

Autonomous driving

Short version/Summary



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Road and Rail Department
Traffic and infrastructure unit

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1 Introduction

The Swedish Transport Agency has initiated a pilot study in the field of autonomous vehicles/driving in order to identify whether and how legislation needs to be modified in order to permit partly or fully automated driving, and if so which legislation. The aim of the pilot study is not to propose legislative amendments, but to identify any need for amendments. In the longer term, the aim is to permit introduction of fully or partly automated driving on roads in 2016.

The development of self-driving vehicles is taking place at a rapid pace, and systems which – under certain conditions – support autonomous driving will soon be ready for market launch. However, as things stand at present there is no clear structure to development. Different stakeholders with access to different policy instruments often operate independently. It may be easy to believe that the challenge is primarily technical in nature, such as ensuring the reliability of these systems. However, today's road traffic system is very complex, with interaction among its various elements which is often difficult to predict and control. This means that development in the field may have a radical effect on the entire road traffic system and its function in society. **Thus this development will probably also impact at an overall societal level in respect of community and urban planning, settlement patterns, travel patterns and travel habits, traffic work, car ownership forms, etc.**

The technology cannot be developed in isolation as it will have a major impact on the road traffic system and need to interact with humans, vehicles, infrastructure and society in order to have the maximum impact. Moreover, the technology is developing quickly and lots of different stakeholders are involved in or affected by the development. **Therefore, it is difficult to predict the development and control it in detail.** Moreover, detailed control risks hampering innovation and so reducing the potential for autonomous driving. This also means that development has to take place via a number of stakeholders acting in cooperation.

The interaction between human and technology is an important element of autonomous driving. Both research and previous experience indicate how important it is for this to work. Observing Human Factors/Man-Technology-Organisation (HF/MTO) at an early stage of system manufacture and design is important in order to create opportunities for human performance and limitations in interaction with the automation. How society will be affected and how this impact is to be managed are two questions which need to be answered. There is a need for further research and knowledge in this field.

It is common to use four levels to describe the degree of automation. Levels 1 and 2 relate to vehicles with self-driving functions which support drivers in certain situations, and vehicles of this type can already be found on our roads. Level 3 relates to vehicles which perform the entire task of driving under certain conditions. The driver should be able to do other things in the meantime, but sit in the driver's seat and be able to intervene. At level 4, the car handles the entire task of driving throughout the entire journey.

Autonomous driving presents a challenge to the Swedish Transport Agency in a number of ways. What role should the agency play? What role should regulation play in order to provide support for technical development? How should such regulation be structured so as not to hamper innovation while also ensuring that the development is helping to meet targets relating to transport policy? **The working group has found, among other things, that the Swedish Transport Agency needs to be more proactive and play an active part in the development of self-driving vehicles.**

2 Current legislation

2.1 Traffic regulation

Road traffic rules relate to the obligations of road users in traffic, e.g. the responsibility of the driver to comply with road traffic rules and drive the vehicle safely. The Swedish Road Traffic Ordinance is worded generally and provides limited opportunities to permit exceptions to general provisions, such as maintaining control over the vehicle. What a driver is or what control involves is not described; these are determined through application. This is also something which is changing over time. **Current legislation provides scope for test operations in real traffic using vehicles with a high degree of automation. The road traffic legislation does not present an obstacle, and if the vehicles fail to meet the technical requirements the Swedish Transport Agency has the opportunity to grant exceptions.** There are vehicle manufacturers who currently have what are known as test dispensations.

The fact that road traffic rules in different countries have been aligned has been a success factor for all types of road transport for a long time. Therefore, the starting point is that the issue of special traffic regulations, special road markings and other arrangements for self-driving vehicles should be implemented internationally within UNECE.

There are still issues in respect of road traffic legislation, such as the issue of liability: this is essentially an issue for the law enforcement agencies to

resolve. The working group is of the opinions that as things stand at present, the Swedish Transport Agency should continue to monitor the application of the law in the projects and investigations taking place in the field of autonomous driving both nationally and internationally.

2.2 Vehicle legislation

The regulations on *how new vehicles should operate and be designed* are harmonised within the EU through Framework Directive 2007/46/EC. The purpose of the regulations is to create an internal market within the Community and aims to ensure a high level of road safety, health protection, environmental protection, energy efficiency and protection against unauthorised use. In other words, the EU regulates which requirements have to be met. However, the more detailed technical provisions are mainly prepared within UNECE (WP 29) and can be found in the UNECE regulations to which the EU legislation refers. There is a certain degree of scope for guaranteeing national, alternative requirements and permitting exceptions for test operations, for instance. However, the harmonised requirements are applicable to series-manufactured vehicles in practice.

The traditional way of regulating vehicles has been based on establishing requirement levels for separate systems which vehicles have to demonstrate that they meet. Essentially, this involves clearly established limits and test methods which are used for testing by independent testing organisations. In the case of the complex safety-critical systems required for autonomous driving, *another approach is probably required*. This will consider how different specific systems are managed individually, but – not least – how they interact with one another.

