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Contents

1 Introduction

1.1 General overview of the national activities and projects

During the period of 2017-2020 there have been two major legislative changes in Finland that affect greatly in the implementation of new transport services and traffic automation. The national Act on Transport Services has been prepared and confirmed in three phases; the last one came into force on 1st of April 2019. The goal of the new act is to bring together legislation on transport markets. The aim of the legislative reform is to provide the users with better transport services and to increase freedom of choice in the transport market. The Act will allow the provision of new type of smooth travel chains consisting of different transport modes (e.g. Mobility as a Service (MaaS) services). The main changes to the national legislation have been

- streamlining the regulation and reducing bureaucracy
- uniform handling of different travel modes
- handling of goods and person transport as services, that can be combined as travel chains
- increased interoperability of ticketing and payment interfaces
- improvement of digital transport services
- centralisation of all licenses regarding transport service operation and vehicles in one registry
- social requirements of road transport
- professional license of heavy goods vehicle operation.

Regarding the implementation of the ITS Directive, the Act on Transport Services has significant impact. As highlighted in the Act on Transport Services, open data is one of the key enablers in the Finnish ITS strategy. There are three types of requirements for interfaces and open data:

- The requirement to open essential information is binding for all parties offering personal transportation services.
- The requirement to open ticketing and payment system information is binding for those parties, that have such a system in place.
- The requirement to enable a party to act on someone else's behalf is binding for those parties that have a ticketing and payment system and a customer account system.

The requirement to open the "essential information" has led to an early adaptation of the Delegated Regulation 'a', as many datasets under the EU regulation were already opened in 2018 due to national legislation. The application programming interface (API) in the ticketing and payment system must at least enable purchase of a single trip ticket as a minimum requirement. The requirement of "a party to act on someone else's behalf" means that a party that owns a customer account must grant a third party (typically a MaaS service provider) a permission to purchase tickets and other services using the ID and other account information of the customer. These requirements can be seen as a key for opening the MaaS market in the country.

Another major change in the legislative framework happened 1st of June 2020, when the new Road Traffic Act entered into force. With the renewal of the act the traffic flow and safety as well as the prerequisites for the digitalisation and automation will be improved, at the same time as the amount of regulation will lessen. In this sense the renewal of the act is preparation for the future of transport.

The new Road Traffic Act contains traffic rules, traffic signs and the regulations related to using a vehicle on the road. Technical development of vehicles and transport has been considered and special attention paid to vulnerable road users, such as cyclists. The new act enables the gradual roll-out of automated road transport applications, e.g. it addresses the situation in which the driver is not necessarily a person sitting in the vehicle. A new requirement in the act is that the geographical information related to traffic signs, traffic lights and other traffic control infrastructure must be made available to the centralized content access point, from which the data is made available for users.

Another updated transport related legislation is the Act on the Transport System and Highways, which was updated on 2018. The act considers mostly traditional investment and maintenance procedures but also sets the progress in digitalisation, transport automation and transport services as a national target. According to the Act, the service levels on the road network should take into account the most important factors such as travel time, predictability, safety and cost efficiency.

In addition to new legislation, also the administration of the national transport infrastructure has changed, when the new organisational structure and responsibilities came into action in the beginning of 2019. The goal of the administrative renewal was to respond to the changes in the operational environment and address the changing customer needs more efficiently. The key organisations and their responsibilities are explained below.

The Finnish Transport and Communication Agency (Traficom) is the authority responsible of licences, registries and approval matters related to vehicles and transport services. The Finnish Transport and Communication Agency has also a leading role in the overall development of the transport system and traffic safety, as well as digitalisation and communication networks. Regarding the implementation of the ITS Directive and its delegated regulations, The Finnish Transport and Communication Agency acts as the National Body and reports to the Ministry of Transport and Communications. The Finnish Transport and Communication Agency is currently also responsible for the National Access Point for Delegated Regulation ‘a’, mainly due to the national legislation. Organisational changes in the national access points are planned.

The Finnish Transport Infrastructure Agency (FTIA) is responsible for the maintenance and development of the national roads, railways and waterways and participates in the development of the whole transport system to foster fluent transport of people and efficient goods transport. Finnish Transport Infrastructure Agency is the owner of national infrastructure databases including Digiroad, which is the database containing the static road data under the delegated regulation ‘b’.

Traffic Management Finland Group (TMFG) is a state-owned company that is responsible for providing and developing traffic control and management services in all traffic modes: air, maritime, rail and road, according to the guidelines and service level agreement with the Finnish Transport Infrastructure Agency.

The mode specific services are organised in separate companies under the Traffic Management Finland Group’s supervision. The subsidiary Intelligent Traffic Management Finland (ITMF) is responsible for operating the road traffic control systems on state road network. Intelligent Traffic Management Finland is working under a service level agreement signed with Finnish Transport Infrastructure Agency. Regarding the ITS Directive, Intelligent Traffic Management Finland is responsible for maintaining the National Access Point (Digitraffic) for Delegated Acts ‘b’ and ‘c’ containing dynamic road and traffic information. Intelligent Traffic Management Finland is also operating the traffic

management centres and roadside ITS infrastructure, that are the origin of most of the dynamic road traffic information on state highways.

A National Transport System Plan is being developed in Finland to cover a 12-year planning period to create long-term decision-making and commitment towards the transport system development. The political decision about the plan will be made during spring 2021. Authorities are responsible of the implementation of the plan, and the projects will be receiving funding from the Government. The main strategic goals of the plan are sustainability, accessibility and efficiency. Intelligent road traffic supported by automatisation is one of the important measures for reaching the goals.

The Ministry of Transport and Communications has launched a project to review what type of legislative amendments will be required to support transport automation. The key objectives have been identified for road, maritime, railway and drone traffic automation. For road traffic the automation is expected to increase the safety, efficiency and sustainability of the traffic. For maritime automation the aim is to verify the functionality of communications and digital and physical infrastructure on a transport system level between countries using the Baltic Sea test area. In rail, the greatest benefits of automation are expected to be achieved via automatic train control. The aim is to allow Control Command and Signalling Technical Specification for Interoperability (CSS TSI) to allow digitalisation and new innovations, e.g. use of Future Rail Mobility Communication System (FRMCS). For drones, the aim is to enable and progress automation test and piloting projects.

The Ministry of Transport and Communications has also launched a project to prepare a logistics digitalisation strategy. The aim of the project is to support and strengthen the development of digitalisation in the logistics sector. The project prepares a logistics digitalisation strategy, which defines vision, goals and measures to strengthen and promote the digitalisation of logistics. The project considers sustainability, functionality and safety aspects.

1.2 General progress since 2017

This chapter provides an overview of the progress made during the last three years period within the four Priority Areas of the ITS Directive. Looking at the first priority area and its target to *optimally use road, traffic and travel data*, a lot of progress has been achieved. The first phase of the Act on Transport Services came into force in 2018, which forced all transport service providers (bus operators, taxis etc.) to open the basic information regarding their services. This information was shared in the National Access Point of more than 10 000 operators already before the Delegated Regulation 'a' was binding. For the servitisation of the transport sector even more important step was that the same law requires transport authorities and operators to open their ticket sales APIs for third parties such as Mobility as a Service (MaaS) operators. This is an important factor to enable MaaS operators to gather a full package of different services into their ecosystem. Hence the prerequisites for rolling out successful MaaS services and combinations of travel chains are in place and awaiting new openings from the market players. Currently there is one significantly active MaaS operator, Maas Global, on the Finnish Market. Whim is currently in operation, in addition to Helsinki, in Antwerp, Birmingham and Vienna and piloting in Tokyo and Singapore.

Legislation driven development continues in 2020 when the location data of all traffic signs and control equipment will be included in Digiroad service because of the updated Road Transport Act. In addition to that, the Traffic Management Finland Ltd., the company operating the roadside and digital information services on national roads since 2019, has opened APIs to the information shown on the

variable message signs and speed limits installed on national roads. These systems have traditionally been 'closed' systems but thanks also to the CEF co-funded NEXT-ITS 3 programmes', investments in the integrated traffic control operating system TLOIK, these critical systems are currently also open and sharing data to be used in any information services on the market. To ensure that the opened data also reaches consumers, the Traffic Management Finland Ltd is developing a mobile application that presents all the relevant static and dynamic road and traffic data to drivers on the road.

In the field of road traffic monitoring, a shift can be seen from the use of roadside equipment to various mobile solutions, even though technical development improves the functionalities of roadside equipment as well. Traffic Management Finland Ltd currently uses floating car data travel time services acquired from the market, and many cities and other authorities are utilising cellular network -based mobility analytics services in many transport analyses tasks.

In the priority area of *Continuity of traffic and freight management ITS services* development continues with a good pace. New highway sections have been instrumented with traffic management systems on motorways and around biggest conurbations. The biggest change however has taken place in the operational IT system of the traffic management centres, operated currently by Traffic Management Finland Ltd. The new operational system TLOIK is in place and previously separate traffic management systems have been integrated into TLOIK environment during 2017-2020. TLOIK fosters uniform functioning and high reliability and efficiency for traffic management operations in Finland. Advancing steps have also started in the field of logistics management. The CEF co-funded FEDeRATED project plans to improve the efficiency of freight transport by digital solutions and EU-wide platform for cargo community network. It will design and validate in the next three years a federated network of platforms concept to enable data sharing in the logistics chain while providing interoperability and harmonisation between individual platforms.

In the priority area of *ITS road safety and security applications* Finland has moved from piloting phase to service production phase. Finland implemented the eCall in 2017 in six Public safety answering points (PSAP) operated by Emergency Response Centre Administration (ERCA). Furthermore, many large and mid-size cities have taken into use a traffic light prioritising system for emergency vehicles (HALI), which prioritises green lights in crossings for emergency vehicles. Currently the system guarantees a safe intersection passage for over 400 emergency vehicles on a mission in over 500 traffic light intersections. Research and development incentives in the priority area have focused on e.g. improving sensor-based operation of automated vehicles in adverse northern weather conditions. The Horizon2020 co-funded project DENSE was able, for example, to extend the line of sight of sensors in restricted visibility conditions, beyond human capabilities.

Perhaps the most significant national development leaps have taken place in the priority area IV *Linking vehicles with the transport infrastructure*. The activities in Finland have focused on defining and testing the main common enablers for traffic management, monitoring and information delivery and automation in transport. These activities have been carried out in good European cooperation as many activities are belonging to CEF and Horizon2020 programmes. Regarding C-ITS development, the main national efforts within the period of 2017-2020 have been the Nordicway 2 and 3 projects. The cloud-oriented NordicWay concept is relying on the use of existing cellular networks and stakeholder clouds to achieve cost-efficient C-ITS provision with the potential of covering most of the vehicle fleet already by 2030. The concept building on interchange nodes can via the federation of the interchange nodes be easily extended to cover all Europe and the whole TEN-T network, so in these Nordic pilots and

activities lies a strong European perspective. Overall the Nordicway project family has already covered all relevant Day 1 and Day 1.5 C-ITS services and extended the scope of C-ITS services to cities, changing thereby also the focus of service portfolio to include more traffic signal-oriented services such as Green Light Optimized Speed Advisory (GLOSA), Time To Green (TTG) and Signal Phase and Time and Map Data (SPAT-MAP). The piloted services are expected to transfer to full production phase with feasible business cases. The Nordicway projects are supported by the European Commission.

