2020

Barents ITS report

Current and existing ITS status and suggestions for ITS pilots in the Barents Region

Nordland FYLKESKOMMUNE

Troms og Finnmark fylkeskommune
Romssa ja Finnmárkku fylkkagielda
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Barents ITS - current and existing ITS status and suggestions for ITS pilots in the Barents Region

Executive summary

Within the Barents Region, by comparison with other parts of the world, infrastructure has a different meaning. Real-time accessibility and safety for public transport and commercial industry are critical.

The low traffic volumes, vast distances, often difficult terrain and highly variable environmental conditions make it challenging to find cost-effective solutions which enable growth. This is especially valid in a cross-border context, where there are multiple jurisdictions.

However, the extreme climate and terrain which influence accessibility also mean that the Region's transport system is a perfect arena for large-scale testing of emerging mobility concepts. These include, amongst others, Cooperative Intelligent Transport Systems (C-ITS), Mobility as a Service (MaaS) and digital condition-monitoring of infrastructure.

Developments in data and data platforms will be important premises for the establishment of services related to cross-border transport management. Going forward, investments in the areas of data and transport management should be a focus for the Barents Regional Transport and Logistic (BRTL) working group and Barents Euro-Arctic Transport Area (BEATA). The investments would benefit all road owners and especially those in remote areas. Also, it would make the region attractive to vehicle OEMs for testing of advanced driver support or automated solutions.

This report lists possible pilots and project that might serve as demonstrations for cross-border ITS operations. Each of the pilots addresses some of the natural barriers that characterize the region, the anticipated increases in traffic volumes and the organizational/cultural barriers.

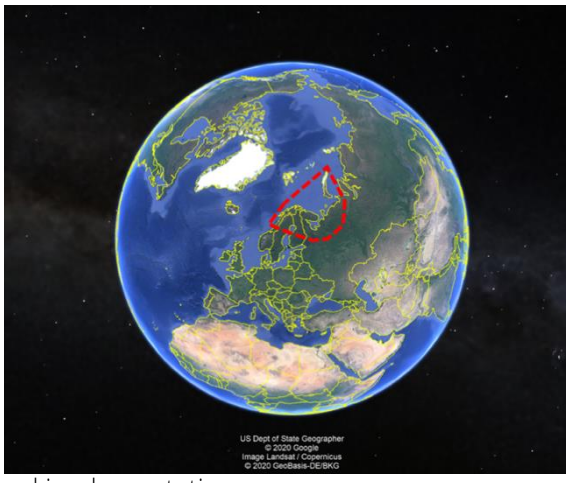
Implementation of the suggested pilots according to the ITS Directive in this challenging geographic location, especially given its multiple cross-border considerations, would move the Barents Region to the leading edge of ITS development in Europe.

In this respect, challenges include that the Region is too small from the traffic volumes and infrastructure user perspectives, and it has fragmented environments and areas. If the Barents Region wants to make best use of various ITS and mobility solutions, cross-border and cross-sectoral solutions must be addressed. ITS Norway also proposes increased use of piloting to give tangible results — to set KPIs and create strategic plans that are part of the BEATA strategy that are addressed at the political level, and which enable us to move ahead and get results.

Implementing ITS and smart mobility thinking in the Barents Region overall is also of great benefit to national and regional transport planning. Improvements in knowledge, innovation and use of solutions will be universal.

This report starts by setting out scope, primary goals and assignments. It then describes cross-border opportunities and concrete actions to follow up. It serves as a single point of reference and contact for ITS/mobility activities in the Barents Region.

1. Introduction and assignment



This report provides a status update of the current and planned use of Intelligent Transport System (ITS) measures and pilots for road transport in the Barents Region. It focuses in particular on ITS projects which can provide cross-border opportunities and value transfer.

The report will provide oversight and serve as a knowledge base for further development of safe, sustainable, smart mobility in the Barents Region. It will highlight important issues as well as the outcomes of current ITS measures and planned implementations.

The report is a part of the on-going Kolartic Program, the Barents Region Transport and Logistics (KO1029 – BRTL) project, and the Barents Regional Working Group for Transport and Logistics (BRWGTL). It will serve as help to the Norwegian Barents Euro-Arctic Transport Area (BEATA) presidency — Norway oversees the Steering Committee (BEATA) until autumn 2021. Together with the input from the revised Joint Barents Transport Plan 2019 (JBTP), the report serves as a good reference source for ongoing transport projects in the region.

The report lists ITS measures mainly from the Barents Region but also includes inspirational projects from other regions.
The report will also:

- Highlight barriers related to infrastructure, communication, border crossings, regulation, procurement, etc. that need to be addressed before implementing new ITS pilots
- Reflect coming mandatory standards and regulations that influence new pilots and projects. For example, the EU ITS Directive imposes requirements for both collection and distribution of mobility-related data through the use of National Access Points (NAPs). Meanwhile, new standards for Cooperative ITS (C-ITS) provide an implementation framework for the next generation of traffic management and communication between all relevant stakeholders.

The report will suggest ITS pilots and development projects for the Barents Region.

Based on the overview and the survey, this report concludes that there are enough reasons to propose several cross-border projects. The report includes outlines for projects as well as examples of potential use cases.

2. Relevant ITS pilots in the Region

Intelligent Transport System (ITS) refers to efforts that apply information, communication and sensor technologies to vehicles and transportation infrastructure. ITS provide real-time information to transportation system operators and road users, enabling them to make better decisions. The main goals of ITS are to increase safety, reduce emissions and reduce congestion.

ITS have their roots in the understanding that the application of technology can smooth traffic flows, increasing road networks' safety and capacity.

Monitoring and control technologies started to be implemented and used more widely by roads administrations in the 1990s. At about the same time, Advanced Driver Assistance Systems (ADAS) and navigational solutions which used the Global Navigation Satellite System (GNSS)-based Global Positioning System (GPS) started to emerge. ITS provide those who operate and maintain roads with information which enables better-informed decisions.

This report provides a comprehensive list of the state of the art of ITS deployments and plans in the Barents Region. There is little evidence of large-scale cross-border deployments of ITS solutions in the region. Therefore, this report concentrates on implementations in each of the countries.

It provides an overview of the current deployments and plans for ITS solutions and projects. There are many ITS-related activities going on in each country — even just in the Barents Region — that it is impossible to assess all. ITS is not yet a household name, but still, per definition, it is close to being a ubiquitous technology found in everything from vehicle safety systems to automated docking of ferries.

In addition to this report the Kolartic Program has funded two other reports in the Barents Region, Green Transport and World Transport Market Logistic Report. These two reports in addition to the Barents ITS report will strengthen the Joint Barents Transport Plan and support the goals and targets for the region.

The assessment is listed in two sections: first, a short description of Traffic Management Centers (TMCs); and second the list of relevant ITS pilots in each country.
It is to be noted that it is very difficult to assess a pilot and its outcome, experience and further plans if information about it had not been received at the time of this report's writing.

2.1 Traffic Management Centers

The Traffic Management Centers (TMCs) in each country in the Barents Region have been in operation for many years. The TMCs do not have close technical or organizational cooperation. They focus on the road users in their own countries and use domestic communication infrastructures. The TMC services are at best complementary and slightly overlapping in the border areas, where they use the RDS-TMC communications protocol. For the road user, this is not an optimal situation.

Most of the TMCs operate under the same EU Directives and requirements and should provide users with the same levels of service and in the same ways no matter where the users are. There is an ongoing effort to fix this by harmonizing systems, operations and the message codes used by Norway, Sweden and Finland. Currently, there are plans to align the code structure between Norway and Sweden.