There are currently no requirements guaranteeing an identified level of safety for the vehicles' self-driving functions. In the opinion of the working group, regulations will be needed which guarantee a sufficiently high level of road safety for vehicles of level 3 or above so as not to impede the market launch. The working group is of the opinion that level 3 vehicles will be technically ready for launch on the market in around 2020.

Vehicle legislation is largely controlled by the EU, and this is where the focus can be influenced. **The Swedish Transport Agency currently has limited knowledge in the field of the EU's plans for regulations in the field, which will require additional input if the authority wishes to actively influence development in the field.**

2.3 Driver competence

At present, there is no need to readjust the driving test or vehicle requirements for the driving test. The same is applicable to any need for

development in driver training. At the moment, training is largely steered by the requirements of the driving test. That said, it is important to monitor and follow technical development among vehicles used for driving tests in Sweden and other countries in order to ensure that the knowledge requirements for the awarding of driving licences continue to be met.

At present we know little about the difficulties of the future systems and any risks they may involve. Therefore, it is too early to draw any conclusions as to whether further requirements should be specified for training beyond what is currently included in driver training for the awarding of class B driving licences. However, it is important for the Swedish Transport Agency to monitor developments and analyse any incidents involving vehicles which use this type of new technology.

2.4 Driver responsibility

One of the most central issues in respect of autonomous vehicles is the responsibility of the driver. **The working group has come to the conclusion that there is nothing in the road traffic legislation to prevent the use of self-driving vehicles in the road transport system. Current road traffic legislation is based on driver responsibility for driving the vehicle.** As long as there is someone who can be considered to be a driver in or in connection with the vehicle, self-driving vehicles up to level 3 can be operated. **Vehicles operating at levels 3 and 4 raise the issue of liability if anything happens.** For level 4 vehicles, which will perhaps have no driver at all, it is even more obviously that the division of liability and concept of liability need to be developed.

With technical developments in respect of traffic and roads, it is likely that the courts' opinions of driver liability in traffic will also change. A higher degree of vehicle automation will probably mean that fewer people will be found guilty of offences relating to accidents and infringements of the law involving vehicles. There will be a reduction in the number of instances in which people can meet requirements to be considered drivers will. It is likely that the courts will demand that people must have had, in some form, the opportunity to influence or intervene in the motion of the vehicle to be deemed to be driving. Cases involving people being regarded as driving negligently will become less common. The actual control exerted by people over vehicles will be reduced as automation increases. **Vehicle automation will probably change the role of the driver, particularly as drivers adapt to automation over time.**

The question is whether it is a problem for people to be regarded as having less criminal liability when vehicles have been involved in accidents and infringements of the law, or whether the fact that technical development can reduce the risk of human error should be viewed as a positive development.

The issue of driver liability and whether or how this should be regulated is a national issue in the first instance. A national change in respect of the issue will probably have a minor effect on corresponding legislation in other countries or sales of vehicles in these countries.

2.5 Levels of automation

For level 1 – 2 vehicles with self-driving functions which support the driver, the driver is liable for any infringements of road traffic rules, the current rules on driver competence are relevant as the driver needs full driving skills and the vehicles can be approved.

There is no provision in the Swedish Road Traffic Ordinance or any other statute which expressly states that the driver must hold onto the steering wheel while driving the vehicle. The provisions of the Swedish Road Traffic Ordinance are instead based on the fact that the driver has control over the vehicle and is responsible for driving the vehicle in a satisfactory manner. The present regulations on driver competence are relevant for level 3 as the driver must be able to drive the vehicle in all situations which the vehicle is unable to handle.

As regards vehicles, the working group is of the opinion that the absence of EU rules for the self-driving function will complicate the introduction of level 3 vehicles. In around 2020, it is likely that the market will offer the first vehicles which, under certain conditions and in specific traffic environments, will be capable of performing the entire task of driving, level 3.

It is unclear as to when level 4 vehicles – where the vehicle manages the entire task of driving throughout the entire journey – can be expected to emerge onto the market and how they will be owned. It may be stated that the current provisions with respect to on-road and off-road traffic, based on the notion that the driver must have control over the vehicle, and requirements in respect of driver competence are not suited to future phenomena. The absence of rules for self-driving vehicles is one aspect which it is thought will impede the market launch.

3 Issues to pursue

The working group has come to the conclusion that the Swedish Transport Agency should continue working with autonomous driving as follows in order to help devise effective regulations.

3.1 Increase the Swedish Transport Agency's knowledge by:

- taking part in or monitoring relevant testing

- studying how other enterprises guarantee the function of safety-critical systems
- exchange with the USA's road safety authority NHTSA, as well as DMV in California.
- means of systematic situation analysis
- charting the need for research from the perspective of the Swedish Transport Agency, identifying whether the research being carried out meets needs and monitoring the priority research fields identified by Viktoria Swedish ICT
- continuing to examine the criteria/opportunities for trials involving level 4 cars on the public roads within a limited area

3.2 Increase the ability to influence by:

- identifying the international groupings which are preparing legislation in the field, and working together with the Ministry of Enterprise, Energy and Communications to determine how Sweden can best proceed.
- intensifying cooperation with the Ministry of Enterprise, Energy and Communications, other authorities, industry and academia in order to contribute to a national consensus and clarify the role of the Swedish Transport Agency.