced Traffic Management Systems

Report on CCC workshop on ““Traffic Management and Autonomous Vehicles”

Title: ““Traffic Management and Autonomous Vehicles” - Towards a Common Vision for Automated Driving – Integrating Automated Vehicles with Advanced Traffic Management Systems”

Venue: Web-based Online-Workshop

Date and Time: December 1st, 2021, 10:00 – 16:00.

Participants: some 40 participants from the NEXT-ITS 3 countries Denmark, Finland, Norway, Sweden, Germany and Austria and the Netherlands.

Hosts: The workshop was hosted by the NEXT-ITS3 working group on traffic management (Dieter Sage (DE), Karolina Hedberg (SE), Torbjörn Haugen (NO), Thomas Westring Roslyng (DK) and Mika Jaatinen (FI).

NEXT-ITS3

Partners: Ministries/Road Administrations from Sweden (Coordinator), Finland, Denmark, Norway and Northern/Eastern Germany. Financially supported by the Central Europe Facility of the European Commission.

The project (2018-2020) covers the Northern part of the Scandinavian-Mediterranean corridor, including the core road network and the key comprehensive network links. The aim is to enhance corridor and network performance by deployment of ITS services that ensure interoperability and continuity of services, support harmonization, and increase the cost-efficiency in the operation of traffic management.

Background and Objectives

In the coming years automated vehicles will be a natural part of our way of life. But, how will that affect the traffic system and in particular the traffic management?

The deployment of automated vehicles can only be successful if the automotive industry, road operators and traffic management develop a consistent approach for an intelligent and integrated traffic management which includes the operation of automated vehicles.

An important issue is the future role of the road authorities and especially the traffic management centres. They will need to manage automatic/connected vehicles in different areas like route guidance, traffic control, optimisation of traffic flow, incident management and event management. What are their expectations? And what are the expectations of road authorities and traffic management from the providers of automated cars?

The aim of this workshop was better understanding the approaches and ideas on both the road operators’ and traffic managements side and the automotive industry side. What are the mutual expectations and requirements and where can gaps be identified on which both sides need to co-operate? There were presenters from road authorities, traffic management centres, car and OEM industries and platform projects like CCAM. There were also presenters from projects on for example autonomous shuttles, geo-fencing as well as physical and digital infrastructure.

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Welcome and Introduction

The workshop started with a welcome and some basic information by the host and the organisers.

1) Automated Driving – Technical Development and Identified Common Interaction Points for OEMs and Road Operators. (Jörg Dubbert, VDI-VDE-IT)

Jörg Dubbert, presented the goals, setting the frame and an introduction into the Technical Development of CCAM (Connected Co-operative and Automated Mobility). He also identified Common Interaction Points for Road Operators, Service Providers and OEMs.

Goals of the workshop:

Break silo thinking: To bring together stakeholders representing road operators and automobile research and industry on the topic of CCAM

- To exchange information and experience concerning the implementation of CCAM on the road network and the integration with traffic management systems
- To discuss the needs for common interaction and mutual expectations in further implementation steps on the roads
- To help anticipate the role, responsibility and accountability of road operators.

Jörg presented three hypotheses:

- Automation of vehicles will finally lead to automated traffic
- Automated intelligent vehicles will need automated traffic management
- Automated vehicles and traffic management must be part of an integrated automated system

He informed about the CEDR-call, which has already identified key problems to be tackled/clarified by national road operators and OEMs in 3 areas:

- Digital Infrastructure
- Connectivity
- Traffic Management

2) Impacts of automated driving on traffic management, (Risto Kulmala, Traficon)

The presentation is based on the EU project EU EIP and the CEDR projects MANTRA & TM4CAD.

After an introduction Risto informed about

- Objectives and mission
- Possible future evolution
- Operation and use of technologies
- The roles of the road operator as conductor or champion in traffic management and supervisor of other stakeholder's traffic management related actions
- Legal Framework
- Expected TM4CAD results by Spring 2023

To support CCAM industry has to build business-process automation and updated operating models based on automation is the main way to go forward and a transport domain has the similar developments and evolution to improve the customer's satisfaction. Therefore, traffic management has to define objectives and mission, operations and use of technologies, road operator/traffic manager role and a legal framework.