Many implemented projects are increasing preparedness for the roll-out of automated driving applications within the following decade. For example, the project called Making full use of Automation for National road TRansport Authorities (MANTRA) has provided the national authorities with a comprehensive roadmap how to adapt their own core business areas of physical and digital infrastructure such as traffic management and information, road and winter maintenance, road design and planning to the requirements of automated driving. Also, the required changes to national legislation are currently under scrutiny. Some other projects have focused on the northern perspective of automated transport, which is necessary to ensure a safe utilisation of the future automated transport application not only in the Nordics, but also in certain regions and occasion in the whole Europe. Another important national perspective has been the use of cellular networks as the connectivity facilitator for automated driving. Finnish Authorities and technology companies have taken significant roles in 5G related research and development projects, supported by both the EU through H2020 as well as national funding agencies. These activities are building understanding on how 5G will support autonomous driving functions, road weather and safety services, road maintenance operations and e.g. V2V video streaming. Concurrently, business cases are being studied as well.

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2 Projects, activities and initiatives

2.1 Priority area I. *Optimal use of road, traffic and travel data*

2.1.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

Digitraffic is a service operated and developed by the Traffic Management Finland Group offering real time traffic information. Currently the service covers road, rail and maritime traffic. The service has been operational since 2008, already before the adoption of the ITS Directive. The objective of the service is to connect stakeholders of the transport sector and enhance transport ecosystem services. Digitraffic enhances the road safety and boosts the efficiency of infrastructure use and traffic operations for both passengers and freight, contributing to the functionality of the C-ITS corridor. The service is constantly updated.

Most of the data is gathered from Traffic Management Finland Group's data sources, which include travel time system, loop detectors, road weather stations and road weather & surface cameras. It also provides history data, road weather forecasts and information about traffic incidents disorders. Road Digitraffic offers several APIs for developers. Open data licence model is Creative Commons 4.0 BY.

For rail traffic, the open API provides data on train compositions and schedules including real-time traffic information, future schedules and history data. Regarding maritime data, the location of the ships, support system for wintertime and information on warnings are available.

Digitraffic is being developed towards a widely used national data marketplace with the aim of enabling other organisations and commercial operators to provide datasets to the service in the near future. https://www.digitraffic.fi/en/service-overview/

Digiroad is a national database that contains the geometry of the Finnish road and street network featured with the most important road attribute data. Digiroad has been available for users since 2004. The Finnish Transport Infrastructure Agency administrates the service and it is constantly updated. There are several development work packages for Digiroad ongoing, e.g. study to develop cycling priorities and publishing a portal 2.0 for private road announcements.

Digiroad data covers the entire country. The data enables and supports the development and commercialisation of services and applications for e.g. route planning, navigation, tourism, and intelligent transportation systems. Digiroad supports the optimal use of road, traffic and travel data. It also supports development of applications for traffic information and traffic management in the area of C-ITS. Digiroad data consists of the centre line geometry of the transport network, traffic-related attribute data and other transport system objects. The centre line geometry covers the vehicle-accessible roads, ferry and cable ferry connections, railways and separate pedestrian and cycle routes. Traffic-related attribute data include data of traffic elements as well as the restrictions, limits and other features of the road and street network.

The new Road Traffic Act, which came into force 1st of June 2020, sets requirements for opening the GIS information of traffic signs, traffic lights and other traffic control infrastructure, from both national

roads and municipal streets, and setting that data available from the centralized content access point, namely the Digiroad. Activities to implement this new requirement are ongoing.

Digiroad data is open for everyone to use and the material can be downloaded from the Finnish Transport Infrastructure Agency's service. The maintenance organisations are the National Land Survey of Finland, the Finnish Transport Infrastructure Agency, and the Finnish municipalities. The Digiroad Operator is responsible for adding and updating the Digiroad data in the database thereby ensuring high quality of the data. More information can be found at https://vayla.fi/web/en/open-data/digiroad

Traffic situation service presents map-based graphic traffic information from all modes (road, maritime, rail) collected by the Traffic Management Finland Group. It covers all railway stations, ports and public roads. The service promotes optimal use of road, traffic and travel data, and improves the interoperability, continuity and seamless mobility.

The service provides information about road traffic incidents, traffic volumes, congestion in the Helsinki region, roadworks, weight limitations on main roads caused by frost breaking, road conditions and weather (including forecast), road camera pictures and ice roads. Information on rail traffic includes arrival and departure times of commuter and long-distance trains and their punctuality. The service also provides information of the maritime traffic (navigational warnings published by the Traffic Management Finland Group and the vessels in port and arriving vessels).

The application was updated in February 2020, featuring the changing signage of road traffic, including speed limits and warnings, information from road weather stations and more detailed driving weather forecasts. In addition, the application offers easier access to railway traffic information to enable more efficient travel connections with a mobile device application, developed for iOS and Android operating systems.

The service is constantly updated on the basis of feedback received from the users. The service is available in the internet at https://liikennetilanne.tmfg.fi/ and in the app stores.

Intelligent Traffic Management Finland (ITM Finland) purchased a floating car data –based travel time information in 2018. The goal was to buy quality *travel time information* from the market to be used in operative traffic management in the traffic management centre in order to improve the efficiency of traffic control, traffic information and incident management. The focus was on the busy, congested and accident-prone main highways in the Helsinki region, where better information is needed the most. The data stored in a database will also be used in all sorts of traffic planning processes. A contract for 3+2 years was signed with a commercial floating car data provider after passing the minimum quality requirements in the validation phase. This purchase is an example of how probe data collected originally for commercial purposes can also be utilised in the operational tasks of transport authorities. The product selected is purely an off-the-shelf product so no changes to the service APIs were needed, which was a goal set for the procurement, to enable efficient use of existing resources and systems. As a result, the cost-efficiency of the information service is very high in comparison to earlier travel time information procurements. The quality framework developed in the EIP and EU EIP projects (European ITS Platform), co-funded by European Commission, was used in the preparation of the minimum quality requirements and in the planning of the validation test. The travel time information is currently used by Intelligent Traffic Management Finland Ltd. in the traffic management centre

managing the traffic in the main arterials and ring roads in the Helsinki region, including the E18 corridor. The use of mobile device-based data in traffic management is just one example of a trend towards mobile solutions in general. Many cities and other authorities are also utilising cellular network -based mobility analytics services in many transport analyses tasks.

Digitransit is an easy-to-access service platform provided by Helsinki Regional Transport and the Finnish Transport Infrastructure Agency. Digitransit is a real-time journey planning and passenger information platform which has been developed together with the Finnish Transport Infrastructure Agency's matka.fi (journey.fi) service. The Digitransit project ensures that route and timetable data gathered from various sources are comprehensive and of high quality. The service promotes optimal use of road, traffic and travel data, and improves the interoperability, continuity and seamless mobility. The objective of the service is to simplify travel planning and help travellers to find better travelling options, improving travellers' mobility and increasing the sustainability and safety of the traffic. The service offers the user optional route planning options from the starting point to the end point, connecting different modes of transportation on the selected time of the day.

The coverage of the service is nationwide and takes into account real-time data where available. The service can combine all modes of transport including public transport, airlines, private car, walking, cycling as well as city bikes. In addition to the open data and APIs, the source code is also open at Github. All interested parties can participate in the development of the open-source service. This is likely to decrease errors, improve security and increase the provision of data that is always up to date.

Once the project is complete, travellers will have a modern timetable and route planner covering all forms of public transport and providing a number of new features. The data and application code are open, enabling service providers to develop new services for travellers. Finnish Transport Infrastructure Agency has prepared a roadmap for the planned development activities. The latest developments of Digitransit include presenting the connections (also with transfers) between passenger hubs in timetable form and developing the features of the virtual monitor to new use cases.

In 2019, Digitransit Platform was introduced to Estonia, widening the user group of the service and the developers working to improve the service further. The service facilitates the electronic data exchange between the relevant public authorities and stakeholders across borders, improving the North Sea-Baltic ITS corridor. More details on the collaboration project can be found in the chapter 2.2.1.

The route and scheduling editor (RAE) of the Finnish Transport Infrastructure Agency can be used for storing public transport stops and stop-specific timetables. The RAE tool has two roles; editor (traffic operator) and administration (road authority).

The RAE tool can be used to store routes in General Transit Feed Specification (gtfs) format files. For example, the traffic operator may provide their application for operating of a certain route to the authority in an electronic form (including route and timetable information). Routes accepted by the authority will automatically pass through to the Finnish Transport Infrastructure Agency's public transport database to be utilised by, for example, Digiroad, the opas.matka.fi service and Digitransit. Therefore, RAE contributes to the cross-border collaboration developed between Finland and Estonia, based on Digitransit development.

In the near future, the service will be maintained by Traffic Management Finland Group, and the aim is to develop one single National Access Point for Finland including NAPs of all the Delegated Regulations.

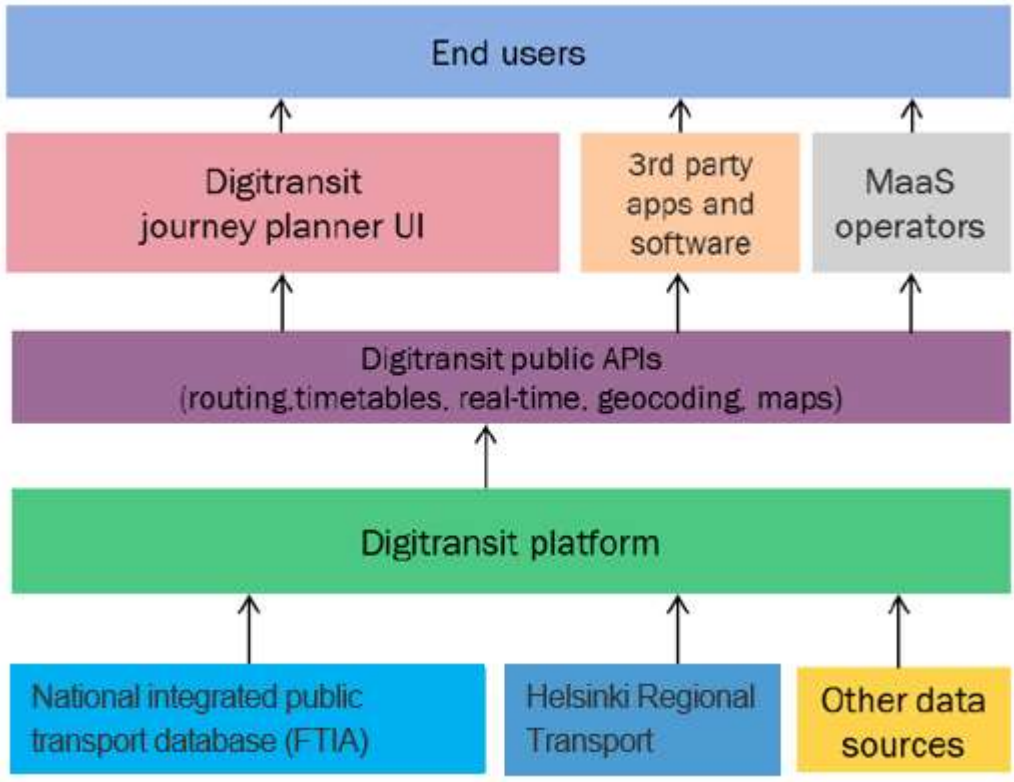

Figure 1 The national public transport information services (source: The Finnish Transport and Communication Agency, 2019).

There are several *ITS development programmes* in Finland. The programmes bring together relevant stakeholders from public and private sides, enhancing the collaboration between different parties to promote the development of the industry.