Closer cooperation between the TMCs at all levels will be beneficial to all ITS deployments in the Barents Region. Harmonization of the vast communication infrastructure would provide a strong base for almost any new ITS deployment and in many respects, this is already underway or about to happen; the current technology used in the TMC networks will gradually adopt the new and emerging standards for Cooperative ITS (C-ITS). The TMCs, hold sizeable unused potential for cross-border ITS in the region.

2.2 Status of national ITS projects and deployments

This section lists relevant national ITS projects and implementations in each country. Combined, they reflect the ITS situation in the region. There are very few services or systems that are genuinely cross-border.

Some of the listed projects and deployments are a few years old, but their results are still valid and worth revisiting. A lot of resources and time have been invested in these projects. Instead of creating everything from scratch, building on these past projects might serve as a good starting point for new cross-border initiatives.

Most of the listed projects are ongoing and will serve as a live resource bank for new initiatives and further work.

Norway

The largest ITS pilots in recent years have been the Aurora and Borealis projects on the E8 between Finland and Norway. These projects encompass most of the current Cooperative ITS (C-ITS) concepts — especially ITS for vulnerable infrastructure. The E8 site has the potential to become a sizeable inter-Nordic test arena where everything from border control, autonomous driving, location issues and C-ITS to data exchange and Mobility as a Service (MaaS) operations can be tested. Most of the test cases of this type are scalable and easy to port to other sites, and all of them will give valuable input for developing ITS strategies and suggestions for further work.

The Borealis E8 site is a 46 km stretch of road from Skibotn in Norway to Kilpisjärvi in Finland. It is where the Norwegian Public Roads Administration (NPRA) tests ITS technology. The NPRA has during the 2017-2019 period tested real-time information gathering about the weather, road surface conditions and traffic incidents, and providing warnings of wildlife or obstacles on the road. The pilot continues in 2020.

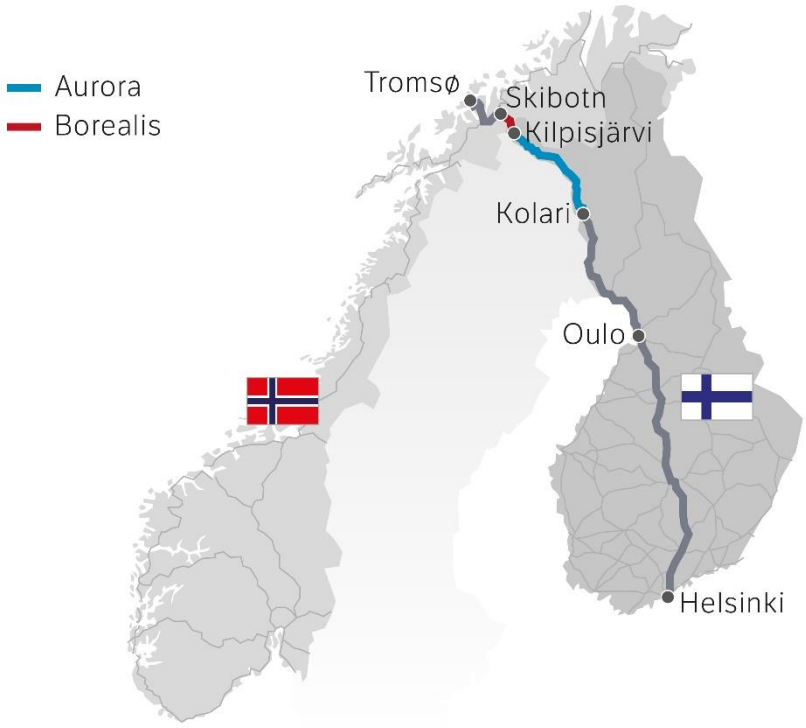


Figure 1© NPRA

It has been a success in gathering a range of stakeholders from both the private and public sectors, and synergies have been achieved for the participants — whether they want to test/develop methods for data collection or technologies to distribute data between users, or try out different services based on collected and shared data. More cooperation over, new ideas and projects even among competitors has also been a positive outcome of Borealis E8.

Goals for the E8 include to provide more robust and predictable conditions for commercial transport and to serve the increasing levels of cross-border tourism and commercial transport in the region. The NPRA wants the E8 to be an open test laboratory which contributes to increased value creation in technology and services related to ITS in general, and to C-ITS in particular. The test laboratory is open to anyone who wishes to contribute to innovation in the transport sector with cross-border implications. This includes domestic and international companies, other interest groups, research institutions and the public.

In general, for the Barents Region, the E8 stretch is an important testing arena for future transport management. Harsh conditions, including the absence of power and communications at some points along its length, make it ideal for piloting solutions for more predictable transport handling.

Borealis E8 Triona and Euroskilt – Piloted in 2019

Participating companies linked smart electronic signs to host ITS stations and sensors. The systems they piloted:

- Obtain data from sensors connected directly to the sign
- Exchange information with external data sources and systems
- Present information to road users in the form of pictograms

The solution provided road users with real-time information about weather, driving conditions and road closures. The aims of the project were to detect stopped vehicles, reduce downtime on the road network, and provide early event notification.

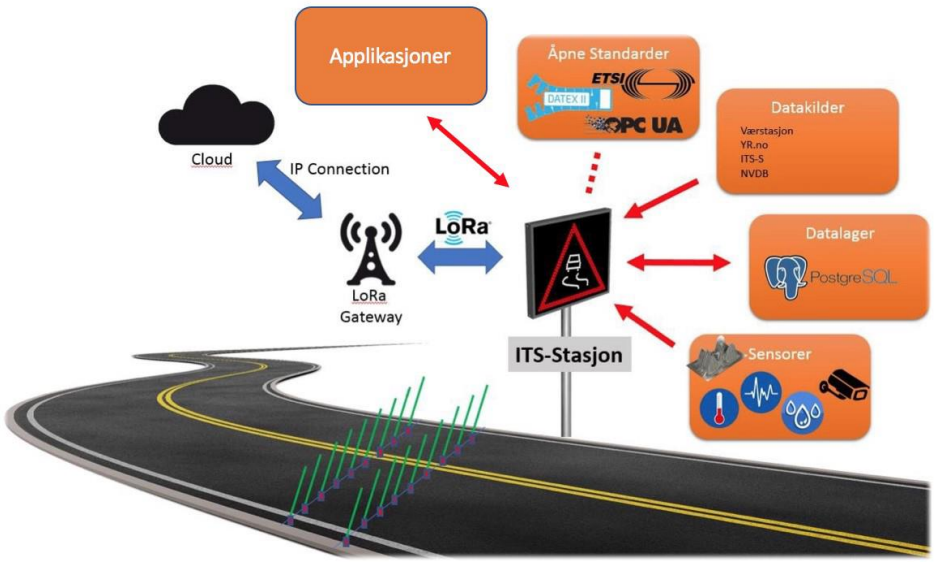


Figure 2 ©NPRA

Borealis E8 Aventi – piloted in 2019

Aventi tested the use of C-ITS, hybrid communication and its pilot autonomous systems for driving on challenging stretches. The project used an EU-standard communication platform dedicated to ITS. The solution also tested hybrid solutions that seamlessly switch between different communications technologies.

Figure 3 © Bjørn Elnes E8-Borealis, Gardeborgbakken in Skibotndalen

Borealis E8 ITS Perception– piloted in 2019

ITS Perception delivers a system for long-distance detection of objects in the roadway. LIDAR sensor technology combined with a smart presentation system will give road authorities new opportunities to monitor particularly vulnerable road sections and possibly alert other road users in the vicinity. Using artificial intelligence, the system can learn and constantly improve recognition of various objects such as vehicles, animals and soft vulnerable road users.

