TRAFIKVERKET

REPORT

Roadmap

Digitalisation of the Road Transport System
Version 2024 (short version)

This is a brief version of the "Roadmap – Digitalisation of the Road Transport System, Version 2024". For a more detailed and comprehensive description of the development towards a digitalised road transport system and what is needed to realize the benefits, please read the complete roadmap.

Digitalisation is a key to making the existing road transport system more efficient, safe, and sustainable. The future road transport system is expected to offer a range of digital services and analytical models that help ensure "everyone arrives smoothly, green, and safe." The goal is for this development to contribute to transport policy objectives and ensure the efficient use of society's resources.

As the vehicle fleet is renewed, there is also progress in the area of digitalisation. Some vehicles are now connected, enabling real-time communication to drivers, while other road users still cannot receive any information except possibly via radio. This mix of connected and non-connected vehicles poses a challenge but also an opportunity for gradual improvement and transition to a more integrated system. It also means that the transport system handles different levels of development, which can complicate clarity in roles and responsibilities. The Swedish Transport Administration and other sector actors navigate a complex ecosystem with some uncertainty about the exact functions and roles for and between these actors.

In response to these challenges, the Swedish Transport Administration has updated the Roadmap - Digitized Road Transport System. The roadmap aims to clarify the current situation, identify current development needs, and point out a direction for future work.

Transport policy objectives

The overarching goal of transport policy is to ensure a socio-economically efficient and long-term sustainable transport supply for citizens and businesses throughout the country. Additionally, the parliament has decided on a functionality objective – accessibility – and a consideration objective – safety, environment, health.

Digital development of the road transport system

Digitalisation is creating new opportunities within the road transport system. Vehicles are becoming increasingly advanced, featuring sophisticated driver support systems and, eventually, fully automated capabilities. As the vehicle fleet evolves, so does the digital infrastructure, facilitating standardized, secure, and rapid information exchange between transport system stakeholders. This development is already creating new opportunities to disseminate information via digital services directly to vehicles. Simultaneously, an increasingly connected society leads to more data sources. These can be used to gain a better understanding of the road transport system through data-driven insights. These insights can inform both future and real-time decisions.

Development of the vehicle fleet

The proportion of connected vehicles is increasing, including those with driver support systems. Several vehicle functions that contribute to transport policy objectives are standard in new vehicles, and more advanced driver support systems are expected to continue contributing to transport policy goals in the future.