- The Ministry of Transport and Communications and the Ministry of Employment and the Economy have established a transport growth program. The aim of the program is to mitigate climate change, which has been identified as a key driver creating a large growth market for solutions and services that reduce emissions.

  The measures of the growth program relate to enabling legislation, proactive research, the know-how and ecosystems of innovative companies, urban market experiments and pilots, public procurement, knowledge utilisation and financing. The growth program was established in 2018 and the implementation will be ongoing until 2022 in cooperation with many organisations. The program includes the Ministry of Education and Science, Ministry of Transport and Communications, ITS Finland Registered Association, Ministry of Environment, Ministry of Agriculture and Forestry of Finland, the cities of Espoo, Helsinki, Oulu, Tampere, Turku and Vantaa, Business Finland, Sitra, Smart & Clean Foundation, VTT Technical Research Centre of Finland and the Häme Association.

The growth program has been the driver for international co-operation between Nordic countries and Estonia, utilising the network of ITS associations. An important co-operation project in promoting the Nordic market is the Nordic Open Mobility and Digitalisation project, which has received funding from Nordic Innovation.

- Another development program, 6Aika, brings together six Finnish cities facing challenges with urbanisation; Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu. The program is partly funded by the European Structural Fund and European Social Fund. The partners are Aalto University, Forum Virium Helsinki, Finnish Geographical Institute and Tampere University of Technology.

  The program has several projects and three major spearhead developments focusing on open innovation platforms, open data and interfaces and open inclusion and customer service. The program has been a big part on supporting the ITS strategies and ITS development of Finnish cities.

- Another cooperation platform is TransDigi, aiming to promote, guide and enhance research, development and innovation activities in the transport sector in order to improve international competitiveness. TransDigi improves collaboration with key research organisations in the transport sector, related authorities and companies. There are several ongoing development projects (listed on https://transdigi.fi/en/hankekortit-search?fs=) and TransDigi has been active on publishing their findings internationally, improving collaboration and sharing knowledge across borders. List of the publications can be found in: https://transdigi.fi/fi/materiaali/julkaisut.

EU EIP (co-funded by EU Commission) serves as a knowledge management center by developing, providing, promoting and maintaining harmonisation tools and processes with substantial value to National Road Authorities and road operators, to private actors as partners in the ITS value chain and network, to the European Commission in implementing and advancing ITS policy and regulation as well as to relevant stakeholders and multi-stakeholder collaborations in the ITS community. Key achievements of EU EIP comprise the European Reference Handbook for harmonized ITS Core Service Deployment in Europe, an improved mechanism for Cross Corridor Cooperation, KPIs for ITS deployment and benefits, the ITS toolkit and the evaluation library, the community building on National Access Points, Innovation timelines and deployment roadmaps, information services quality frameworks and assessment methods, physical and digital infrastructure attributes for automated driving, good practices how to automate road operator's own ITS and integrating C-ITS into road operators day-to-day business. The entire EU EIP results address all of the ITS Priority Areas I-IV (and, in doing so, have also relevance for the sections 2.1 to 2.4) and contribute also to the knowledge on KPIs related to ITS Corridors.

As a follow up of the previous NEXT-ITS and NEXT-ITS 2 projects, the *NEXT-ITS 3* project (2018-2020) covers the Northern part of the Scandinavian-Mediterranean corridor, including the core road network and the key comprehensive network links. The project connects North and East Germany and the Nordic countries (Denmark, Finland, Norway and Sweden) to the Central and West European road networks through the Northern sections of the Scandinavian – Mediterranean CEF Corridor. The

Northern sections connect with the North-Sea – Baltic CEF Corridor in Berlin, Bremen and Helsinki and to the Orient – East Med CEF Corridor in Bremen, Rostock and Berlin. NEXT-ITS is co-funded by CEF.

The aim of the project is to enhance corridor and network performance by full-scale deployment of ITS services that ensure interoperability and continuity of services, support harmonisation, and increase the cost-efficiency in the operation of traffic management.

The ITS services concerned in NEXT-ITS 3 are the following:

- information services, including heavy goods vehicles, parking services, giving the road users a possibility to make good decisions
- traffic management services to steer and regulate the traffic flow
- incident Management to restore normal traffic flow as quickly as possible
- utilisation of connected vehicles in traffic management
- data collection through various sources of information as well as data mining and fusion.

2.1.2 Progress since 2017

Description of the progress in the area since 2017:

Since 2017, there has been progress especially on the open innovation platforms, open data and interfaces. In addition, open inclusion and customer service development have been in the focus. There has been development in passenger information systems as well, e.g. changing signage of road traffic, including speed limits and warnings, information from road weather stations and more detailed driving weather forecasts.

The cross-border collaboration has progressed since 2017 especially with Estonia and Nordic countries, improving the knowledge and data exchange between public authorities and stakeholders.

2.1.3 Delegated Regulation (EU) 2017/1926 on the provision of EU-wide multimodal travel information services (priority action a)

Measures undertaken, if any, to set up a national access point and on the modalities of its functioning: (including information on the weblink to the NAP and discovery services available to users)

Finland has set up a national access point for multimodal traffic and travel information in line with the requirements as set out in the Commission Delegated Regulation 2017/1926. The Finnish multimodal access point is a register of mobility services and related application programming interfaces (APIs), which has been setup in accordance with both the EU regulation and the Finnish Act on Transport Services. Respective data is provided by transport authorities, transport operators, transport on demand service providers and infrastructure managers. The Finnish Transport and Communication Agency is responsible for the multimodal access point. The national access point is available in Finnish, English and Swedish and can be found from the following website: www.finap.fi.

The national legislation, namely the Act on Transport Services, required that the national access point for multimodal data and related tools had to be implemented by 1st of December 2018.

Information on the progress made since 1 December 2019:

Planning of the opening of the datasets due in the following years continues.

Additional information (e.g. which data types are being provided? Have metadata catalogues been implemented? Are quality requirements being checked?):

The NAP catalogue includes, for example, passenger transport services (by road, sea and air); stations, ports and terminals; vehicle-for-hire services and commercial shared mobility services; general commercial parking services and brokering services. Data is provided both by the actors own machine-readable interfaces or from the NAP after it has been digitised with the NAP tools. The NAP itself is machine-readable and the user interface allows filtering the content based on transport operator, transport name, type, operating area, mode of transport and interface content.

Some of the data categories of the delegated regulation 'a' are published in other access points and are referred to in the multimodal NAP, including topographic places, connection links and transfer times and road-, cycling- and pedestrian network.

All transport services are published in a GeoJSON export, which can be formed with the transport-operator-id and id fields in the service search API response default objects. The JSON-schema contains all the properties of the different transport-service types. NeTEx enumerations are used wherever possible. NeTEx is not yet provided by the public transport authorities and operators. Therefore, a GTFS to NeTEx conversion is being implemented in NAP as a first step. The Nordic countries have agreed on a Nordic NeTEx profile, which serves as a basis for further Finnish development.

According to national Act on Transport Services the interfaces to dynamic data has to be published in the NAP if they are available.

A major communications campaign took place both on the Act on Transport Services and the Delegated Regulation 'a' including a roadshow, newsletter, mail and email information to stakeholders as well as presentations and discussions in several forums and congresses. Dissemination also included online education for municipalities. The NAP Helpdesk with phone service started in December 2017. A network of stakeholders has been established in which experiences from implementation can be exchanged and different obligations of Act on Transport Services are discussed.

2.1.4 Reporting obligation under Delegated Regulation (EU) 2015/962 on the provision of EU-wide real-time traffic information services (priority action b)

(see guidance provided in Member States experts follow up meetings)

Measures undertaken, if any, to set up a national access point and on the modalities of its functioning:

In compliance with Article 3 of the Delegated Regulation (EU) 2015/962 a national Single Point of Access through which data is accessible has been set up as follows:

- Static road data is available for exchange and re-use in compliance with Article 4 of the Delegated regulation via the Digiroad service (www.digiroad.fi).
- Dynamic road status and traffic data is available for exchange and re-use in compliance with Articles 5 and 6 of the Delegated regulation via the Digitraffic service (www.digitraffic.fi).

All data in the afore-mentioned services is shared according to the principles of open data under a Creative Commons Attribution 4.0 International License.

Improved functionalities have been added to the NAP of dynamic road status data and traffic data to increase the usage of the provided data among different information service providers and developers. In addition to Datex2-based interfaces also parallel JSON-based API:s and new attributes such as line geometry have been added to improve the usability of the data especially among small mobile application developers. For certain datasets also "push" type MQTT interfaces have been added in parallel, to decrease the amount of unnecessary data exchange between interfaces.

The policy towards declarations of compliance have remained the same. Declaration of compliance has been received from the Finnish Transport Infrastructure Agency. The future policy of Declarations of Compliance is currently under discussion and best European practises are being followed.

Where relevant, the list of motorways not included in the comprehensive trans-European road network and identified priority zones:

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Additional information (e.g. which data types are being provided? Have metadata catalogues been implemented? Are quality requirements being checked?):

More datasets under the priority action 'b' regulation have been opened and provided to the respective NAP, namely the dynamic status of variable speed limit signs and the status of variable message signs.

2.1.5 Reporting obligation under Delegated Regulation (EU) No 886/2013 on data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users (priority action c)

(see guidance provided in Member States experts follow up meetings)

Progress made in implementing the information service, including the criteria used to define its level of quality and the means used to monitor its quality:

The implementation activities for priority action 'c' are defined in the national implementation plan prepared by the Finnish Transport Infrastructure Agency. The targeted quality levels have been studied in the EIP- and EIP+ -projects in cooperation with other Member States.

Intelligent Traffic Management Finland operates the traffic management centres which provide traffic reports on safety related traffic events as specified in the Delegated Regulation. The safety related traffic reports are distributed through the Traffic Management Finland Group's web pages (http://liikennetilanne.liikennevirasto.fi/), Liikennetilanne application in application stores and via social media e.g. Facebook and Twitter. The Traffic Management Centres also deliver information directly to existing distribution channels, including variable message signs as well as RDS-TA, public and private media broadcasters and external service providers. The information is provided free of charge.

In addition to the set-up of the message distribution, Finnish transport authorities have invested in the monitoring and early observation of the safety-related events. The roadside monitoring station network has been expanded and new ways of collecting and disseminating safety-related information have been piloted for an example in the NordicWay projects together with the other Nordic countries. In the pilots the safety-related events are being identified using both drivers' observations, observations generated by machine vision as well as data read from the vehicles' CAN-bus data. The

NordicWay2 pilot data was distributed between the involved partners and the safety-related messages were made available for all users through the involved apps. The messages were also distributed through the Digitraffic service from a separate API.

Also, the reindeer warning service produces safety-relevant event messages in the northern areas of Finland. The reindeer warning service was opened for the public in August 2017 and is currently operated on commercial basis (See 2.3.1.1).

The Finnish authorities have been active in the European Data Task Force to develop the common practises in the implementation of the delegated regulation. The group aims at introducing methods and principles for efficiently using safety-related event data originated to the vehicle probes and systems, in a wider context and services.

Results of the assessment of compliance with the requirements set out in Articles 3 to 8 of Delegated Regulation (EU) No 886/2013:

In accordance with the Commission Delegated Regulation (EU) No 886/2016 The Finnish Transport Infrastructure Agency has given a formal declaration stating that their service provision is in compliance with the requirements and specifications of the Delegated Regulation. Also, Tomtom Ltd has stated that it is providing safety-related traffic information in Finland and has provided the necessary information regarding their service into the National Access Point.