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Traffic management is more or less a part of overall mobility management and should be closely integrated with fleet management.

There is a need for an ODD and the development of the ODD from ODD & ISAD attributes to ODD & fleet & traffic management but there is also some awareness to define the limitations and risk in connection to ODD.

There are for now two Legal frameworks and it is expected that the result from the TM4CAD will be presented in the spring 2023.

Question: Thorbjørn Haugen: There has been a lot of competition from road authorities but the work is now in a close cooperation with the OEMs and public authorities. However, what about the privacy issues with sharing of data and which data shall be shared and which data shall not and how to share data?

Answer: Risto Kulmala: The ODD is in the interest to the OEMs. To share that data there is focus on the privacy to protect road users.

Comment from Jörg Dubbert: ODD and ISA management and the fleet management is quite new in this connection. The fleet management still has to be in hand of the fleet owners but there will be an integration in to the Traffic Management and should be integrated in Traffic Management centres

3. NordicWay 3 Urban Connection (Anna Johansson Jacques, Swedish Transport Administration)

Abstract: NordicWay projects have tested and shown how C-ITS services can enhance traffic safety and fluency as well as contribute to environmental benefits. Examples of services are Geofencing, Road Works Warning, Traffic Signal Information, Traffic Signal Priority etc. The partially EU-financed project is a collaboration between public and private partners in Finland, Norway, Sweden and Denmark. Next step (NordicWay 3) is to get C-ITS services as close to deployment as possible through coordinated pilots across countries and cities. For more information: www.nordicway.net

Introduction: NordicWay 3 is a collaboration between public and private partners in Finland, Norway, Sweden and Denmark. NordicWay 3 is co-financed by the European Union within the Connecting Europe Facility (CEF) program managed by CINEA, 2019 -2023

The mission is to move form testing deployment to deployment, but there is still some testing to preform before the mission is reached.

- NordicWay 1 had focus on Communication through cellular network
- NordicWay had focus on National pilots testing C-ITS services
- NordicWay 3 has focus on objectives Foundation to build on

Next step aims to get C-ITS services to deployment through coordinated pilots across countries and cities and further develop the role of the cities, investigating roles and processes, to enhance traffic safety and fluency as well as environmental benefits by reducing CO2 emissions through digitalization in the ecosystem of C-ITS+

The project has both private and public beneficiaries. Involved cities include Trondheim, Oslo (both Norway), Gothenburg, Uppsala, Stockholm (all Sweden) and Tampere, Helsinki (both Finland)

To support the data sharing there is a need for an evolution of the interchange network from simple setup to a network setup. The trust in the exchange of data and standardisation work are important issues.

There are some challenges to the thrust in the exchange of data but the thrust problem is between people and organizations and therefor there is in some organizations legally issues there has to be solved.

There are Flagship pilots where the following topics are examined:

● TSI – Traffic Signal Information

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- TSP – Traffic Signal Priority
- Geofence
- EVA – Emergency Vehicle Approaching
- RWW – Road Works

Pilot CCAM demonstrations of technology, architecture and business models.

- Swedish PoC: In-Vehicle Signage IVS and Motorway Control Systems MCS
- Swedish PoC: National MAP process
- Swedish PoC: Hybrid initiative
- Finnish PoC: Methodology for the selection of Finnish CCAM PoC
- Finnish PoC: Finnish Transport Infrastructur

4. Traffic Management in Sweden in the era of connected and more automated vehicles and fleets (Per-Olof Svensk, Swedish Transport Administration)

Abstract: Connected vehicles will give us new opportunities to reach out to the vehicles and to get data from them. This will give road operators possibilities to manage the traffic more in order to optimize the use of the existing road infrastructure. The question is how to do that? Should we strive for very intelligent roads or can we rely on intelligent vehicles? Our belief is that public authorities should set the basic prerequisites and the necessary regulations for road traffic, but most of the intelligence will be placed in the vehicles. This means that for a safe, efficient and environmental friendly transport system, collaboration between public and private stakeholders is crucial. One example is regarding data, authorities and road operators have data that will be needed in the vehicles, at the same time road operators would benefit from using data generated in the vehicles. In our opinion vehicle manufacturers, fleet owners and service providers are responsible for proper use of data in the vehicles, specifically when it comes to ADAS and automation.