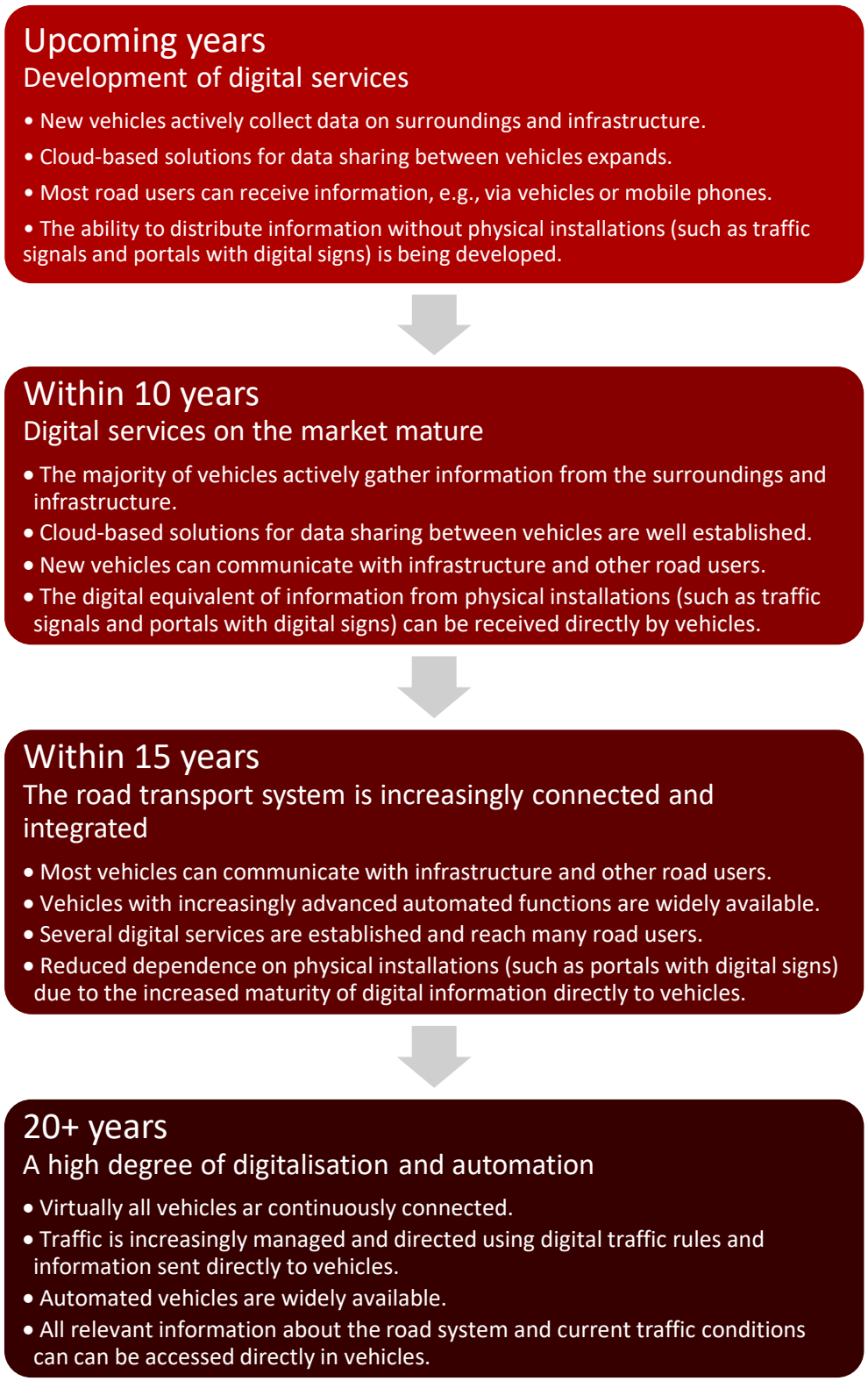
Digital services

Most vehicles sold on the European market today are connected, and studies show that, with a few exceptions, all vehicles will be connected by 2050. As a result, the opportunities for data exchange and digital services in vehicles are expanding at a rapid pace. These services enable vehicles to communicate with each other and their surroundings, providing information directly to the vehicle about road obstacles and current speed limits.

Data-driven insights

In a likely future, the transport system is not just a static set of roads and vehicles but can adapt to users' needs and changing conditions. By collecting and analysing a variety of data sets, a whole new level of understanding of how the road network is used and affected is enabled. By integrating artificial intelligence (AI) and machine learning into analysis tools, predictions about traffic patterns can be made, potential problems can be identified, and effective solutions can be created before issues arise.

Figure 1: Anticipated timeline of technological progress in the road transport system



Focus areas

To leverage digitalisation in the road transport system, development is needed in four key focus areas: physical road infrastructure, connectivity and communication channels, forms of data exchange, and data and information quantities. The ecosystem in a digitalized road transport system includes many different actors who all need to collaborate to realize the potential and contribute to the transport policy objectives.

Physical road infrastructure

The physical infrastructure, in its basic form, has a long lifespan. This presents challenges for road operators to quickly and cost-effectively adapt the infrastructure as new digital solutions are introduced into the road transport system. It is therefore important to continuously build knowledge about how the role and function of physical road infrastructure contribute to or are affected by digital development. Identified development needs within physical road infrastructure include:

- Socioeconomic effects of driver support systems
- Behaviours and driver support systems
- Impact of automated vehicles

Connectivity and communication channels

In the digitalized road transport system, traditional physical infrastructure tends to merge with digital infrastructure. A digitalized road transport system means that connectivity will play a different and larger role than it has in the past. Identified development needs within connectivity and communication channels include:

- Prioritization in commercial networks
- Connectivity across the entire road network
- Enhanced cybersecurity
- Redundancy in communication

Forms of data exchange

The ability to exchange standardized data is crucial for leveraging the benefits of digitalisation in the road transport system. To facilitate data exchange, data needs to be published and made accessible to those who should and can access and benefit from the data sets. When data is exchanged, it creates opportunities to combine

different data sets for new insights and the development of digital services. A service often builds on several layers of data, both static and dynamic. Depending on the types of data to be shared and how they are to be used, different requirements are placed on the functionality of the data exchange. Identified development needs within forms of data exchange include:

- Exchange nodes for real-time data
- Coordination of exchange nodes
- Data exchange for vehicle services

Data and information quantities

In a digitalized road transport system, large amounts of data are produced and consumed. Data generated within the transport system can be used to improve deliveries and create value for users. A crucial factor for achieving this is ensuring that the data have sufficient quality for their intended use. Some applications require higher data quality than others, and these requirements need to be communicated between data consumers and producers. Identified development needs within data and information quantities include:

- Described and standardised data from all road operators
- Providing digital traffic regulations
- Providing and utilizing dynamic data
- Providing data collected from multiple road operators
- Open data in relation to security and the principle of public access.