The Ministry of Transport and Communications has designated the Finnish Transport and Communications Agency as the national body to assess whether the requirements set out in the Delegated Regulation are fulfilled by the service providers dedicated to traffic information. So far, the Finnish Transport and Communications Agency has not perceived any deviations or irregularities in the service provision in Finland.

Where relevant, a description of changes to the national access point:

-

Additional information (e.g. sources of data used for the provision of safety related traffic information):

-

2.2 Priority area II. *Continuity of traffic and freight management ITS services*

2.2.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

The FinEst Smart Mobility aims to mitigate the congestion and other negative externalities borne out of the large traffic volumes passing through the Helsinki West Harbour and Tallinn Old City Harbour ports and both cities, by developing intelligent traffic solutions. There is over 8 million annual ferry passengers between Helsinki and Tallinn, connection being one of the busiest in the world. The project has received its funding through Interreg Central Baltic programme (centralbaltic.eu) for years 2016-2019.

The project had four core smart mobility pilots, improving the cross-border multimodal travel information and the continuity and interoperability of traffic and freight management services on the North Sea-Baltic corridor. The pilots were:

- Harbour's PSO – Predicted and smooth outbound traffic
- Shared rides from West Harbour to Helsinki airport
- FinEst API – Ferry traffic prediction data API
- FinEst Mobility App – JIT route guidance for truck drivers

The objective of *FEDeRATED (Corridor as a Service)* project is to improve the efficiency of freight transport by digital solutions. FEDeRATED is a CEF co-funded consortium, designing an EU platform integrating digital cargo community networks. The project has altogether 15 partners located in 6 EU Member States and runs from 2019 until the end of 2023. FEDeRATED project will design and validate a federated network of platforms concept to enable data sharing in the logistics chain while providing interoperability and harmonisation between individual platforms.

The project will enable smooth electronic data exchange between the relevant public authorities and improve the availability of existing road and traffic data. Furthermore, it will enhance the continuity of cross-border ITS services for the management of freight along transport corridors.

NEXT-ITS 3 project, presented in the Priority Area 1, focuses also on the continuity of traffic management services. The following traffic management services have been implemented in Finland under the NEXT-ITS 3 project:

- Deployments in the Traffic Management Centres (Activity 1)

  The objective of this activity has been to renew and purchase equipment to facilitate the use of the Road Traffic Management Integrated User Interface (TLOIK) operator support system which has become the main operational tool for road traffic management centres used for situational awareness and traffic management. The activity will address the whole Finnish core network, with the aim of enhancing corridor performance for the mobility of people and goods, and to support and ensure the performance of the core network in Finland.

- Enhanced traffic management on core network Kempele-Kello (Activity 2)

  The objective of this activity has been to deploy an integrated traffic management system on the motorway section Kempele-Kello on road E75 in the region of Oulu. The activity is targeting the high accident risks on the section by implementing variable speed limits and a variable message sign warning system. This activity will contribute to an improved corridor performance and improved core network performance by reducing the risk of crashes and of crash related incidents and congestion, by harmonising traffic flow via variable speed limits, and by enhancing traffic management via integrated and more effective incident management tools.

  In addition to the ITS implementation projects the NEXT-ITS 3 also facilitates studies addressing real-time data, road weather monitoring and cooperation activities with other ITS corridors. There is also a technical coordination activity. For example, the

Traveller Information Services Activity organised a workshop for the National Access Points regarding real-time and safety relevant information together with EU EIP sub activity 4.6.

In addition to the deployment projects there are various coordination and harmonisation activities within the project. The technical coordination team provides added value as a harmonisation interface between national implementation and the European framework. By strategic governance of national deployments, the team safeguards interoperability with respect to Deployment guidelines, Delegated Acts and applicable standards. The technical coordination team also staffs European ITS Experts Groups in different countries. The group has e.g. organised European level workshops on various traffic management related topics.

2.2.2 Progress since 2017

Description of the progress in the area since 2017:

The Finnish main activities since 2017 have been improving the efficiency of freight transport by digital solutions and improving the cross-border multimodal travel information. In addition, the continuity and interoperability of traffic and freight management services on the North Sea-Baltic corridor have been in the focus. The coverage of traffic management systems has been improved in the TERN-network and the functionalities of the ITS systems used in the traffic management centres has been developed by implementing an integrated operational system T-LOIK.

2.3 Priority area III. *ITS road safety and security applications*

2.3.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

The *Porokello* reindeer warning service, that produces safety-relevant event messages in the northern Finland, was opened for the public in August 2017. After the pilot phase organisational questions have been solved as the Regional Council of Lapland and insurance company Pohjola joined in the consortium in the beginning of 2019. In 2019 the operation of the service was funded by Pohjola and EU fund for Rural Areas. At the same time, the possibility to send warnings for other road users was widened for all registered users of the 'Porokello' application. Also, a new service "Reindeer Warnings" was opened in 2019 especially targeted for tourists. Currently the 'Porokello' service is owned by Paikkatieto Online Ltd. and is continuing its operating on commercial basis, as Pohjola Insurance company as the main partner in 2020. More partners are beings sought.

eCall is a system that provides an automated message including the precise crash location to the emergency services following a road crash. The eCall was implemented by Finnish Public Safety Answering Points (PSAP) organisation during October 2017. The Finnish Transport and Communications Agency is responsible of the functionality of the system in Finland. More information on the activities in chapter 2.3.3.

The development of the system has enabled the availability of the necessary equipment in the emergency call response centres receiving the data emitted from the vehicles and the facilitation of the electronic data exchange between the vehicles and the emergency call response centres.

Traffic light prioritising system for emergency vehicles (HALI) prioritises traffic lights for emergency vehicles on a mission. The development of HALI was kicked off in the city of Oulu in 2004 as a regional development but has later grown into a national system developed together with City of Oulu, Rescue Department of Oulu-Koillismaa and the Intelligent Traffic Management Finland Group. The service was implemented in 16 Finnish cities in 2019 and will be piloted in several new cities in 2020. HALI service covers eight rescue departments, four hospital districts, one police department, one rescue helicopter service (priorities for rapid vehicle access) and it operates over 500 traffic light intersections and over 400 emergency vehicles.

The system is continuously being developed. Currently cities have their own systems to run HALI service, but the goal is to centralise the service in one location to create a national system with sufficient cyber security for Finland. For 2021, the aim is to develop unambiguous system interface specification to allow international use of the system. Due to the system, the safety of the emergency vehicles on the mission has increased and travel time has reduced. The service improves the traffic in general, since starting from 2011 there has not been any traffic accidents related to the emergency vehicles on a mission when the HALI service has been in use.

As a part of NordicWay2 project, a safety analysis was prepared in 2019 to study functionality of *C-ITS messages for automated vehicles in Arctic conditions*. One of the key research areas was to determine how should C-ITS Day 1 hybrid services improving traffic flow and safety, be implemented in the Aurora Borealis corridor in Lapland, and what is their technical functionality. The project also looked into which Day 1 services are worth implementing in the Aurora Borealis Corridor. Technical Research Centre of Finland VTT, Sensible 4 and Lapland University of Applied Sciences were responsible for the conducted studies. The project was funded by the Finnish Transport Infrastructure Agency, The Finnish Transport and Communications Agency and EU Commission.

The project called *DENSE* (aDverse wEather eNvironmental Sensing system) aimed to improve the human interaction with vehicles. Its objective was to enable sensor-based cars to operate in all weather conditions, enhancing mobility and safety. DENSE will strengthen Europe's leading position of the automotive industry and open new doors for exploiting infrared, laser and radar technologies. The project was funded by Business Finland and ECSEL-EU-H2020, and it was ongoing from 2016 to 2019. The project identified key improvements: extending the line of sight for sensors in restricted visibility conditions beyond the capabilities of human beings. Finnish partners were developing radar and LiDAR technologies for automated driving functions. https://www.dense247.eu/home/

The objective of *TrustVehicle* project is to develop technical solutions for automated driving to better assess critical situations in mixed traffic scenarios. The project also aims to develop automated driving under harsh environmental conditions and to increase the safety and reliability of automated vehicles and to contribute to end-user acceptance. VTT leads the work package focusing on the development of adaptive human machine interfaces for L3 automated driving. VTT does close cooperation with OEMs to ensure safe management of the transition phases between automated and manual driving. The project started in June 2017 and was completed in May 2020. The project is co-funded by Horizon programme. https://www.trustvehicle.eu/

2.3.2 Progress since 2017

Description of the progress in the area since 2017:

The greatest progress in the area since 2017 has been especially in developing and implementing national systems to improve road safety, e.g. eCall and traffic lights priorities for emergency vehicles. Also, the warning services for reindeers on the road have successfully moved from pilot phase to production phase. For automated road traffic, there have been many research projects developing technical solutions to improve the safety and reliability of automated vehicles in difficult weather conditions.

2.3.3 112 eCall (priority action d)

Information on any changes regarding the national eCall PSAPs Infrastructure and the authorities that are competent for assessing the conformity of the operations of the eCall PSAPs:

Finland implemented eCall in 2017 in six PSAPs operated by Emergency Response Centre Administration (ERCA). In 2017, Emergency Response Centre Administration asked VTT Technical Research Centre of Finland Ltd to perform a conformance assessment for the PSAP information system (ELS). The conformance assessment was carried out in December 2017 - March 2018 and received by the Finnish Transport and Communications Agency which had been appointed in Finland as a public authority with competence to receive the conformance assessment of the PSAP and assess the conformity of the PSAP.

The information system of the PSAPs operated by Emergency Response Centre Administration is currently being updated. The earlier information system used by PSAPs (ELS) has been replaced with a new information system (ERICA). The ERICA system has eCall functionalities, and the roll-out of the system is expected to be completed soon. Once the final or close to final version of the system has been installed in all six PSAPs, a new conformance assessment will be carried out for the eCall functionalities of the system.

The operation of eCall and ERA-GLONASS in border areas has been tested in Finland near the Finnish-Russian border in 2019. These tests focused on the network selection behaviour of the ERA-GLONASS IVS, and they were carried out with an IVS developed for testing purposes equipped with a SIM card from JSC GLONASS. The test results suggest that an IVS equipped with JSC GLONASS SIM card will likely prefer to register to a Russian mobile network in areas where at least one Russian network is available. It therefore seems possible, that an emergency call originating from an ERA-GLONASS IVS located in territory of Finland may be connected to a Russian PSAP, if a Russian mobile network is available. These results are applicable to a situation in which the operator of the ERA-GLONASS system, JSC GLONASS, has no roaming agreement with Finnish mobile network operators. The operation of eCall and ERA-GLONASS in border areas will be re-tested in Finland and Russia once JSC GLONASS has established a roaming agreement with one or more Finnish mobile network operators.

Additional information:

- Finland has also carried out interoperability tests between pan-European eCall and Russian ERA-GLONASS systems. Interoperability tests have been carried out in Finland and in Russia in collaboration with the operator of the ERA-GLONASS system in Russia, JSC GLONASS. There is also a plan to repeat the interoperability tests once the roll-out of ERICA has been completed in PSAPs in Finland.

2.3.4 Reporting obligation under Delegated Regulation (EU) No 885/2013 on the provision of information services for safe and secure parking places for trucks and commercial vehicles (priority action e)

Number of different parking places and parking spaces on their territory:

There are 5 229 traffic rest areas on main roads in Finland, of which 576 are commercial, 1 403 refuelling points and 3 250 owned by the Government. The development needs of the service areas have been studied (amount, locations, services). Crime is not a major problem in the rest areas (primarily fuel thefts).