Borealis E8 Q-Free – piloted in 2019

Q-Free piloted the use of small in-road sensors for the continuous monitoring of particularly challenging sections of road. The sensors are milled into the road surface and notify the transport authority of abnormal events (slowing or stationary traffic). The technology monitors driving and weather conditions. For example, low speeds may indicate difficult driving conditions and/or low road surface friction. The alerts provided can enable road authorities to act before dangerous situations arise or develop further.

Borealis E8 Bouvet - piloted in 2019
This digital system from Bouvet helps heavy traffic on local roads to avoid potentially dangerous meeting situations. The project uses elements of machine learning, the Internet of Things (IoT) and cloud computing to optimize results.

An example is heavy transport meeting on narrow bridges or in one-way tunnels where there is not the opportunity to pass each other. This leads to traffic being stopped in both directions. Situations like this can lead to dangerous situations, major delays and accidents.

A speed tuning system shall, via a voice app, provide speed advice to converging vehicles on routes with problem sections. This form of controlled traffic flow through a bottleneck is often called Takting.

Figure 4 ©NPRA

Borealis E8 Norce - piloted in 2019
The Norce, Norwegian research center, has had two pilots on the E8.

The first tested installations of fiber-optic acoustic cable at two locations along the E8. In particular, the effects of installation methods on long-term measurement sensitivity and service life were studied.

A variety of traffic flow parameters were measured, including count and speed, stopped vehicles and queueing.
A second looked at how to facilitate

- Collection of data from road authorities, emergency agencies and road users/ the public
- Rapid flow of information between the various stakeholders
- 3D visualization of the situation in real time

The purpose is to enable the NPRA and the emergency services to improve their service to road users before and during unforeseen events.

Borealis E8 PSI-Group - piloted in 2019
The travel time prediction on road sections pilot from PSI Group will give commercial organisations greater predictability, enabling production and transport to be planned with higher precision and efficiency. By considering both weather forecasts and winter operations, more precise travel time forecasts with longer time horizons can be achieved.

Figure 5 ©NPRA

BITS (Båtsfjord intelligente transportsystems) from Troms and Finnmark County
These solution uses GPS data and real-time information about weather, snow clearing and other road conditions. Mobile phones will send positional information and collect data about road conditions. Artificial intelligence will improve the analysis of the images and data. Road users are given access to accurate, timely information about road conditions.

Finland

Aurora E8 2017-2019
On the other side of the Norwegian border and continuing on the E8, the Aurora intelligent road is operated by the Finnish Transport Agency (FTA). This 10 km intelligent road section was set up for testing Automated Vehicles (AVs) and their related technologies in challenging road and weather conditions. The test section, which was opened in November 2017, has been fully developed and provided with power and data connections.

Arctic Challenge 2017-2019
The aim of the Arctic Challenge project was to study automated driving in snowy and icy conditions. The project studied four areas in Arctic conditions:

- Posts and poles for guidance and positioning
- C-ITS
- Remote control and wireless data transfer in good and poor weather conditions
- Location data and positioning

WIRMA 2018-2020
The objective of the WIRMA project was to design, implement and test an IoT system for winter road maintenance in the north. The long-term vision was to overcome winter maintenance challenges using modern digital solutions — specifically, by providing more data, information and knowledge to the road maintenance and ITS domain with a focus on vehicle-based data and vehicle-mounted sensors.
Porokelloapp 2018 – ongoing-

Via the Porokello website or the free Porokello app for mobile phones or GPS systems, travellers are provided with with reindeer alerts. The alerts are valid for half an hour, within a 750 m radius.

Lapin Reittiopas — Open Arctic MaaS
This service aims to combine different transportation modes and show different travel options for locals and tourists. Lapin Reittiopas is a door-to-door trip planner for people using public transportation and it is offered by Finland's VTT Technical Research Centre.

The Lapin Reittiopas trip planner covers the local traffic in northern Finland (ski bus, railway station bus, airport bus) and traffic found from the opas.matka.fi service provided by the Finnish Transport Agency (rail, domestic air, rural and urban bus). There is no pricing information included in the service at this point.

Figure 6 © NPRA

ALASCA 2017-2018
The objective of the Automated Road Monitoring Pilot Using 2D Laser Scanning (ALASCA) regional pilot project was to develop and test a laser scanning unit that would enable crowd-sourced data collection from roads, especially by using large goods vehicles equipped with 2D laser scanning units. The idea was to create new solutions for road monitoring, especially for quickly changing winter conditions.

Nordic Silk Way 2019
This project was commissioned by the Finnish Transport Safety Agency (Trafi). The aim was to develop cross-border digital services, in particular to support smoother cross-border cooperation among companies in the logistics sector. The focus areas include automation, intelligent infrastructure and more efficient goods transport.

Sweden

Drive Sweden 2017-2018
This project developed a cloud-based traffic control platform that enables smooth and seamless information exchange between coordinators of emergency and automated vehicles.

Drive Sweden 2020-2021
The purpose of the project is to investigate the conditions under which self-driving vehicles can offer more attractive public transport in the countryside and thus contribute to a transition to a sustainable transport system.

Drive Sweden with Västerbotten region 2020
This project addresses future transport systems for sparsely populated areas in the form of transport services operated by autonomous, electric and on demand-controlled vehicles and drones.

The project is based on an ongoing project, Tomorrow's Letter Pigeons, which is developing a drone-based solution which supports good-quality healthcare at a distance

Interreg Sweden-Norway program
The overall aim of this program is, through cross-border cooperation, to create the best conditions for an economically strong region with an attractive living environment. It will tackle common challenges identified in the border region and utilize unused potential. By the removal of border barriers and making use of the border regions collective resources, better cross-border regional connections will be established.

The programme has the following priorities for 2014-2020:

- Innovative environments
- Small and medium-sized enterprises
- Natural and cultural heritage
- Sustainable transportation
- Employment

Russia

ERA-GLONASS is the Russian equivalent of eCall and was went into operation on 1 January 2017. Russian ERA-GLONASS and EU's eCall have similar functionalities and thus are forming a common road safety space throughout Russia and EU Member States. For the Barents Region this has a huge impact on road safety and communication. Cooperation on exchanging information of emergency calls at the cross-border level is essential.