Swedish Transport Administration has identified areas needed to develop in order for the operational traffic management to meet the upcoming challenges and opportunities and a road map is on the way.

Traffic Management - General considerations

- Automatic Driving will give new opportunities to traffic management
- New opportunities to reach out to the vehicle and to get data from vehicles
- Collaboration between all stakeholders is fundamental to agree on roles in the eco-system, sustainable business models, need for regulations supporting digitalization, cyber security and Integrity issues

Traffic Management – areas to develop

Essential for the future is Collaborative Traffic Management, collaboration with other road owners (municipalities) and external service providers, advanced AI- and data-driven decision support for operational traffic management including ability for short-term prediction of traffic, Dynamic traffic regulations (dynamic geofencing), multi-modal traffic management to support fleet management both for persons and for goods and to define how traffic management can supporting automate driving.

The Eco-system for data exchange in a digitalized transport system is important for data and digital infrastructure just as harmonization and standardization are.

The role of authorities in supporting ADAS & AD is more or less that what you see on the road network must also be available digitally. Dynamic traffic regulations (dynamic geofencing) can be a powerful tool to manage groups of vehicles (not individual vehicles)

The role of commercial stakeholders in supporting ADAS&AD

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Service- and ADAS-providers use public data and data from many other sources to establish services for traffic information, navigation and ADAS-applications. Vehicle manufacturers, fleet owners and service providers are responsible for proper use of data in the vehicles, especially when there are errors in the data.

Vehicle manufacturers need to collect data and compare current driving conditions with the ODD in order to understand if AD-mode is possible or not for each vehicle. This is not allowed now, but is should be OEMs who are responsible no matter what. And Drivers (non-AD-mode) or vehicle manufacturers (AD-mode) are always responsible for manoeuvring the vehicles it is not a task for operational traffic management.

Question: We don´t see the NAP's in your presentation. Why is this?

Answer: As I see it data in NAP are metadata, which shows which data is available but it is not available in the systems.

Question: Where is the Interchange Note in this?

Answer: We have talked about the Interchange note but it has to evolve before we can fit it in. Just now this is difficult. But it is very important to have exact geographically data for AD.

5. Contributions of NRAs to a cross sector roadmap for connected, cooperative and automated mobility (Manfred Harrer, Asfinag/WG CAD Co-Chair), Torsten Geissler (BASt/CCAM Infrastructure, Serge Van Dam (WG CAD Co-Chair))

Manfred Harrer and Torsten Geißler informed about the ERTRAC CCAM Roadmap Version 0.9 which was produced as final draft and presented at the ITS World Congress 2021

The focus in the scope on Enablers of Connected Cooperative Automated Mobility was

– Confined Areas ➔ Urban Mobility
– Corridors ➔ Highway Automation
– Rural Automation steps

The Roadmap is out for consultation (www.ertrac.org, ERTRAC)

KEY MESSAGES - STRUCTURE OF ROAD

(1) Vision 2050: Specific automation domains have linked/combined, transport modes are synchronized

(2) Agenda 2030: Separate domains develop and offer a large variety of use cases (Decade of co-creation research and technology)

(3) Outlook 2040: Use cases widen up and grow together (Decade of maturity, bringing benefits to society in larger scale)

(4) Enablers: Strong interaction between Technologies, Infrastructure and Transport / Traffic / Fleet Management

(5) International comparison: update since 2019

Infrastructure and business models

There is a need for new systems to share data in real time and clear ways to collaborate. So data sharing and collaboration is very important for the future development of automated and connected vehicles

Question: Risto Kulmala: Robot taxis are not very visible in this roadmap, but they are in the US and China. How is this being followed up in the EU?

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Answer: What we see right now is HUBs where you can switch from AD to non AD. But the robot taxis is becoming more and more important so it should be a part of the future work.