At the moment there are no parking places in Finland that fall under the criteria of Safe and secure parking places for trucks and commercial vehicles that are defined in the Delegated Regulation 'e'. Therefore, no data is available in the National Access Point either. However, the rest areas on highway E18 are reported to the common European information portal due to the good safety and security situation in Finland overall.

TRANSPark is a portal maintained by the International Transport Forum (IRU). It offers detailed information of over 4 000 parking areas in 41 countries with regard to services, number of parking slots and security level. In Finland, 300 refuelling points and two ports (Hanko and Vuosaari) offering parking areas are listed in the service.

Percentage of parking places registered in the information service:

-

Percentage of parking places providing dynamic information on the availability of parking spaces and the priority zones:

-

Additional information: (e.g. has a national access point been set up to provide truck parking data? Does it include dynamic data? What is the source of data (public / private)? Is data published on the European Access Point for Truck Parking hosted by DG MOVE? If not, is there any intention to do it in the future?)

The rest areas on the highway network are listed in the European Access Point for Truck Parking because of the good safety and security situation in the country overall.

2.4 Priority area IV. *Linking the vehicle with the transport infrastructure*

2.4.1 Description of the national activities and projects

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status: in particular, provide information on the C-ITS deployment initiatives and their technical specifications.

The deployment of C-ITS and automation in transport is based on new innovations produced by public and private organisations. Research and innovation are supported by the main EU research programmes e.g. CEF, Horizon 2020 and the Regional Development Funds. National research activities and projects belong usually to some national ongoing research programme. Transport is seen as a strategic innovation area for research and piloting and especially because of opportunities in smart mobility. In Finland the backbone is the National Transport Growth Programme defining the strategy for the transport research. Business oriented smart transport research is coordinated by the Business Finland agency and their programmes such as Smart Mobility and Growth Engine. Major cities Helsinki, Espoo, Tampere, Turku and Oulu have their joint strategy for sustainable urban development.

The Finnish authorities have been very active in *EU EIP Activity 4.2 Facilitating automated driving*, in which The Finnish Transport and Communications Agency is the leading European partner. The scope of this activity is to prepare road authorities and operators to make decisions on facilitating automated driving and automating their own core business. The concrete actions contain the following:

- Task 1. **Identify the requirements** of higher level (SAE 3-5) of automated driving for road authorities/operators - road markings, traffic signs, real-time and predictive traffic information, digital maps, cooperative ITS infrastructure
- Task 2. **Assess the direct and indirect impacts** of higher-level automated driving on traffic, mobility and the core business of road authorities and operators; investigate the socio-economic benefits and costs of automated driving from the road operator's perspective
- Task 3. **Provide a road map and action plan**, focussing on the needs of road operators to facilitate automated driving on the TEN road network
- Task 4. **Identify the requirements of automating road operator ITS** to facilitate automated driving (i.e. self-maintenance, self-optimisation, self-management, self-healing); and automation level of traffic centre operations and services (control/management/information)
- Task 5. **Monitor, liaise and disseminate**, to gain better understanding in global activities, R&D, deployment, and policy development, disseminate lessons learned

One of the key results of the activity from the national viewpoint so far has been the report "The impact of automated transport on the role, operations and costs of road operators and authorities in Finland", which increases understanding of the likely to-the-market and market-penetration scenarios of different automated applications, as well an understanding of the requirements and costs related to setting up the operational design domains (ODDs) for these applications. The report is widely used in regional and municipalities activities and helping stakeholders to plan their strategies and piloting plans regarding automated vehicles.

NordicWay projects (1, 2 and 3) supported by CEF funding have developed hybrid C-ITS services since 2015. The cloud-oriented NordicWay concept is relying on the use of existing cellular networks and stakeholder clouds to achieve cost-efficient C-ITS provision with the potential of covering most of the

vehicle fleet already by 2030. The concept building on interchange nodes can via the federation of the interchange nodes be easily extended to cover all Europe and the whole TEN-T network, for instance.

NordicWay 1 showed that the concept works for selected Day 1 C-ITS services with sufficiently low latencies and high reliability, good user acceptance, and expected safety impact. NordicWay 2 extended the service portfolio to cover all relevant Day 1 and Day 1.5 C-ITS services and some automated driving use cases as well as the road network coverage. It also proved the feasibility of the federation of interchange nodes – in fact, the Finnish C-ITS pilot deployment contained three national interchange nodes all federated with the other nodes in NordicWay's other countries. The assessments focused now on user acceptance, technical performance, eco-systems and socio-economy. NordicWay 3 further extends the scope of C-ITS services to cities, changing thereby also the focus of service portfolio to include more traffic signal-oriented services such as GLOSA, TTG, SPAT-MAP etc.

NordicWay has been very active in European harmonisation activities within C-Roads, and in the forefront especially with regard to hybrid solutions and evaluation.

https://www.nordicway.net/

The CEDR-funded *MANTRA* is a research project looking at the impact of highly automated driving on the road authorities and their core business, and the project has a very strong Finnish involvement. MANTRA has studied at the impacts of highly automated driving on mobility, road safety and traffic flow, and especially on physical and digital infrastructures. Concerning the latter, MANTRA has further developed EU EIP's ODD taxonomy as well as the relevant physical and digital infrastructure attribute catalogue to support road authorities and also the other stakeholders via the CCAM platform. A further added value from MANTRA is a comprehensive roadmap for road authorities and operators to adapt their own core business areas of physical and digital infrastructure, traffic management, incident and event management, traffic information services, roadworks, road and winter maintenance, road user charging, enforcement, road design and planning, asset management, and new core business. https://www.mantra-research.eu/

Arctic Challenge research project was a part of the NordicWay 2 project including intelligent transport, digitalisation, automation, infrastructure maintenance development activities and testing mainly in Lapland and in severe winter conditions. The objective of the project was to study automation and intelligent infrastructure solutions for road transport and the functionality of these solutions in arctic conditions. Four main research areas were stated: 1) Posts and poles for guidance and positioning, 2) C-ITS hybrid services, 3) Remote control and wireless transfer, 4) Location data and positioning, need of automated driving. A lot of field testing were performed related to the various research areas and in the road sector developed for the arctic testing with all the required instrumentation.

The posts and poles focused on radar and passive reflectors. The results indicated that shifting snow weakens the detected signal, the 20 metres pole interval seemed to be the optimum distance at 80 km/h speed in the traffic flow. The results showed that UWB technology can offer a positioning accuracy of few centimetres. The research on the C-ITS technology and services in arctic conditions indicated that ITS-G5 technology was more mature than LTE, however having higher implementation cost. Remote control of automated vehicles may be a solution in harsh conditions without proper road lane markings and GNSS availability. The location and positioning testing with GNSS, RTK-GNSS and

Lidar resulted that combining data from multiple sensors yield a reliable positioning estimate with a maximum average error of 0,264 metres and lateral of 0,187 metres HD map included.

This research project was coordinated by the Finnish Transport Infrastructure Agency and the Finnish Transport and Communications Agency in 2017-2019. https://julkaisut.vayla.fi/pdf12/vt_2019-19_arctic_challenge_web.pdf

5G projects

Today's vehicle instrumentation data (incl. cameras) allows various advanced services, but it is generally acknowledged that safe and efficient operation of automated vehicles (cars, trucks, busses, pods, shuttles etc.) requires efficient communication between the vehicles and the vehicles and the infrastructure, increasingly also information about the local conditions such as the weather. So far, the adoption of advanced services has suffered from insufficient communication media. 5G is expected to bring the first scalable solution to this connectivity problem.

Therefore, the EU, which has a vision of close to zero casualties in traffic by 2050 and sees a substantial contribution coming from automation, is supporting a range of 5G Research and Innovation Actions in the H2020 program. 5G projects are also supported by other programs such as Eureka, and by national funding agencies (such as Business Finland in Finland).

To ensure smooth transition to a "5G world" and to maximize the reliability, it is needed to consider upgrading from 4G/LTE and perhaps hybrid network environments, including ITS-G5 in particular in the pilots which are supported by many projects.

In the period 2017 – 2020 Finnish partners have actively participated in a number of European projects. Besides, there have been a number of nationally supported projects and studies and building of an ecosystem (Table 1).

Table 1 Main objectives of 5G projects

Name (type)	Funding	Main objectives
5G DRIVE (Project)	EU H2020	5G-DRIVE will trial and validate the interoperability between EU and China 5G networks 3.5 GHz for enhanced mobile broadband V2X scenarios. It is expected to have an impact on the validation of standards and trigger the roll-out of real 5G networks and innovative V2X solutions.
5G SAFE (Project)	Business Finland	The main objective of the 5G-SAFE is to improve road safety, optimize logistics and road maintenance, and contribute to the future of autonomous driving by delivering novel focused and time-critical services to vehicles, road users, and 3rd party organisations in a reliable and scalable manner.
5G-SAFE-PLUS (Project)	Eureka Celtic-Next	The 5G-Safe-Plus project aims to prevent traffic accidents and avoid casualties by delivering 5G-enabled time-critical road safety services to vehicles. Here, accurate weather and road maintenance information (esp. local road weather data) plays a key role together with direct incident/accident event information.
5G MOBIX (Project)	EU H2020	5G-MOBIX will develop and test automated vehicle functionalities using 5G core technological innovations along multiple cross-border corridors and urban trial sites, under

		conditions of vehicular traffic, network coverage, service demand, as well as considering the inherently distinct legal, business and social local aspects.
5GVÄYLÄ (Study)	CEF	The purpose of the study was to identify the benefits, needs and challenges of digital infrastructure in the activities of the transport infrastructure authorities, and to find out how the Finnish Transport Infrastructure Agency can enable and promote the development of telecommunications networks.
5G MOMENTUM (Ecosystem)		5G Momentum is an ecosystem established 2018, aiming at making Finland the leading country in the 5G technology. The ecosystem supports the development and use of 5G services by creating a new type of coordination network for the 5G trials and pilots.
LuxTurrim5G (Ecosystem)		LuxTurrim5G is a multidisciplinary group of companies and research groups led by Nokia, creating a digital backbone of the smart city and new data-based services. The focus is on productization and practical piloting of the 5G smart pole concept created by the ecosystem and creating a platform utilising data in a reliable and secured way, developing new digital services for cities.

5G DRIVE activities are structured around three main pillars:

1. Testing and demonstrating the latest 5G key technologies in Enhanced Mobile Broadband (eMBB) and V2X scenarios in pre-commercial 5G networks through trials in Finland, Italy and the UK.

2. Researching key innovation in networking slicing, network virtualisation, 5G transport network, edge computing and new radio features to fill gaps between standards and real-world deployment.

3. Boosting and increasing EU-China collaboration on 5G at all levels through extensive dissemination and exploitation actions.

Some deliverables are already available, and all deliverables will be available in the beginning of 2021.

The European Commission has taken the first step to boost 5G global cooperation with many countries and regions, including through jointly funded projects, global 5G events and other initiatives. The EC and China have agreed to fund joint projects on 5G trials to address two of the most promising 5G deployment scenarios. 5G-DRIVE, in collaboration with its Chinese twinning counterpart, has the ambition to fulfil this goal.