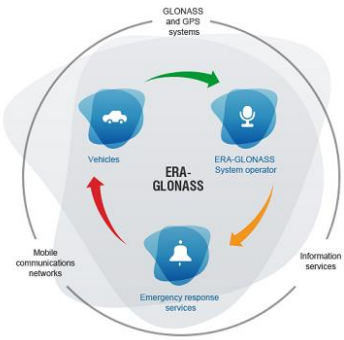


Figure 7 ©Everything RF

Table 1: ITS projects and pilots

Norway

ITS Projects	What	Owner	Time frame
Borealis E8	46km road from Skibotn-Kilpisjärvi		2017-2019
Borealis E8 Smart signs	Smart electronic signs hosting information from ITS stations and sensors	Triona/Euroskilt	November 2019
Borealis E8 C-ITS and hybrid communication	Autonomous systems for driving on challenging stretches	Aventi	November 2019
Borealis E8	Using LIDAR sensors for long-distance detection of objects in the roadway.	ITS Perception	November 2019
Borealis E8	Small sensors in the road for continuous monitoring of particularly challenging routes.	Q-Free	November 2019
Borealis E8 /Skervøy	Digital system to help the heavy vehicles in rural areas to avoid potentially dangerous meeting situations. The project uses elements of machine learning, IoT and cloud solutions	Bouvet	November 2019
Borealis E8	Platooning Read more here in Norwegian	Scania / Ahola	May 2018
Borealis E8	Development of a system based on acoustic fiber for registration of traffic incidents.	NORCE	November 2019
Borealis E8	Situational understanding of unforeseen events	NORCE	November 2019
Borealis E8	Travel time prediction on road sections	PSI -Group	November 2019
Båtsfjord intelligente transportsystemer	Develop platform for data dissemination	Troms og Finnmark fylkeskommune	2019

Finland

ITS Projects	What	Owner	Time frame
E8 Aurora	Improve traffic safety and the reliability of freight movements on Main Road 21 Kolari-Kilpisjärvi	Vayla	2018-2019
Vayla – Finnish Transport Infrastructure Agency	Road transport automation in snowy and icy conditions	Arctic Challenge	2019
WIRMA	Industrial IoT for winter road maintenance	Wirma Final Report	2018-2020

Reindeer Warning Bell	Spotting and warning of reindeers on roads	https://porokello.fi/	2018 -
Open Arctic MaaS	Advance mobility services for local people and tourism	https://www.arcticmaas.fi/	Ongoing
2D Laser scanner in automated road monitoring	Automated road monitoring pilot using 2D laser scanning	ALASCA	2018
Nordic Silk Way	Smoother, digitized cross-border movements between Finland and Russia	Finland Russia	2019

Sweden

ITS Projects	What	Owner	Time frame
Drive Sweden	Develop a cloud-based traffic control platform that enables smooth and seamless information exchange between coordinators of emergency vehicles and automated vehicles.	https://www.drivesweden.net/en/projects/ad-aware-traffic-control-emergency-vehicles	2017-2018
Drive Sweden	Autonomous countryside	https://www.drivesweden.net/en/projects-5/autonomous-countryside	2020-2021
Drive Sweden	Smart Rural Transport Services	https://www.drivesweden.net/en/projects-5/smart-rural-transport-services	2020
Interreg Sweden-Norway		http://www.interreg-sverige-norge.com/planera/malet-med-programmet/insatsomraden/insatsomrade-hallbara-transporter/	On-going

Russia

ITS Projects	What	Owner	Time frame
Cross Border	Smoother, digitized cross-border movements between Finland and Russia	Finnish Transport and Communications Agency	

Relevant Nordic projects

ITS Projects	What	Owner	Time frame
Patterød-krysset E6	Using C-ITS for detecting traffic congestion and wrong way drivers and comparing this to conventional ITS technology. In addition, NKOM is monitoring the radio frequency spectrums for disturbances and anomalies both for C-ITS and GNSS.	NPRA	2020
NOMAD	The NOMAD project (Nordic Open Mobility and Digitalization) was started in 2019, partly financed by Nordic Innovation. The project aims to facilitate seamless mobility across the Nordics using several modes of transportation. Piloting pan-Nordic MaaS applications and thereby unlock the ability for an individual to plan and pay for a multimodal journey using a single mobile application. Present MaaS operations remain anchored to a single metropolitan region and their respective transportation networks.	http://nomadmobility.org/ ITS- Nordics (The ITS-organisations in the Nordics) Kyyti Group Oy in close cooperation with UbiGo, Rise and TØI	2019-2021
ODIN	Accelerate and coordinate the work necessary to create a unified market within the mobility sector in the Nordics	ODIN	2021
Nordic Way 2	Enhancing traffic safety through C-ITS. The project is European Commission Connecting Europe Facility-funded between 2017 and 2020, and it is implemented by the National Road Authorities of Finland, Norway, Sweden, and Denmark as well as private companies and research centers.	http://vejdirektoratet.dk/EN/roadsector/Nordicway/Pages/Default.aspx https://vayla.fi/web/en/projects/pilots/nordicway2#.XFWjMlVKios	
CaaS Nordic	The goal of Corridor as a Service concept is to improve goods logistics combining ITS systems.	**https://www.caasnordic.eu/**	2018

3 National and regional strategies and plans

Joint Barents Transport Plan

The Joint Barents Transport Plan (JBTP) serves as a framework for cooperation on transport issues in the Barents Region. The current plan includes issues such as tourism and connected mobility and takes into account measures to mitigate climate change. ITS will play a vital role in this because it offers a regulated and standardized framework for connected mobility, integration of mobility resources and encourages more automatization and use of GNSS.

Its primary focus is the development of an efficient, interconnected transport system, with good external connections to the world markets. Digitalisation and connectivity are important. Further development of the transport system should meet UN Sustainable Development Goals, enable regional development and create new opportunities for relevant industries.

The recommendations in the JBTP are summarized in four main areas:

1. Increase knowledge about the transport flows and transport needs in the Barents Region
2. Create conditions for transport system users to reduce emissions of greenhouse gases
3. Increase road safety and safety at sea
4. Create a more efficient transport system and reduce border crossing obstacles

Traditional ITS solutions will contribute to the three last recommendations directly. All of them are well aligned with and taken up by the national and regional transportation plans of Norway, Sweden, Finland and partly those of Russia.

3.1 Norway

Norway's National Transport Plan (NTP) runs for 10 years. It is submitted for revision to the Storting (the Parliament) in the form of a White Paper every four years. It gives a long-term perspective of the Government's transport goals and strategies. The current NTP runs from 2018 to 2029 and is clearly aimed at using new technologies and ITS as means to deliver increased mobility, decreased transport costs and reduced emissions.

ITS in the National Transport Plan

Faster implementation of ITS is listed as one of the most important reforms in the document. Chapter 3.3 is dedicated to ITS and new technology and it describes implementation plans for each mode and sector. This is followed up by concrete measures including new regulations, increased funding and a focus on MaaS, autonomy and cooperative systems.

Transport21, Tech-report and National Transport Plan (2022-2033)

These ambitions are reflected in the long-term strategies of the transport agencies and supported by the Transport21 report for research planning and the final report from the Minister's Technology Advisory Board. These reports and strategies serve as a platform which support understanding of how technology and ITS will reform the sector – and are widely used as bases for pilots and implementations.

This common platform is being used as a general reference framework for the preparation of the next NTP 2022-2033, which is now in progress. In this new NTP, the importance of knowledge development, regulation, standardization and cooperation will be highlighted. It will further focus on development of ITS and data as important infrastructures for the future. All sectors will be included.

Troms and Finnmark and Nordland counties

Two counties, Troms and Finnmark and Nordland have their own regional transport and strategy plans. As Troms and Finnmark are now one county, their regional plans will have to merge. All three plans have green transport and achieving safe, efficient and predictable transportation systems by using ITS as main goals. ITS has a big impact in the transport strategy as the northern counties have become more aware of the benefits of ITS in general, specifically C-ITS as a prerequisite for real-time and safe transport.

3.2 Finland

National Transport System Plan

Before 2019, Finland had regionally based transportation plans. In order to meet new environmental goals and the mobility demands of the population, businesses, municipalities and the public sector across the country, a national plan was needed. As of 2021, Finland will have its first National Transport System Plan (2021–2032) including a government funding program.
The transport system comprises transport networks, services, data and all transport modes — road, railway, water and air. The Plan will be based on the Transport System and Highways Act that was implemented in August 2018. This Act removed or lowered the barriers to allow autonomous driving and implementation of MaaS – and brought Finland to the forefront of ITS in Europe.