6. SHUTTLES&CO Autonomous Shuttles & Co in the digital urban traffic test bed

(Oliver Strop, Strop Consulting)

Oliver Strop presented the project Shuttles & Co. With the project Shuttles & Co, Berlin wants to help shape the development of digitization, networking and automation of urban mobility in order to be able to provide the prerequisites for safe, efficient and sustainable mobility in the future. When testing highly automated fleet vehicles in Berlin's intermodal mobility system, future operating concepts as well as technical and infrastructural requirements are tested and evaluated. Processes for perception and prediction, the recognition and updating of map objects are being further developed and the integration of data and exchange platforms is being tested.

Oliver presented the project focus and the basics including the participating organisations. He explained the status quo and the current focus of work. The status quo is that official approval for service exist only with an operator, the goal however is to come to real autonomous vehicles and to become part of connected ITS. In the context of AD credible data is important.

The location (District of Reinickendorf) and the technical details of the test bed were also presented.

Data acquisition area are motorway, tunnel, city road, traffic light controller (different suppliers), GLOSA corridor and shuttle services.

Cooperative perception (Vehicle precepts other vehicles, Vehicle exchange map data, Communication also possible via RSU as ETSIG5/p-WLAN relais) and cooperative traffic control (GLOSA / Infrastructure 2 Vehicle trials with Cohda Wireless OBU and RSU from Swarco/ Cohda wireless and Yunex) was also presented. Trial with Traffic control based on simulated CAMs (SUMO simulation based on detected traffic on site) are carried out.

Prospect, Administrations should

- Influence development of V2X-ecosystem
- Adapt their processes to enable the implementation of C-ITS technology (IT-Security, homologation of new traffic technology, …)
- Roll out infrastructure as multi-channel communication with as much participants as possible > V2N2X
- Harvest and analyse V2X-messages as new data input
- Use new data to establish better traffic flow > detection and reaction for all road users/ traffic participants

7. Hadrian – Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs (Peter Mörtl, Virtual Vehicle Research GmbH)

Abstract: The HADRIAN project is an EU H2020 funded project to investigate and improve the driver's role in automated driving. This includes also the road infrastructure needs for automated driving in levels 2 and 3, more from an end-user perspective. The main aim is to make both the duration of automated driving and the withdrawal from automatic driving back to manual driving more predictable for the user through the road infrastructure. The aim is to increase both acceptance and safety of the human driver role.

Hadrian Project, abstract from website https://hadrianproject.eu/general-overview/

Fully autonomous driving consists of a vehicle operating without human interaction under virtually all operating conditions. Because such fully autonomous operations will be practically infeasible over the next 10 years on public roads in Europe at large, the human will likely remain key to create acceptable and

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practicable automated driving solutions. During manual driving, the main role of the driver is to manage the vehicle in a variety of environmental conditions and has to remain continuously attentive and thus prepared to fulfil the requirements associated with the current conditions.

However, during certain types of automated driving, for example when transitioning to and from automated driving but also while supervising or planning the automated driving periods, new tasks and responsibilities emerge for the human. Current automated driving development approaches run into difficulties when designing driving automation systems for human use because they focus on the automated driving functionality per se but leave human interactions more a by-product of the design process than the start of it. To ensure that these new driver tasks and responsibilities will be acceptable and safe, the HADRIAN project investigates innovative approaches and technologies that go beyond current automated driving development approaches.

Driver needs for safe and acceptable automated driving: Implications from a European Research Project on vehicles and road infrastructure. The project started in 2019 and runs for 42 months.

Objective

- Focus on the driver / user perspective who, in the foreseeable future, will still need to be part of AD system (ADS)
- Focus here on level 3 automated driving, conditional automated driving per SAE J3016 (2021) where (essentially)

What does this mean for the driver, what when something happens and requires manual driving again etc.

Human Interaction Challenges for ADL 3

Watching versus doing (humans are good controllers but bad monitors):

- Switching responsibilities
- Monitoring Automation

Understanding each other

- Collaboration between human and automation
- Understanding what is going on
- Understanding what will happens next.

Focus on road user behaviour in AD e.g. and what does that mean for the driver, what when something happens and requires manual driving again etc.