5G-DRIVE will bridge current 5G developments in Europe and China through joint trials and research activities to facilitate technology convergence, spectrum harmonisation and business innovation before the large-scale commercial deployment of 5G networks occurs. 5G-DRIVE will develop key 5G technologies and pre-commercial testbeds for eMBB and V2X services in collaboration with the Chinese twinning project. Trials for testing and validating key 5G functionalities, services and network planning will be carried out in Europe and China.

5G-SAFE developed services and solutions validated in four pilots. These services have been based on the use cases identified in WP2 (Requirements, specifications and business evaluation) and the results of WP 4 (WP4 – Advanced road safety services). The pilot cases covered by the project were

- Pilot 1: Road weather and safety services
- Pilot 2: Road condition, weather and maintenance provision for road maintenance operations
- Pilot 3: V2V-video streaming to/between vehicles
- Pilot 4: Automated driving.

The two-year 5G-SAFE belonging to the Challenge Finland competition has successfully developed solutions that improve road safety through providing novel time-critical digital services to vehicles and their drivers as well as essential information for road maintenance and other 3rd party organisations. The work was carried out in collaborative consortium that consisted of the key Finnish research and industry stakeholders. The main services in 5G-SAFE were related road weather, road maintenance and autonomous driving. These services utilized sensor and video data that were collected from the test vehicles. Based on these data alerts were generated and information to drivers, road users, and autonomous vehicle control systems were distributed successfully.

5G-SAFE-Plus aims to prevent traffic accidents and avoid casualties with time-critical road safety services to vehicles such as accurate weather, hazard and road condition information. The services may also be used by automated vehicles in challenging weather and road conditions. To ensure smooth transition to 5G and to maximize reliability, hybrid network environments, including 3G, 4G, 5G, ITS-G5 and, if possible, also satellite communication, will be used so that the service provision can be guaranteed continuously.

For supporting real-time requirements and ensuring scalability, the solution includes means for local processing (e.g. fog/edge) and information aggregation. Information security plays a key role as well and will be considered by design in the overall solution, to be validated in pilot constructions in real environments.

5G-SAFE PLUS will directly contribute to the EU goals of safer and more efficient mobility. So far, the adoption of advanced services has suffered from insufficient communication media and 5G is expected to bring the first scalable solution to it. To ensure smooth transition to a “5G world” and to maximize the reliability, the 5G-SAFE project considers hybrid network environments, including 4G/LTE, 5G, ITS-G5 and satellite communication. The idea is that the vehicles are connected to each other, the roadside infrastructure and cloud-based services always through the most optimal means of communications. The overall solution and services will be validated in pilot constructions hosted by the partners in several countries.

5G-MOBIX will develop and test automated vehicle functionalities using 5G core technological innovations along multiple cross-border corridors and urban trial sites, under conditions of vehicular traffic, network coverage, service demand, as well as considering the inherently distinct legal, business and social local aspects. It will also evaluate benefits in the CCAM context as well as define deployment scenarios and identify and respond to standardisation and spectrum gaps. The expected benefit of 5G will be tested during trials on 5G corridors in different EU countries as well as in China and in Korea.

5G-MOBIX will directly contribute to the EU goals of safer and more efficient mobility and ITS Corridor development. 5G-MOBIX will develop and test automated vehicle functionalities using 5G core technological innovations along multiple cross-border corridors and urban trial sites, under conditions of vehicular traffic, network coverage, service demand, as well as considering the inherently distinct legal, business and social local aspects. 5G-MOBIX will use the data and experiences of x-border corridors and trial sites for cost benefit analysis and assessment of the commercial impact of technologies and deployment.

As a result of the evaluations and international consultations with the public and industry stakeholders, 5G-MOBIX will identify new business opportunities for the 5G enabled CCAM and propose recommendations and options for its deployment. Furthermore, 5G-MOBIX will provide global 5G deployment scenarios and recommendations for EU-wide 5G corridor deployment and cross-border testing.

5GVÄYLÄ study was carried out in 2019. It was based on a total of 25 interviews with representatives of the Finnish Transport Infrastructure Agency, telecommunications operators, ELY Centres, cities, research institutes, and traffic management companies. The interviewees were asked about the development of 5G data connections, and in particular about connections along main transport routes and the opportunities and challenges involved in developing data connections.

The results of the 5GVÄYLÄ study can be used to promote the EU goals of safer and more efficient automated mobility. During the study, methods that the Finnish Transport Infrastructure Agency can use to promote the realisation of the 5G network and other data connections along the main roads and railways were identified. The study identified amongst the strategic measures that the role of the transport infrastructure authorities in promoting telecommunications issues requires clarification. 5GVÄYLÄ was co-funded by CEF as part of NordicWay 3.

Link to the study: https://julkaisut.vayla.fi/pdf12/vj_2019-52_5g_vaylaviraston_toiminnassa_web.pdf

During the year 2019 *5G MOMENTUM* has organised eight networking events and workshops to its members. The focus now is in many pilots which are starting. It supports the participation of Finnish partners in the EU 5G projects. One important development is the opening of the Hervanta 5G test network at Tampere for pilots. This is a network built jointly by Nokia and University of Tampere and corresponds in functionality the commercial networks but offers a controlled environment.

The objective of *LuxTurrim5G* is to develop and pilot key technical solutions and concepts for 5G infrastructure enabling the connectivity and city-wide IoT and sensor network. In LuxTurrim several digital services have been piloted, e.g. first and last mile logistics, autonomous transportation, public safety and situational awareness, information sharing and advertisement, weather and air quality monitoring and healthy living. The result of the project was proof-of-concepts including four functional smart poles and about 40 demos. The project built also a solid basis both for technical and business concepts for further study.

The work done in LuxTurrim5G is being continued in two parallel highly interlinked projects LuxTurrim5G+ and Neutral Host Pilot. These projects are funded by the partners and Business Finland. LuxTurrim5G+ focuses on the productization and practical piloting of the 5G smart pole concept

created by the ecosystem, while the Neutral Host Pilot creates a platform utilising data in a reliable and secured way and develops new digital services to meet real needs of cities.

Description of the progress in the area since 2017:

The activities in Finland have focused on defining and testing the main common enablers for traffic management, monitoring and information delivery and automation in transport. Many projects have been going on in good EU cooperation and are either belonging to CEF or to Horizon 2020 programs. The cross-border piloting of the needed platform and service functions, as well as business concepts, have been analysed further from the early experiences and services definitions. A lot of efforts focus on communication system development and testing and especially on 5G. The C-ITS development is also supporting the national interests on transport automation and in cooperative, connected and automated mobility. Table 2 summarizes the information about the included projects.

Table 2 Timetable, current status, coordinator, partners and total resources of the 5G projects

Project	Timetable	Coordinator	Finnish Partners	Resources
5G DRIVE	2018-2021	Eurescom	VTT, VEDIA	6.0 M€
5G SAFE	2017-2018	VTT (FI)	VTT, FMI Services, Destia, Kaltiot, SITO UNIKIE	2.0 M€
5G SAFE PLUS	2020-2023	Sitowise	Sitowise, FMI, VTT, Teconer, Unikie, InfoTripla, Destia, Vaisala	9.8 M€
5G MOBIX	2018-2021	Ertico	AALTO, Sensible 4	26.5 M€
5GVÄYLÄ	2019	Finnish Transport Infrastructure Agency		N/A
5G MOMENTUM	2017 -	The Finnish Transport and Communication Agency		N/A
LuxTurrim5G	2017-2019	Nokia Bell Labs	VTT, Aalto University, Tampere University, Exel Composites, Premix, Sitowise, Teleste, Vaisala, Inagon, Lammin Ikkuna, Ensto, Rumble Tools, Spinverse	26.0 M€

2.5 Other initiatives / highlights

2.5.1 Description of other national initiatives / highlights and projects not covered in priority areas 1-4:

Description of the relevant initiatives, their objective, timescale, milestones, resources, lead stakeholder(s) and status:

The new transport policy goals and development of *sustainable urban mobility plans* have defined new mobility strategies in many European cities. There are many reasons why a new paradigm of mobility is needed. The cities are facing the challenges of climate change, need for better quality of life, carbon free mobility and many other necessary improvements. There will be many new solutions to the urban mobility needs, supported by new technology-based innovations and also by automation. Recently many projects have been launched dealing with the problem of last/first mile. Finland has been actively involved in the projects of piloting and testing of autonomous shuttles as solutions of the last/first mile problem. The activities were started with CityMobil2 project and continued with national SOHJOA and ROBUST projects and in good EU cooperation e.g. in FABULOS and SHOW projects. Many other national projects are going on in this field and trying to solve the problems of mobility and the additional Nordic problem of operation in harsh weather conditions.

Main cities in Finland, cities of Helsinki, Tampere, Turku and Oulu, have their own transport strategies and development programs supporting the fulfilment of the national goals and activities. ITS and C-ITS is in deployment phase following the general EU strategy and ideas.

SOHJOA-project brought the first small electric bus piloting the services on the streets with normal traffic in Finland. The buses operated as innovative platforms for the companies producing intelligent products and services for the piloting. Self-driving last-mile electric buses were tested in several areas, in three areas in Helsinki, in Espoo and in Tampere during 2016-2018. The piloting related to the NordicWay project were performed in Helsinki in 2018. Many SME companies tested their ideas in the project. It launched a couple of promising start-ups that will develop further the piloted technology and systems.

Piloting was based on two EasyMile EZ10-vehicles fulfilling the US standard SAE J3016 and having all the necessary sensors and systems and operating on level 4 of automation. One of the main research results was that the technology of the busses in this early phase does not allow their operations in the normal traffic and requires further development and testing.

SOHJOA-project was supported with EU Structural Fund and the national 6Aika programme (see chapter 2.1.1 for more information on 6Aika). https://www.sohjoa.fi

SOHJOA BALTIC-project researches, promotes and pilots automated driverless minibuses as a part of the public transport chain, especially for the first/last mile connectivity. The project includes partners from Finland, Estonia, Sweden, Latvia, Germany, Norway, and Denmark, and it is testing minibuses in routes in six Baltic Sea Regions.

The project has been working with the technology testing but also in important fields of automation. It published in 2019 a European legal implementation roadmap providing an overview of the legal challenges that arise when implementing automated busses as a part of public transport. The report identifies the main bottlenecks and gives practical insight into the requirements.

Large pilots have been operated in five countries. SOHJOA-BALTIC project is funded by Interreg, European regional Development Fund, duration 2017-2020. It is coordinated by Metropolia University of Applied Sciences in Finland. https://www.sohjoabaltic.eu/

The national project *ROBUSTA* developed various topics related to automation in transport, mainly 1) Baseline understanding of remote operation, 2) Passenger experiences related to self-driving vehicles, 3) Remote operation system market potential, and 4) Vehicle automation and its impact.

The project gathered key insights of human factors in human computer interactions that need to be considered in the design of remote operation environments ending up baseline understanding and framework for design of robust and safe remote operation of autonomous busses.

The passenger experience was divided in three main phases: 1) before ride and getting into vehicle, 2) during the drive, and 3) egressing vehicle and after ride and taking the service quality in the focus. The results suggested that majority of actual travel experiences were positive, males more excited than females. Presence of driver seems to be a key issue for perception of safety. The travelling and waiting times were experienced as appropriate. The autonomous vehicles were defined as futuristic, aesthetic and innovative. The results suggest that remote operation requires not only robust system development but also other technologies especially 5G reducing latency in operation.

The *FABULOS* project seeks new solutions and technologies to prepare cities for future mobility, including self-driving buses. Novel transport solution is developed utilizing pre-commercial procurement allowing risk sharing and proper competition. The procurement has development phases from 0 to 3. Finally, in the phase 3 the best possible suppliers will be competing with their systems. After phase 3 there will be a commercial procurement with the suppliers.