National Growth Program

The link between development of the transportation systems and industrial growth is very important. To enhance this link a National Growth Program 2018-2022 for transport was initiated. This describes Finland's technology ambitions and promotes the use of ITS in all modes with an emphasis on autonomy, C-ITS and MaaS.

The Growth Program intends (in the preparatory phase) to create an internationally competitive ecosystem that includes; automated transport, intelligent infrastructure, intelligent light rail transport, electric transport, MaaS, and autonomous maritime transport. The other potential areas identified in the early stage include rural mobility services, digital logistics, business models and Hyperloop (if there is a demand). The Growth Program gives a roadmap for implementation based on these elements where cities serve as a platform for autonomy, MaaS and data-sharing. Traditionally, Finland has had numerous ITS projects. Many of the projects have been carried out in cooperation with the other Nordic and Barents countries — Sweden, Norway and Russia.

CaaS Nordic

CaaS Nordic is a non-profit organization and promotes Corridor as a Service (CaaS) expertise, data-sharing and living lab activities in regional and international cooperation. The purpose of the non-profit association is to promote the exposure of an international logistics hub in the Baltic Sea Region for freight transport between the East and the West.

Figure 9©Vedia

3.3 Sweden

National Transportation Plan (2019-2024)

The National Transportation Plan for Sweden (2019-2024) focuses mainly on development of sustainable infrastructure for the future. It does not promote the use of ITS or specific technologies and so does not overlap significantly with Sweden's separate ITS Strategy. The Transportation Plan serves more as an alignment and policy tool for adjacent disciplines.

ITS Strategy

"Leading the way by innovative transport solutions" is the vision for Sweden's ITS Strategy and Action Plan. It describes how and why Sweden should take a leading role in developing and introducing innovative transport solutions that are beneficial to citizens and industry. The ITS strategy encompasses all actors and modes and is based on strong collaboration and coordination between modes. The main focus areas are city logistics, C-ITS , Cooperative, Connected and Autonomous Mobility (CCAM), MaaS/public transport, micro-mobility, traffic management and regulation. The Strategy and Action Plan, serve as the national focus for ITS implementations.

Drive Sweden

Drive Sweden (2018-2030) is a cross-functional collaboration platform that drives the move towards sustainable mobility solutions for people and goods. The main focus is development and demonstration of efficient, connected and automated transport system that are sustainable, safe and accessible for all. The platform is financed as a Strategic Innovation Program (SIP) and has more than 130 members from the automotive industry, transportation operators, research organizations and public authorities. The members run projects that are generally supported by the National Plan and ITS strategy but are not tied to these plans. Drive Sweden has a portfolio of about 50 different projects and programs. Most focus on next-generation mobility for rural areas, cities, automated driving, MaaS and the combination of technologies.

Norbotten county

Norbotten, one of the two counties in Sweden in the Barents Region, is looking into how ITS solutions can help solve its expectations and needs when it comes to transport safety. Communication is important with such long distances and remote services; safety becomes a key issue.

Although we can assume that most or all individuals will have smartphones, and that information will be disseminated via apps, there are a number of issues to address — who should disseminate the information, who will finance, the system, geographic coverage (or the lack of it) and different operators, informing potential users of the availability of service, etc.

Examples of information that would be valuable to a road user are:

- Warnings of wildlife on the roads
- Incidents/accidents and estimated lengths of delays/times until roads re-open
- Scheduled road closures and planned reopening times
- Winter maintenance/snow clearance, the locations of snow plows and thus the opportunity to see when the road was last cleared.
- Real-time locations of buses in cross-border regions.
- Locations and opening times of local services

Easy access to such information results in better journey planning, with appropriate rest stops and better use of local facilities with less queueing. The results are greater convenience, time savings and improved safety and security.

3.4 Russia

Transport is one of the leading sectors of the economy in Russia. Russia exports oil, gas and metal and the creation and development of cross-border solutions are necessary. As transport logistics has such an economical and political impact, the need to apply innovative technology solutions into the transportation and infrastructure process is essential.

Russia has a Transport Strategy, and many reports, however, mostly are in Russian and have not been easily accessible.

Finland is the country in Barents Region that has the most extensive cooperation with Russia on transport and ITS.

Border crossings

The Finnish and Russian aim is that ITS cooperation will focus especially on the challenges of border crossings. Digitalization of logistics in particular is promoted. Interest in new transport service models and different sharing economy solutions are emerging in Russia and these could also be worthy of further study.

CaaS – Corridor-as-a-Service

CaaS is a concept for combining logistics and ITS to become intelligent logistics. Developing the logistics corridor was a focus of last year's cooperation between Finland and Russia. In Finland, cooperation has become more concrete in the development and implementation of the CaaS concept. The CaaS Nordic Association has been established in Finland. This Association promotes innovation that leverages the development of digital services, use of international standards, and use of interfaces for integration.

Test corridor

Between Russia and Norway, the E105 road between Murmansk and Kirkenes could be explored further as an ITS test corridor for heavy goods movements, automatic border crossings, automated vehicles, etc.

EU and the Baltics

The EU has no specific coordination activities with Russia in ITS, apart from being an observer in the Barents cooperation.

The Baltic countries have different pilots going on with Russia and Belarus. However, these are often projects that are focused on the electronic exchange of information for transport operations rather than on ITS.

3.5 JBTP and national transport plans

The Joint Barents Transport Plan focuses on the interconnections and the exit corridors for the transport system. The nature of the Region poses severe challenges for all modes of transport. Taking this into account, the JBTP describes status and future transportation needs for enhanced accessibility and safety, based on expected industrial/economic development and climate issues.

Barents transport policy

Even if the national transportation plans share common goals for the region on a national level, they have very different structures and focus areas. None of them are broken down to meet the JBTP objectives and it is hard to find concrete measures for the use of ITS in the Barents Region.

Support for JBTP and ITS deployment

However, the Barents Region is not left in the dark. At the national level in all countries, there is a clear recognition of the importance of the transport system in the Barents Region. In the table below the most important plans, programs and strategies are listed per country. It shows the support for the general JBTP, and the deployment of ITS in the Barents Region.

Table 2: National and regional plans and support for JBTP

Country	Plans	Modes	Support JBTP	Support ITS in JBTP
Sweden	NTP (2019-2024)	All modes	X	
	ITS Strategy	Roads, MaaS/city, goods, autonomy, TM		X
	Drive Sweden (2018 – 2030)	Mainly roads, MaaS/city, autonomy		X
	Norbotten	Roads	X	
Norway	NTP (2018-2029)	All modes	X	X
	NTP chap. 3 & 3.3	All modes		X
	Draft NTP (2022-2033)	All modes	X	X
	Transport21	Roads		X
	Tech-report	Roads, MaaS/city, autonomy		X
Finland	NTSP (2021-2032)	All modes	X	
	National Growth Program			X
	CaaS Nordic	All modes, goods and logistics		X
Russia	NTP and Regional TP	All modes	X	X
	CaaS Nordic	All modes, goods and logistics		

3.6 Regulation, standardisation and EU

Political climate

This report is apolitical however it should be mentioned that some of the planned ITS projects and plans face political challenges such as connectivity and data sharing.

Technology and standards exist but the regulatory environments in each country remain still immature.