Peter presented the holistic approach, User needs and societal interests regarding automated driving. Examples for “From Mobility needs to AD Scenarios” were presented. He furthermore showed study results on to measure the impact of ADL predictability on acceptance and safety.

He also presented HADRIAN Demonstration with road infrastructure integration, Demonstration of ADL predictability on A2 Motorway near Graz:

There were four planned passenger vehicle scenarios:

- Scenario 1 Predictable transition back from ADL 2 to manual driving
- Scenario 2 Continue ADL 3 through a construction zone
- Scenario 3 During ADL 3, avoid unforeseen obstacle on road while continuing ADL3
- Scenario 4 Planned termination of ADL3 driving

Conclusions

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From the perspective of the presented project, following steps are proposed to achieve a common vision for AD

1. Define specific mobility use cases
2. Define solutions with an AD system architecture that combines vehicle and infrastructure to meet mobility use cases
    - Including the driver prerequisites
3. Measure the operational benefits: safety, acceptance, and comfort
    - Represents business cases
4. Demonstrate and confirm technical and operational feasibility using road tests

8. TransAID - Recommendations for enabling infrastructure-assisted automated driving (Anton Wijbenga, MapTM)

Anton started his presentation with an overview on the Horizon 2020 funded project TransAID. The project runs from September 2017 – February 2021 had a budget of 3,8 Mio Euro and consisted of 7 partners from 6 EU countries and 12 associated partners.

TransAID Approach

Automated driving limitations (harsh weather conditions, parking vehicles, limited sight etc.).

Several examples have been shown where the AD could not be done and that there are situations where AD could not handle it.

Transition of Control process

There are several processes in connection whit AD where the driver must take-over but what if the driver does not take-over?

Identifying Transition Areas & use cases

Therefor there are several factors that need to be in place for hardware and software to handle human error. (System failures, external conditions, human factor, other)

1. Provide vehicle path information
2. Provide speed, headway and/or lane advice
3. Traffic separation
4. Guidance to safe spot
5. Orchestration, distribution and scheduling

TransAID results

Findings, requirements and recommendations for automatic driving, e.g. information services, traffic control measures, traffic regulations, spatial planning, V2X message sets, roadside equipment and signalling etc.

Use case results

- All use cases showed positive results on safety, efficiency or emissions
- In case of higher LOS, TM measures are less effective
- Distribution ToCs in time and space is a solid solution
- Remote operation/control could also be an option especially in driverless shuttles

V2X Communication and Services

- MCS&CPS are key to manage CAVs in/around Tas
- Redundancy mitigation & Compression & Acknowledgement

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- Informing non-V2X vehicles can be a challenge
- Intermediary Service

Recommendations

1) Services
Recommendation for CCAM to further explore the services
Traffic Accidents will occur for a long time
The next steps should be to study ODD and infrastructure support definitions, additional pilots in the real world

2) Digital Infra
Consensus on the need of connectivity
Infra digitalisation and communication
Strong dependency on infrastructure capabilities
Continue work on extending ETSI standards

3) Other
Physical Infrastructure (dedicated lanes, safe spots and sufficient space for automated vehicles)
Need for adaptation of traffic regulations towards automated driving
Consider remote management in case of level 4 driverless
US more hesitant in adapting infrastructure support (liability issues) & more consensus between EU and Japan

Question: Risto Kulmala: ETSI must be used but is it accepted or what?

Answer: It was up on WG21 (or WG2 or WG1) so work is on but the exact state is currently unknown.

Question: Is there a recommendation for the various manoeuvres such as what the driver is told when the cars suddenly does something different than expected?

Answer: This is work to be done as it has only been on test sites yet.

Concerning the possible necessary areas for emergency stops for automated vehicles Klaus Lund Anderssen mentioned that it might be a problem to develop a high number of these possible areas because
(1) investments in the physical infrastructure are longer processes and cannot be carried out in short time,
(2) they might be costly and
(3) the space in some areas is limited.

9 Cloud Infrastructure Services for Automated Driving in the UNICARagil Project

(Raphael van Kempen, Institut für Kraftfahrzeuge - RWTH Aachen University)

UNICARagil: Project with 22 partners (15 University chairs/institutes and 8 Industry) with 26 Mio € national funding, lasting 48 month (until end of January 2022).