FABULOS is now in the phase 3 when three chosen consortia are testing their technology and solutions, autonomous buses as a part of existing public transport systems and fleets of three buses each in Gjesdal, Helmond, Helsinki, Lamia and Tallinn in 2020.

FABULOS project is funded by EU Horizon 2020 research and innovation programme. The coordinator is Forum Virium Helsinki Oy, Finland. https://fabulos.eu

The City of Tampere is involved in the recently started *EU SHOW* project aiming at to support the migration paths towards affective and persuasive sustainable urban transport through technical solutions, business models and priority scenarios by deploying shared, connected and electrified fleets of autonomous vehicles. They will be also demand responsive, integrated with Mobility and Logistics as Service (MaaS/LaaS) and systems in real-life urban environments. The City of Tampere is one of the six satellite sites of the project. SHOW as a whole is supporting Tampere in piloting the last/first mile automation solutions required in the city transport system development and service offer to its citizens.

Tampere has two large demonstrations in the project: Hervanta suburb with several autonomous and electrified shuttles and Tampere Hospital Campus area where flexible autonomous pods will be operated. Tampere demonstrations of the SHOW project are funded partly by EU Horizon 2020 research and innovation programme and partly by the city. https://show.eu

Finest Smart Mobility project has been seeking dynamic and practical improvements and enablers to enhance the mobility and mobility planning, smooth integration of the different modalities and easy to use information of the public transport options and to prioritize sustainable transport mode choices.

The Finest Smart Mobility project included in 2018-2019 altogether 5 large pilots trying to solve the identified problems and set goals: 1) Just-in-time logistics for inbound heavy goods vehicles, based on truck parking at the ring-roads of the cities, 2) Smart and dynamic mobility management for outbound traffic, 3) Smart Park&Ride for ferry passengers with private cars to increase the use of public transport for the port entry/exit, 4) Smart traffic solution for transport chain from Estonia to the Helsinki Airport with the ferry connections, and 5) Tallinn ring-road feasibility study. It was estimated that the pilots would result in 5-10% less time spend in the city area by the heavy goods vehicles, 5% less private vehicles in the port area and reduced congestion and faster out-bound traffic by average 20 minutes/trip.

The project was a public-private partnership type of project involving port of Helsinki and Tallinn, cities of Helsinki, Tallinn and Vantaa, Road Administration in Estonia, Forum Virium Helsinki, ITL Digital Lab and many private companies working as an innovative ecosystem. Finest Smart Mobility project is co-funded by EU Interreg Central Baltic 2014-2020 programme. The project coordinator was Forum Virium Helsinki, Finland. www.finestsmartmobility.com.

Mobility as a Service is spreading to all developed countries in the world either as a strategic transport view or/and as a practical transport service concept. Today many new and large MaaS projects have been started in Europe and also e.g. in US. MaaS is supported and enabled by the various new technologies related to digitalisation and mobile applications let alone new internet and automation-based know-how.

Currently there is one significantly active MaaS operator, Maas Global, on the Finnish Market. Maas Global launched its fully commercial MaaS application “Whim” in 2017. In the spring of 2020 the service had over 115 000 registered users. Whim is today operational in Helsinki, Turku, Antwerp, Birmingham, Vienna, the Netherlands and is also piloting in Japan and Singapore. Whim is planning to expand to London and Zurich by the end of the 2020. The user is able to plan and pay for public transport, taxi, car rental, car sharing and city bike trips.

A review (https://ramboll.com/-/media/files/rfi/publications/Ramboll_whimpact-2019.pdf) in 2019 analysed how MaaS and Whim has succeeded in Helsinki region in Finland. The data suggests that public transport is the backbone of the user travel habits. MaaS supports multimodality and supports first/last mile mobility choices. As a whole the early results of the MaaS and Whim concept seem to be promising in many ways. While the prerequisites for rolling out successful MaaS services and combinations of travel chains are in place, the market has been somewhat slow to develop. According to operators, the reason the market has not evolved has to do with the challenging commercial terms in the market.

Kyyti Group Oy in Finland has started to develop a major *Smart Mobility Ecosystem* based on countrywide MaaS concept and its platform system. The innovative and cooperative ecosystem consists of various operators, business companies and public organisations. The project integrates value added mobility services, platform to combine rides in rural areas, urban mobility systems with smart tram ecosystem, autonomous vehicles and mobility services ecosystem and research alliance.

The Smart Mobility Ecosystem integrates the countrywide and local mobility services into a complete one mobility system. Kyyti Group Oy project is supported and financed by Business Finland the national development agency.

Corridor as a Service (CaaS) is a new and still developing approach and model for large logistics systems but at the same time including many elements as intelligent transport system supporting the delivery and procurement of products. In the CaaS approach main logistics corridors are tightly connected to logistics hubs by providing robust data and information sharing for the operating environment. CaaS has its roots in the corridor cooperation with Finland and Russia (e.g. FITSRUS and SCANWAY projects). The preliminary CaaS concept was defined in 2018 in Finland and is a PPP-collaboration.

Several projects have been launched related to the CaaS ecosystem. The bilateral cooperation in Intelligent Transport System development between Finland and Russia has continued with a project Smooth and digital cross-border transport between Finland and Russia as "Nordic Silk Way" in 2018-2019 coordinated by The Finnish Transport and Communications Agency. Later on, the goal with CaaS ecosystem was extended to include the development of main Europe-Asia logistic corridor with fluent, reliable and secure supply chain supported by advanced technology solutions and systems. The CaaS technology and platforms are developed in a separate project with the support of the development programmes of the Business Finland. https://www.businessfinland.fi/en/for-finnish-customers/home/

The City of Helsinki has during the last years focused on development of sustainable transport system and multimodal transport policy trusting more on public transport and new mobility modes reducing greenhouse gas emissions and car use with the support of digitalisation and new technologies. Helsinki has been the pioneer of Mobility as a Service (MaaS) deployment and is continuing its efforts to improve mobility with MaaS and cooperation also with Whim. Helsinki has decided to largen its tram network remarkably offering also increased housing development. This policy also requires supporting transport services development also the managing of first/last mile problem related to new mobility services and transport automation. Helsinki belongs to the 6Aika development programme (see chapter 2.1.1 for more information). Helsinki is also an implementing body in NordicWay 3 project (see chapter 2.4.1 for more information).

The City of Helsinki renewed its smart mobility plans introducing an Intelligent Transport System Plan in 2019 focusing during 2020-2030 in four areas: traffic information, traffic management, transport services and transport automation. The main actions include improvement of traffic information through multiple channels especially development of compiling of traffic data and real-time traffic monitoring, enhancing the impact of transport management and bring automation in to support the transport system services. However, the transport system development requires close cooperation in Helsinki Capital Region that has six municipalities.

Forum Virium is the City of Helsinki owned innovation company working together with authorities and companies driving the creation of digital city services and also development of intelligent transport services. The company has been involved in e.g. large EU projects and many national programmes as 6Aika programme (see chapter 2.1.1 for more information). Many projects have dealt with automation and searching solution to the fist/last mile problems e.g. SOHJOA and ROBUSTA projects. Forum Virium continues its smart mobility activities in several projects as Jätkäsaari Smart Mobility test area with

commercial mobility services projects, as a partner and coordinator in EU FABULOS project, intelligent city logistic projects e.g. utilisation of drones and autonomous delivery pilots.

The City of Tampere has a Smart Urban Plan for the development of all important urban functions. Tampere is cooperating with the Tampere Region and has deep cooperation e.g. in the regional public transport service offer. City of Tampere has developed open data services and provides the necessary data to all public and private service operators.

Tampere is actively involved in 6Aika development programme (see chapter 2.1.1 for more information), where the main cities in Finland work together for sustainable and intelligent mobility research, testing and deployment. Tampere has been one of the test sites for last/first mile solution analysis and supported the research on new open innovation platforms and solutions in city logistics. Of the C-ITS services in Tampere, GLOSA system (Green Light Optimized Speed Advisory) and CrossCycle have been in use for a few years. GLOSA system is based on cellular network and is used in about 20 intersections. CrossCycle is C-ITS -system for cyclists, providing traffic light priorities to cyclists. Tampere is also an implementing partner in NordicWay 3 project (see chapter 2.4.1 for more information).

The City of Tampere is a partner in the EU H2020 SHOW (SHared automation Operating models for Worldwide adoption) project and one of the satellite test-sites in the project. https://smarttampere.fi/verkostoidu/alykas-liikkuminen/

The City of Turku is keen on cooperation with national and international transport research and development projects and especially dealing with MaaS. In 2016-2020 the city has been working with the EU H2020 CIVITAS ECCENTRIC project. Turku has been responsible for coordinating the MaaS development in the project. One of the outputs has been the MaaS readiness model that Turku has been utilized as a basis of their development focusing on integrating public transport services. The first introduced service was city bike system in 2018. Later on, this Fölix system launched e.g. integrated ticket with the theatre shows. The Fölix service was enlarged in the Turku Region integrating also taxis and public transport in a seamless trip chain. https://civitas.eu/eccentric

The City of Turku has improved mobility service development by increasing the usage of traffic data, cooperation and piloting in its Smart and Wise top project. Turku is also actively involved in the 6Aika development programme (see chapter 2.1.1 for more information). The city is developing innovative and customer-based charging systems for electric vehicles, system cooperation and user interests and acceptance as a participant in the EU H2020 project USER-CHI in 2020-2024. https://www.elektroauto.community/forums/topic/3175-european-project-user-chi/

The City of Oulu is a city with an active Oulu University and innovative cooperation with local companies coordinated by Business Oulu, a public utility implementing the city´s industry and employment policies. The city will develop intelligent transport systems with a sustainable transport framework. Oulu Automotive Cluster coordinated by Business Oulu includes almost 50 local companies working together. Oulu is part of the 6Aika development programme (see chapter 2.1.1 for more information).

Recently smart traffic signals have been launched favouring pedestrians and cyclists, real-time maintenance monitoring system and mobile system able to monitor the winter conditions on the cycle

tracks. New innovations related to truck platooning has been researched. The results indicate that this platooning system may have a positive effect on transport costs and truck drivers seem to have also a positive attitude on the system.

2.5.2 Progress since 2017

Description of the progress in the area since 2017:

During the recent years there has been clearly three focus areas in the development activities in Finland. Many projects have supported the development of C-ITS systems and finally also services that can either be public or private ones. The new data processes and system architectures with relevant business models make it possible to launch the Day 1 and Day 1.5 C-ITS services directed to better safety and smooth and efficient traffic flows.

A lot of development efforts have focused in C-ITS system development based on new 5G innovations aiming at new digitized services and development of digitized infrastructure capable of modifying and reducing investment and operation costs. The problems in latency requirements in C-ITS services seem to be solved, supporting also the development automation and remote operations that is one of the major research areas in Finland.

Urban mobility is also one of the key researches and development directions. Major cities invest substantially in smart and sustainable urban transport system development. Since 2017 several MaaS projects have been launched covering also the needs for countryside travel and reaching of the necessary services there with smart business models and PPP. Special interest on urban mobility development has been devoted to find a reasonable solution to the last/first mile problem with automated shuttles and pods.

3 Key Performance Indicators (KPIs)

Note: ***The EC document on "ITS KPIs for the EU" is to be used for comprehensive definitions of the KPIs and further guidance. The EU EIP Activity 5 report on "ITS Deployment and Benefit KPIs definitions" is a complementary document providing in particular estimation methods.***

KPI will be reported separately by type of road network / priority zone / transport network and nodes (when appropriate).