MaaS – all modes

EU regulations for public transport have come into effect as part of the ITS Directive The ITS Directive of the EU (2010/40/EU). These regulations will require each Member State to distribute a minimum set of public transport data through a National Access Point (NAP) National Access Point (NAP).
All the data in the NAPs are open to all mobility stakeholders in each country.
The aim of the NAPs is to facilitate access, easy exchange and re-use of transport and mobility-related data in order to support the provision of EU-wide interoperable travel and traffic services to end-users.
In Norway, Sweden and Finland this is well underway, awaiting only harmonized implementation of the relevant CEN standards.

Data accessibility and data exchange is highly relevant and crucial for the Barents Region. This includes all future ITS projects/pilots and seamless MaaS.

C-ITS – cooperative systems for the road sector

EU regulation for C-ITS is following up the ITS Action Plan and is expected to come into effect soon. This will harmonize the use of cooperation systems in all EU countries. After that, cross-border issues will only relate to the telecommunications standards and roaming services in each country.

Autonomy - road sector

There are three main areas that are or will be regulated:

1. Vehicle technical regulations:
    a. Common international regulations for automated vehicles are prepared in UNECE / WP29. More than 60 countries are involved in this work, including EU Member States, Norway, China, Russia, the USA and others.
    b. The first step for Level 3 (automated driving) will be adopted this year (the goal of WP29).
    c. Expanding the scope to Level 4 or higher has not started
2. Traffic rules/regulations:
    a. International agreements (mostly by the same countries mention above) within UNECE / WP1. Regulations will be changed to accommodate for automatic system take-over from manual driving. This is mainly reflected in each nation's national traffic rules in slightly different wording (e.g. some require hands on the steering wheel while others say that drivers should be in control at all times). Once a change is adopted, it is incorporated into traffic rules.
3. Criminal law, liability and penalties:
    a. Will be or might be regulated internationally but probably not started in any of the countries of the Barents Region.

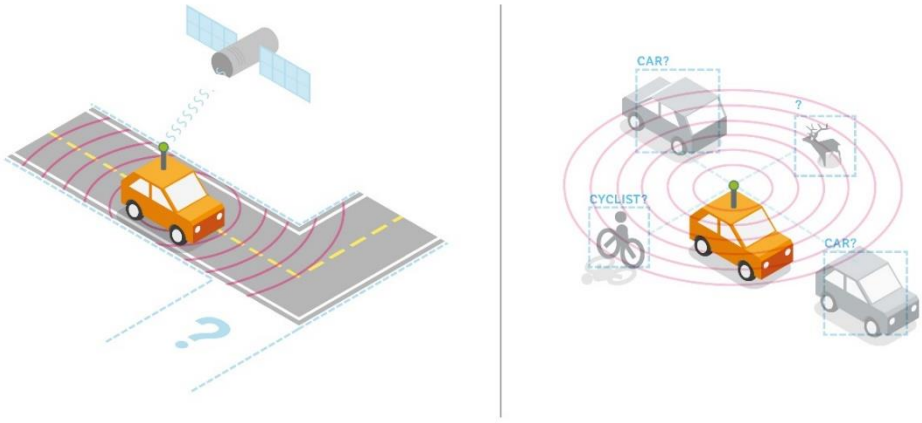


Figure 10 ©NPRA

Implementation

In anticipation of the upcoming international regulations (points 1 and 2 above), many countries have made temporary regulations for testing self-driving vehicles. This is based on an application to the national authority, temporary permits, risk assessments, reporting and exemptions from current regulations. The principles of permission are basically the same in all countries, as they are based on international rules

Carmakers

Vehicle manufacturers can also apply to the EU for similar non-conformity permits for automated vehicles, but so far none has done so. The temporary regulatory framework for testing will continue to be used for perhaps three to five years.

Standardisation

ITS standards including Cooperative-ITS standards are maintained at a European level by CEN, The European Committee for Standardization and CEN/TC 278 are responsible for them.

Standards have an important role to play for future safe and smart mobility. Cooperative, connected and automated vehicles need to have common standards, so that the connected vehicles can talk to each other and to the road infrastructure. This will lead to safer roads, increased mobility, more sustainable transportation and better management of roads.

A report in English from the Norwegian Public Roads Administration provides an overview of all these standards.

Figure 11 ©Erlend Gausen

4. Suggested ITS pilots for the Region

Following the goals and based on the findings in this study, this report includes a list of suggestions for further work, described as well-defined ITS pilots and suggestions for quick-win actions.
There is need for more research and development, R&D, and piloting both with private business and public participation. Piloting is important to test new technology and understand operational conditions and challenges, and should be focused on data handling, transport management (connectivity) and infrastructure.

ITS Norway has noted a lot of interest in initiating concrete pan-Barents ITS pilots. Many good suggestions have been received, especially from private companies in Norway, and some from Finland. Motivation is high but there is still a need to have a clear plan for what the region and authorities want to achieve. The plan, made up of relevant suggestions, has to be part of an overall strategy that will receive political blessing.

All suggestions for pilots are provided by applying the structured methodology specified in the assignment contract. There is a strong call for all the suggested pilots to include testing of their solutions with real users during the project period. This will make the pilots easier to evaluate and help participating companies to more quickly commercialize the results. Also, reuse of data and results from previous pilots will be deemed valuable.

Template for the pilot description:

a) Pilot goals, needs/demands to be met and purpose
b) Area of actions/pilots
c) Actions/pilots and infrastructure/equipment
d) Cost estimates
e) The basic infrastructure necessary for carrying out the pilots
f) Relevant regulations necessary for the implementation and utilization of the piloting results

4.1 Webstep

Contact: Angele Abboud, Senior Data Scientist, Webstep Bergen +47 93 99 33 77

a) Goals, need and purpose

The Barents Region is facing challenges due to the Arctic climate and high exposure to ongoing climate change. Transport and infrastructure are affected. There is a need to develop intelligent logistics and management of transport and infrastructure to monitor and maintain services and to predict and mitigate risk. The goal of this pilot is to use transport network and infrastructure data combined with geospatial data (weather, vegetation, elevation, water levels…) and machine learning to gain a better understanding of past events and predict future risks. The purpose is to establish data-driven decisions for asset management, maintenance and risk mapping.

b) Actions /pilots

This pilot is relevant for network infrastructure such as transportation (road, railways.) or the energy sector (power grid network), as well as isolated infrastructure with a need to be monitored from a distance. This project can be cross-border since it is based on data sharing and can include all countries in the Barents Region.

c) Actions/pilots' interest and infrastructure/equipment

Asset management, maintenance and risk assessment of infrastructure comes from a good understanding of what has happened in the past. Combining historical geospatial data with infrastructure data offers a strong understanding of what happened and allows application of machine learning gain an accurate prediction of what could happen in the same conditions (see Figure 1).

The pilots will consist of:

- Combining data from infrastructure networks and, historical events (closed roads, infrastructure maintenance...), with relevant geospatial data (weather, vegetation, elevation...).
- Provide a descriptive tool to visualize and understand events in this area.
- Use machine learning to optimize maintenance and predict a risk assessment of areas.

d) Costs/current budgets?

Based on previous work done in other areas of actions by Webstep Solutions, some of the data platform required has already been built.
The main cost will be on integrating new data sources, developing a tailored dashboard, defining the use case and implementing the machine learning model.
The time estimated to deliver a minimum viable product is five weeks with a data engineer and data scientist, for an estimated cost of NOK 300,000.

e) Basic infrastructure supporting the action/pilot

The pilot can be developed under the Digital Forretning platform of Webstep Solutions, which provides a scalable solution hosted on a cloud platform to gather and analyze data.

f) Relevant regulations

Data sharing security policy should follow regulations for each of the countries involved in the pilots. An agreement of consent for data sharing for the proposed processing should be obtained from each participant.