The Swedish Transport Administration's strategic positions

In 2021, the Swedish Transport Administration outlined its role and direction in a digitalized road transport system. The Administration continually reviews these decisions to stay current with connected vehicles and increased automation. A revision in 2024–2025 will focus on roadside equipment for communication with vehicles and digital infrastructure. The Administration's strategic positions are as follows:

- The starting point is that the intelligence primarily resides in the vehicles, not in the road infrastructure. Therefore, the Swedish Transport Administration takes a restrictive stance on making adjustments to road infrastructure to support vehicles with advanced driver assistance systems, connectivity, and automated vehicles.
- The Swedish Transport Administration aims for a standard in physical road markings that also considers the traffic safety benefits that vehicles with advanced driver assistance systems can provide.
- The Swedish Transport Administration considers commercial communications solutions from external actors to be the primary means of exchanging data to and from vehicles.
- The Swedish Transport Administration currently has no intention of establishing roadside equipment for direct communication with vehicles. However, should such solutions prove cost-effective on certain road segments in the future, they may be considered.
- Within the scope of its mission, the Swedish Transport Administration will promote and facilitate the development of IT and communication infrastructure along the state road network, which is preferably driven by various market actors.
- The Swedish Transport Administration will strive to provide data in ways and through channels that yield the greatest societal benefits.
- The Swedish Transport Administration shall provide machine-readable data that describes traffic regulations, state infrastructure characteristics, and current status of locations or segments within the infrastructure for which we are responsible.

Applications of digitalisation in the transport system

Digitalisation can be applied in the form of various analytical models and services within the transport system, contributing to efficiency and value creation. These applications are enabled by the technical and digital advancements occurring in the road transport system. As the foundational elements described in the focus areas are developed, the proposed applications will be utilized on an increasingly larger scale.

The applications of digitalisation in the road transport system have been categorized into four areas for clarity. For a more detailed description, refer to the full version where each application includes a background description of a need or problem, along with an idea of how digitalisation can contribute to the solution. The extent to which the applications have been tested or will produce the desired effect varies. In some cases, the developments are advanced and well-tested, while in others, they are still in the conceptual stage.

Resource-efficient planning through digitalisation

The transport system faces significant challenges, where reducing climate impact must be balanced with increasing demand for transportation. Sensor technology and digitalisation can improve planning and efficiency. Digital services can be cost-effective alternatives to physical investments, but they require initial infrastructure investments and tailored financing models.

- Digital analysis of road standards
- Coordination to reduce ramp congestion
- Managing congestion issues with digital information
- Safe overtaking of slow-moving vehicles
- Digital speed limits
- Increasing capacity in the existing road network through automation
- Digital bus semaphores
- Data-driven travel time analyses
- Wildlife warnings based on sensors
- New data sets for climate adaptation
- Reduced speed for access to low bearing capacity roads

Connected road maintenance

Maintaining roads requires continuous monitoring of their condition to quickly address deficiencies. By using data from various sources, including vehicle-generated data and drone inspections, the understanding of road conditions can be improved, allowing for more efficient planning of maintenance measures.

- Efficient winter maintenance supported by vehicle data
- Connected road surface measurements
- Traffic flow analysis at traffic signal installations
- Connected operation and maintenance of bicycle infrastructure
- Predictive winter road maintenance
- Automatic data analysis for remote bridge inspection

Efficient, safe, and sustainable contracting

The future of infrastructure construction and maintenance demands a strong focus on efficiency, traffic safety, and sustainability through digitalisation and access to data. Leveraging the opportunities of digitalisation within contracting requires investments in both technology and skills, as well as the adaptation of regulations and business models for sustainable development.

- Connected roadworks
- Connected and automated road construction
- Automated highway maintenance
- Reporting of digital environmental data
- Safe speeds for construction vehicles
- Safety for flaggers during paving operations
- Higher load efficiency in construction transport
- Efficient logistics flows to and from construction sites
- Drone inspections for mass calculation

Future road traffic management

Road traffic management, which focuses on directing and informing traffic to enhance flow and safety, is evolving through digitalisation and collaboration with commercial partners. Both physical and regulatory measures, along with digital channels, are employed for traffic control and communication. Connected vehicles and new technologies like AI enable improved traffic management and disruption handling through enhanced data exchange and automated enforcement of traffic regulations.

- Improved operational capability increase capacity
- New opportunities with dynamic traffic control
- Wide-reaching traffic information
- Disruption management through collaboration

Continued work

The content of the roadmap serves as a direction for the Swedish Transport Administration's work and focus on the development of the digitalisation of the road transport system. As this field and the work within it are continually evolving, further efforts will be required to advance the development needs of the focus areas and to evaluate and implement the applications outlined in the roadmap.

We hope the roadmap provides you with thoughts, questions, or insights into your work within this area. The implementation of the roadmap requires collaboration with various stakeholders, and all focus areas need strong cooperation. Continued dialogues about the roadmap are essential for making progress and integrating new solutions into the planning and development of the road transport system. We welcome and encourage feedback and discussions on how you and your organization can contribute to shaping the future of the road transport system together.

Title
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