The deployment KPIs are calculated for the TEN-T road network with the length of 5195 km. [3]

The values used and their sources are described in the table below.

As the benefits of the services cannot be directly measured, they have to be estimated. The benefits calculations for road transport regarding change of travel time, injury accidents and emissions are based on estimates by Risto Kulmala made for the projects NEXT-ITS and NEXT-ITS2. The travel time benefit calculations for public transport are based on a national travel survey[1] and a report[2] on a journey planner for the region of Helsinki.

	Length (km)	Vehicle km travelled (million / year)	Veh. hours driven (million/year)	injury accidents (average 2014 – 2018)	CO_2 emissions (million tonnes/year)
TEN-T network	5195[3]	16628[4]	173.767[4]	697[4]	4117.042[5]
Information gathering: road weather and traffic volume	5195[6]				
Information gathering: travel time	150[7]				
Traffic management and control measures	592[8]				
Cooperative ITS services and applications	*5195*[9]				

Real time traffic information	5195[6]				
Dynamic travel information	178[10]				

[1] National Travel Survey 2010–2011. Finnish Transport Agency, Transport Planning. Helsinki 2012.

[2] Laine, T., Pesonen, H., Moilanen, P. (2003). An assessment of the effects and cost-effectiveness of a public transport journey planner. FITS publications 22/2003, Ministry of Transport and Communications.

[3] Peltola, H. & Innamaa, S. (2020). TEN-tieverkon turvallisuustilanne Suomessa 2019 [Safety of TEN road network in Finland 2019]. Väylävirasto publications 6/2020.

[4] Estimated based on "Väylävirasto publications 6/2020" data.

[5] On average 247.6 g/km in 2019. The value is estimated based on NEXT-ITS2 values for 2012 and 2015.

[6] The traffic situation service covers all main roads

[7] Antola, P. Experiences from the procurement of travel time information service. 17.8.2018.

- Network length covers only TEN-T roads.

[8] Matti Huju (Traficon Ltd) 2020

[9] In May 2020, the three pilot deployments of NordicWay 2 cover all of the TEN-T road network

[10] Estimation of TEN-T network containing local bus traffic (Matti Huju, Traficon Ltd)

3.1 Deployment KPIs

3.1.1 Information gathering infrastructures / equipment (road KPI)

Figures to be provided by type of network / zone.

Figures to distinguish fixed and mobile equipment.

KPI to be calculated by type of network / zone (when relevant).

- Length of road network type / road sections (in km) equipped with information gathering infrastructures & Total length of this same road network type (in km):
- KPI = (kilometres of road network type equipped with information gathering infrastructures / total kilometres of same road network type) x 100

For road weather and traffic volume services: KPI = 100

KPI for road weather and traffic volume services was 100 already in previous 2017 progress report. However, the quality of data has improved since then because many older measurement stations have been replaced by newer models.

For travel time services: KPI = 150/5195*100 = 3

Travel time information is currently acquired as a service and is based on floating car data (FCD) technology. Travel time services KPI is lower compared to 2017 because the FCD based service has not been implemented in such large scale as previously planned. The procurement options were not used as it was seen that there is for now no need for the service outside Helsinki region main roads.

3.1.2 Incident detection (road KPI)

- Length of road network type / road sections (in km) equipped with ITS to detect incident & Total length of this same road network type (in km):
- KPI = (kilometres of road network type equipped with ITS to detect incident / total kilometres of same road network type) x 100

For manual incident detection: KPI = 100

For all TEN roads (except for critical sections such as tunnels), the EasyWay service quality requirement is to detect incidents within either 15 (sections of safety or flow concerns) or 30 minutes of their occurrence. This is implemented manually via road users or manually/automatically by police/rescue authority reports.

Automated incident detection has mostly been deployed in tunnels in Finland, complying with the service level objectives agreed by EasyWay for Europe. It is deployed on 8.3 km of tunnels (the total length of road tunnels in Finland is about 13.7 km). In addition, an automatic incident detection is used on 1 km open road section on E18.

3.1.3 Traffic management and traffic control measures (road KPI)

- Length of road network type / road sections (in km) covered by traffic management and traffic control measures & Total length of this same road network type (in km):
- KPI = (kilometres of road network type covered by traffic management and traffic control measures / total kilometres of same road network type) x 100

KPI = 592/5195*100 = 11

592 km is the length of Finnish TEN-T road network equipped with variable speed limits and / or variable message signs. The KPI is slightly lower compared to 2017 situation as some older traffic control systems have been decommissioned. The decommissioning was done because the service level preconditions for replacement investments were not fulfilled.

3.1.4 Cooperative-ITS services and applications (road KPI)

- Length of road network type / road sections (in km) covered by C-ITS services or applications & Total length of this same road network type (in km):
- KPI = (kilometres of road network type covered by C-ITS services or applications / total kilometres of same road network type) x 100

KPI = 5195/5195*100 = 100

In May 2020, the three pilot deployments of NordicWay 2 cover all of the TEN-T road network with a C-Roads hybrid service utilizing the cellular network and specific NordicWay interchange nodes. However, the number of users was still quite modest, 3600 active users / month.

3.1.5 Real-time traffic information (road KPI)

- Length of road network type / road sections (in km) with provision of real-time traffic information services & Total length of this same road network type (in km):
- KPI = (kilometres of road network type with provision of real-time traffic information services / total kilometres of same road network type) x 100

KPI = 5195/5195*100 = 100

Real-time traffic information KPI was 100 already in previous 2017 progress report. However, nowadays the traffic information is more comprehensive and more accurate.

3.1.6 Dynamic travel information (multimodal KPI)

- Length of transport network type (in km) with provision of dynamic travel information services & Total length of this same transport network type (in km):
- KPI = (kilometres of transport network type with provision of dynamic travel information services / total kilometres of same transport network type) x 100

Comprehensive dynamic travel information including both long-distance and local bus transport is not currently available from Finnish TEN-T road network. However, many urban regions provide real-time travel information for their local transport network which contains routes on TEN-T roads. Some long-distance bus operators may provide dynamic travel information for their own services.

For TEN-T rail network comprehensive dynamic travel information is available for whole network.

KPI = 178/5195*100 = 3

KPI is calculated based on the estimated length of TEN-T road network whereof dynamic travel information about local bus traffic is available through Digitransit platform (8 urban areas).

3.1.7 Freight information (multimodal if possible or road KPI)

There are no specific information services by road authorities for the freight/logistics sector. The generic information services offered in the internet, mobile applications and roadside VMSs are also used by freight operators.

3.1.8 112 eCalls (road KPI)

N.a. – will be provided through the COCOM 112 questionnaire

3.2 Benefits KPIs

3.2.1 Change in travel time (road KPI)

Figures to be provided also include vehicle.km for the route / area considered

KPI = ((travel time before ITS implementation or improvement – travel time after ITS implementation or improvement) / travel time before ITS implementation or improvement) x 100

ITS measures deployed and mostly supported by TENT-T and CEF programmes (VIKING, EasyWay, NEXT-ITS…) reduced travel times on the TEN-T network and its most important national links by 2.1 million vehicle hours in 2019. The corresponding vehicle kilometrage were 22 860 million vehicle km.

KPI = ((travel time before ITS implementation or improvement – travel time after ITS implementation or improvement) / travel time before ITS implementation or improvement) x 100

KPI (TEN) = 0.9%

In the greater Helsinki area with 4.7 million journeys on a working day with average length of 7.9 km or 24 minutes, 8.8% of the journeys are made by bus. The daily person kilometrage by bus is about 3-million-person km. The multimodal journey planner has resulted in decrease of journey times for 25% of its users, and the reduction has on average been about 6 minutes. For all public transport users, this means 0,45-minute reduction per journey or 1.9%

KPI (PT) = 1.9%

3.2.2 Change in road accident resulting in death or injuries numbers (road KPI)

Results shall be provided / aggregated at national level to be representative enough. If possible, distinction can be made between accidents resulting in deaths, serious injuries or slight injuries.

Figures to be provided also include vehicle.km for the route / area considered.

- Number of road accident resulting in death or injuries before ITS implementation or improvement:

KPI = ((number of road accident resulting in death or injuries before ITS implementation or improvement – number of road accident resulting in death or injuries after ITS implementation or improvement) / number of road accident resulting in death or injuries before ITS implementation or improvement) x 100

ITS measures deployed and mostly supported by TENT-T and CEF programmes (VIKING, EasyWay, NEXT-ITS…) reduced accidents resulting in death or injury on the TEN-T network and its most important national links by 86 (-13.2%) in 2019. The corresponding vehicle kilometrage were 22 860 million vehicle km. In total, there were 652 such accidents on the network.

KPI (TEN) = 13.2%

On the road network of Lapland, with length of 7 857 km and 2 152 vehicle km, the Porokello reindeer warning service has reduced the number of motor vehicle collisions with reindeer. Before the service, there were on average more than 3 400 such collisions annually. The ITS service has reduced these by about 260 annually or 7.5%. Typically, these collisions do not result in human fatalities nor injuries.

KPI (Reindeer) = 7.5%

Signal priorities have been implemented for more than 500 intersections and more than 400 emergency vehicles in medium- and large-size cities. These have resulted in the reduction of 3.4 injury accidents involving emergency vehicles at signalised intersections, i.e. an 80% reduction.

As no other studies provide other results of the safety impact of this ITS use case transferable to Finnish conditions, this needs to be used as the KPI

KPI (Emergency vehicles at signals) = 80%

3.2.3 Change in traffic-CO_2 emissions (road KPI)

Routes / areas where ITS has been implemented or improved should be specified. Length along / area within which the change in CO_2 emissions is calculated should be long / wide enough to be representative.

KPI = ((traffic CO_2 emissions before ITS implementation or improvement – traffic CO_2 emissions after implementation or improvement) / traffic CO_2 emissions before ITS implementation or improvement) x 100

ITS measures deployed and mostly supported by TENT-T and CEF programmes (VIKING, EasyWay, NEXT-ITS…) reduced CO_2 emissions on the TEN-T network and its most important national links by 39 000 tonnes (-0.8%) in 2019. The corresponding vehicle kilometrage were 22 860 million vehicle km. In total, 4.8 million tonnes of CO_2 were emitted by road transport on the network.

KPI = 0.8%

3.3 Financial KPIs

ITS includes any types of systems and services altogether.

Annual investment in road ITS (as a % of total transport infrastructure investments):

The annual investment into renewal and development of road management systems on the TEN-T is approximately 3.5 M€ annually.

The amount of road investments on the TEN-T road network was 185 million euros (2019), **hence the KPI is 2 %.**

Annual operating & maintenance costs of road ITS (in euros per kilometre of network covered):

The annual maintenance costs of road ITS systems is approximately 2.5 million euros on the TEN-T network. In addition, the life-cycle management costs of TEN-T roadside equipment is 0.5 million euros annually.

The costs for the development and maintenance of ITS services is 0.5 M€ on TEN-T network annually.

The costs for the TMC operations are 4 million euros annually for the whole national operation. It is not possible to separate the operational costs for different parts of the national road network accurately.

The KPI calculated for the TEN-T road network (5 195 km) is hence 1 444 euros/km.

The above mentioned investment and maintenance costs exclude the costs for HVAC-systems, tunnel safety systems, electricity, tunnel lightning and traffic lights.