Objectives:

1. Modular structures for agile, automated vehicle concepts
2. Disruptive concepts in hardware and software architecture
3. Modular platform with dynamic modules
4. Fully automated and driverless vehicles
5. Four prototypes of different characteristics

Overall System

- Cloud functionality

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- Control Room
- Intelligent Infrastructure

Service Centre

- Passenger confidence in driverless vehicles
- Service personnel available around the clock
- Emergency contact for passengers and public authorities

Control Centre

- Mission planning and status monitoring
- Vehicle detects system limit ➔ Teleoperator can take over contro
- Ensure availability, extend area of operation

Collective Environment Model

- Cooperative perception and behavior prediction
- reduce uncertainty and extend field of view
- ”Info Bee” contributes information from above

Collective Memory

- Recognize relevant scenarios to learn from
- Collect data for perception and planning
- Learn perception and prediction models from relevant scenarios

Summary
Automated Driving

- Clear signage and markings
- High-definition maps (up-to-date!)
- I2V communication (e.g. traffic light states)
- Reliable mobile communication to control centre

Cloud Services for AD

- Mobile communication with high bandwidth and low latency
- Edge computing, e.g. for exchange of perception data
- High performance cloud computing, e.g. for data aggregation and collective learning

Summary and Conclusions

The workshop provided interesting information on the views of authorities, the industry and several research projects.

Findings from the EU EIP and the CEDR projects MANTRA & TM4CAD and the role of the operator have been presented. NordicWay projects have tested and shown how C-ITS services can enhance traffic safety and fluency as well as contribute to environmental benefits. This project has carried out coordinated pilots across countries and cities.

The presentation on “Traffic Management in Sweden in the era of connected and more automated vehicles and fleets” has shown the views of the authorities. It was stated that the authorities should set the basic prerequisites and the necessary regulations for road traffic, but most of the intelligence will be placed in the vehicles. This means that for a safe, efficient and environmental friendly transport system, collaboration between public and private stakeholders is crucial.

Contributions of NRAs to a cross sector roadmap for connected, cooperative and automated mobility presented version 0.9 of the ERTRAC Roadmap with views to the future steps of automatic driving.

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Autonomous Shuttles & Co in the digital urban traffic test showed the interim results of a large pilot service in Berlin with passenger vehicles and which technical and organizational issues have to be taken into account.

The Hadrian project presented a Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs. The driver needs for safe and acceptable automated driving was addressed.

The research project TransAID presented recommendations for enabling infrastructure-assisted automated driving and important limitations for automated driving was shown. The UNICARagil project focused on cloud Infrastructure Services for Automated Driving

The research projects and pilots showed what seems possible in the near future, but also pointed out where further research is necessary and where specific limitations for automatic driving still exists and has to be further dealt with.

In particular, the ERTRAC Roadmap showed further steps in the future and what can or should be achieved towards autonomous driving. From the authorities' side the CEDR tendering which has been carried out recently gives an overview on what are very important issues to be dealt with in the near future.

It seems that in particular authorities and the industry/service providers still focus on their specific tasks in the field of autonomous driving.

This workshop has been a useful tool to promote a practical information exchange on the implementation of automated driving amongst stakeholders from the road operators, research institutions and the automobile sector. We have seen different viewpoints, which must grow into one common picture. The ERTRAC roadmap on CCAM is certainly a valuable European concept in this field. In addition, the CCAM Partnership might be a valuable body to follow and to support in order to understand the available concepts, to learn for own activities of the road operators in Europe and to make useful contacts with the leading stakeholders in Europe.

The workshop participants could also collect a lot of background information on the ideas and activities of the Nordic road operators and on research and development projects, which are working on concrete automated driving solutions related to the interests of road operators. Having in mind that automated driving will become a relevant day-to-day topic in the near future, it might be valuable to the road operators in Northern Europe to install a regular activity in NEXT, ITS which uses this first step for further information exchange in the ecosystem and concept development concerning automated driving in Northern Europe.

Thus for the future a closer cooperation of the industry/service providers and the authorities is necessary to come to a common view on what has to be done and who will have to do this.

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