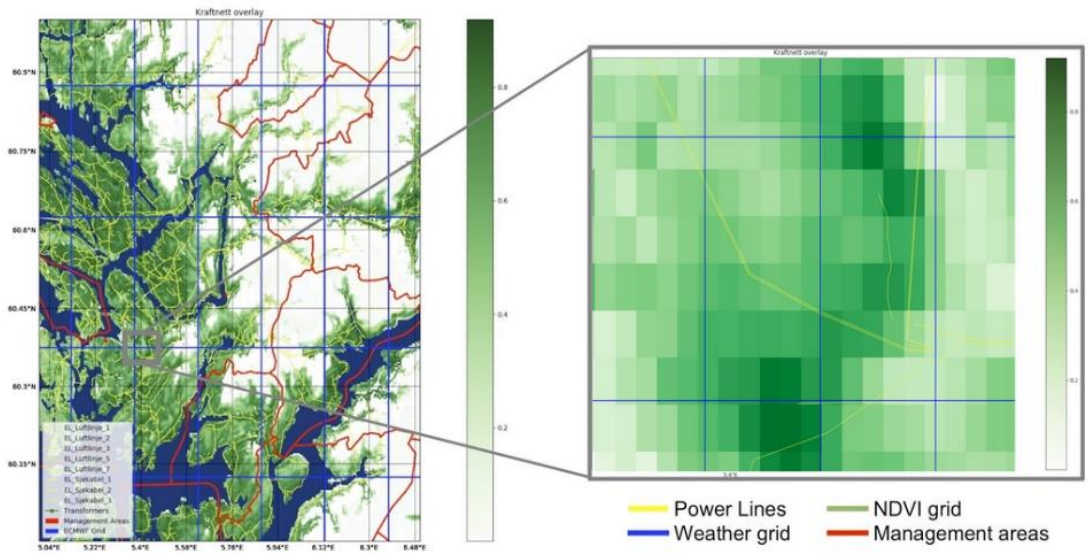


Figure 8: (Map with combined data of power grid and geospatial data (vegetation density, wind...). (RIGHT) Zoomed in with 300m resolution to exemplify the different risk of power line outages depending on the region and surroundings of the power line. The darker the color the higher risk.

4.2 Aventi

Title: V2X Pilot for border crossing of trucks in the Barents region
Contact: Bjørn Elnes , Aventi +47 414 36 326

a) Goals, need and purpose

The goal for the pilot is to make border crossing for trucks controlled and efficient by implementing V2X technology.
Norway and Russia are not members of the European Toll Union and many solutions have been proposed and tested to automate customs clearance.
Related to this, it is very useful for the toll stations to know where the trucks are when they are getting closer to the border, and pinpoint exactly when they cross over. At the same time, all countries in Europe, including Norway and Russia, expect to implement a C-ITS platform sometimes in the future. Our proposal for a V2X pilot is to test if this platform will be useful for the toll stations.
In addition, this V2X pilot will demonstrate how the truck can change subscription to V2I related information from one country's road authority to another's when the truck crosses the border. We will also demonstrate that the truck driver will receive traffic alerts in his/her native language.

b) Actions/pilots

The following areas are good locations for this pilot:

- The Norwegian Russian border on E105,
- The Norwegian Finnish border on E8 near Kilpisjärvi.
- The Norwegian Swedish border on E10 near Riksgränsen

c) Actions/pilots' interest and infrastructure/equipment

- For border crossings with reliable cellular 3G/4G, it will be sufficient with a backend system running in Microsoft Azure, and a C-ITS app running on the truck driver's smartphone.
- For border crossings without good cellular coverage, we will in addition install RSU (Roadside Unit) at the border and OBU (Onboard Unit) in the trucks. We can choose between ITS-G5 OBU/RSU or C-V2X OBU/RSU when the project starts.

d) Costs/current budgets?

- Backend system running in Azure for one year: €10,000
- Engineering and testing in Oslo, Norway: €80,000
- Optional: 2 OBU and 2 RSU (ITS-G5 or V2X): €10,000
- Onsite installation and testing at border crossing: Charged by the hour, travel and accommodations.

e) Basic infrastructure supporting the action/pilot

- For a purely cellular based approach, no infrastructure is necessary.
- Using optional RSU (Roadside Units), power and Internet connection is necessary, and a pole, gantry or building near the road to mount the RSU.

f) Relevant regulations

- GDPR will apply if the solution is tested by professional truck drivers during their daily work, ensuring their privacy.
- If the OBU/RSU option is selected, the national radio communication authorities must allow V2X transmissions in the 5.9GHz band. This is already allowed in the EU and Norway, and probably in Russia too.

4.3 Bouvet,

Contact, Lars Klyve, Bouvet, Mobile +47 911 97 390

In the pilot, we intend to utilize some of the pilot solutions that have been developed in connection with the Borealis project at E8 / Skibotndalen. The interchange node developed in connection with the Nordic Way will play a key role in providing real-time information.

a) Goals, need and purpose

Overall goals for the pilot: Contribute to safer and faster freight transport from the coast of Northern Norway to Helsinki.
A large part of Norwegian fish exports is carried out on these roads. Safe and fast freight transport is essential for the fish to reach their markets within the agreed time. Especially during winter, there are challenging parts for freight transport to get through. It is therefore important to have cost-effective measures implemented that support the Norwegian export industry.

The report "Freight transport in the Senja Seafood Region, Priorities from key industry players (Version II, June 2018)" states that the transport challenges at Senja are significant and that these creates a problem for the fishing industry. Several measures are needed.

'Hard investments' are both very expensive and time-consuming. ITS measures can be implemented quickly and at low cost.
Through the pilot, we want to test whether the solution can contribute to safer and faster freight transport.

Secondary objectives:

- Safer and more secure driving by providing drivers with tools that make it easier to comply with driving and rest regulations in an optimal way.
- Demonstrate that a combination of individual/isolated pilots in the Barents Region can contribute to new and useful services that support the need for better accessibility, safer heavy transport and reductions in greenhouse gas emissions.
- Demonstrate that the solution architecture is suitable for cross-border and real-time information that can create new societal beneficial services. Give business enterprises better tools and more predictability to plan logistics processes and logistics dependent processes.

b) Actions/pilots

- The pilot is planned for the route from Senja in Norway to Helsinki in Finland (or parts of the route).
- Be able to utilize infrastructure and solutions that already exist on the E8 / Skibotndalen
- Test cross-border and real-time information between Norway-Finland (E8) and Norway-Sweden (E10)
- Verify and demonstrate if ITS measures can remedy the situation at Senja (transferable to other harbours/industries)

c) Actions/pilots' interest and infrastructure/equipment

For the Senja route to Helsinki, the driver should be given advice regarding the resting places that can be used on the route. The advice is given through a mobile phone app. It must be considered whether one can build on existing transport apps already available.

Functionality of the solution:

- Indication of distance and estimated start time
- Get suggestions for resting places
  - Driving and resting rules
  - Messages from TMC and other sources of information
  - Is the rest area cleared of snow (wintertime)?
  - Available space at the expected time of arrival
- Receiving real-time information
- Book a resting place
- Information updates when underway if new real-time information is available that has consequences for previous recommendations. These include speed recommendations to reduce greenhouse gas emissions.

What needs to be clarified and considered in advance/down the road (the list is probably not exhaustive):

- Current driving and rest regulations
- Different type of resting places
- Capacity of the resting places
- Infrastructure, including electricity and mobile coverage
- Engage other relevant Borealis pilots as part of this pilot

Dynamic throughput of traffic: (Takting) smart fleet management through bottlenecks in the road network

This pilot is planned to be carried out on Senja, which is proposed as the starting point for the Senja-Helsinki route. The pilot is based on dynamic throughput with driving advice for drivers that was carried out in the Borealis project. The solution will help prevent heavier vehicles from meeting in unsuitable places (narrow bridges or tunnels).

- Drivers will be advised to optimize speed to avoid bottlenecks and advised of meeting locations.
- Drivers have a mobile phone through which they receive real-time information and advice. Example: "The driver will be advised to slow down to a suggested speed in order to avoid meeting at a bottleneck on the road".

We envision that in this sub-pilot we will combine dynamic throughput with Aventi's technology/solutions to also cover areas without mobile coverage. It will also be able to interact with Q-Free's sensors to locate snow chain places.

Collection/categorization of real-time information

Through the Interchange Node, collect and categorize real-time information from other Borealis/Nordic Way/Barents Region pilots. Establish a data platform. Identify what other types of information from different data sources may be incorporated to create new societal beneficial services.
Considerations in relation to GDPR.

d) Costs/current budgets?

Between NOK 1 and 4 million depending on the level of ambition.

e) Basic infrastructure supporting the action/pilot

Infrastructure measures may be needed if sensors are to be used in the resting places, or due to poor / lack of mobile coverage at Senja and at other points on the route.

f) Relevant regulations

Use of real-time information related to the Interchange nodes in Sweden and Finland.

Access to relevant information from the Norwegian Public Roads Administration and other information owners.
Assess the use and linking of information in relation to GDPR

4.4 ITS Perception

Contact: Hans Petter Flugstad CEO Mobile+ 47 900 90 741

a) Goals, need and purpose

Off-grid solution for detection and sharing of real-time traffic data from problematic rural road sections. This pilot will explore easy deployments of advanced, roadside sensors to areas normally not connected to the grid. Typical problems addressed will be critical sections and bottlenecks, especially for heavy trucks — steep or narrow roads or fixed structures (tunnels, bridges) that can be limiting for over-sized trucks to pass or meet.

b) Actions/pilots

Nordics and Barents area.

c) Actions/pilots' interest and infrastructure/equipment

Road infrastructure – ITS and C-ITS systems.
Roadside sensors, fuel cell power and mobile/satellite communications

d) Costs/current budgets?

One site pilot test, estimate NOK 600,000

e) Basic infrastructure supporting the action/pilot

Fixed poles or masts.

f) Relevant regulations

Road administrative regulations.

Table 3: ITS – Norwegian Pilots

Pilotname	Purpose	Cost
Webstep	Understanding past events and Predicting future risks by combining geospatial data and machine learning.	NOK 300,000
Aventi	make border crossing for trucks controlled and efficient by implementing V2X technology.	NOK 1,000,000
Bouvet	Contribute to safer and faster freight transport from the coast of Northern Norway to Helsinki.	NOK 1,000,000 – 4,000,000
ITS Perception	Off-grid solution for detection and sharing of real-time traffic data from problematic rural road sections	NOK 600,000

4.5 Other ITS-pilots – Quick wins/"Low-hanging fruit"

This report is making recommendations on relevant "quick wins/"low-hanging fruit" and basic actions that could be given priority for further work. These ideas do not follow the template/methods described in the previous pilot section but are equally important to mention.

- A general recommendation to increase awareness of the mapping situation and working with the Norwegian Mapping Authority and equivalent partners on the Finnish and Swedish sides to test seamless data and accurate positioning on the road. Correct, easily accessible and reliable geographical information and appropriate reference frames for location services that enable users to determine correct positioning by having the right geographic coordinates with sufficient accuracy and reliability is crucial. For transport and infrastructure, this information or data is essential. Navigation at sea, securing roads and infrastructure, autonomous vehicles and goods handling are a few examples of areas that will rely upon good quality geographical information. We need seamless data for maps, a global frame of reference and a common Barents Region strategy for geographic information (geodetic reference). Geodata or map data needs to be open for cross-border purposes.

- Continue working with pilots based on the E8 Arctic test road in both Norway and Finland. A lot of time and resources have been invested on both sides of the border — but not too much has been done cross-border so far. The E8 and the border crossing can be used to test ITS solutions like MaaS, C-ITS, logistics, sustainable mobility and resting places for trucks. There is a lot of local knowledge and there is equipment and utilities such as sensors, power, wifi and fibre cables already built into the infrastructure in both countries. ITS Norway believes that this area is of great importance and an excellent basis on which to continue piloting and testing. The E8 site has the potential to become a sizeably important inter-Nordic test arena

- Following the ITS Action Plan and ITS Directive 2010/40/EU, safe and secure resting areas for commercial vehicles/drivers would make a fine pilot. Currently, there are initiatives both in Norway and Finland that are developing ideas around this topic. Apart from improving the overall capacity of truck parking areas, the areas have to be equipped with digital information to provide access to safe and secure truck parking data through the NAP. The pilot can fit a couple of rest areas across borders with the state-of-the-art digital sensors and services to give the right type of information to pilot resting areas.

- A comprehensive risk management plan for the transport sector in the Barents Region. A risk management plan includes security of the roads, energy sector, connectivity in the area, tourisms and goods transport.

- As part of the EU Horizon DT-ART-06-2020 application e-DEAL, there are eight pilots. One of these aims to demonstrate the robustness and reliability (functional safety) and user acceptance of connected and highly automated driving technologies and systems for passenger cars (SAE level 4) for different use cases in particularly challenging and complex environments. Partly based on the Borealis-Project SINTEF, ITS Norway/SAMS, Aventi, Semcon and AOGLONASS will set up this pilot running from Kirkenes to Zapolyarny with Paxter/Lexus. This is a well-defined pilot that might be

demonstrated either as a part of an EU-project or as a BRTL-pilot. Ref: https://aoglonass.ru/en/

- To be successful, MaaS needs professional actors with a profound understanding of the marked and mobility operations. This is especially important when border crossings are in focus. One of the largest bus operators in Finland, Matkahuolto organize passenger and goods transport in northern Finland and has about 10 stations along the Norwegian and Swedish border. On the Norwegian side, a start-up company is setting up an on-demand, Uber-like service for tourists. The two companies could team up to make a tourist-oriented cross-border service between Norway, Finland and Sweden.

Figure 8 ©Bjørn Elnes, E8-Borealis, Gardeborgbakken inn Skibotndalen

5. Challenges to ITS in the Barents Region

This report documents the findings of the existing ITS situation in the Barents Region and gives a short overview of the current situation. It should be borne in mind that the quality of data varies from country to country and even region to region in each country. Also, the ambitions in terms of aims and outcomes vary from region to region. Even though the Barents Region is working towards sustainable transport solutions, the real actions are not always implemented and the path from thought to action is not always easy to follow or see.

To enable the work done by the BEATA and the JBPT to continue, the region needs to have an overall transport strategy that reflects the current and future situation. For seamless travel transport, stakeholders must provide good service in the form of the right infrastructure and communication. The transport sector must achieve digital integration between the road and the public sector. This must be made available in a way that increases collaboration in line with the region's plans.

Digital integration across all transport modes can be an important tool for better traffic planning and management in the Barents Region. A good example of this is the Norwegian Avinor system which has systems that display real-time information on departures and arrivals at airports. The information is then distributed to external parties like Flytoget (the airport train service) that shows flight departures on board. Hotels, taxis, buses and trains also have access to the system.

It is desirable to incorporate similar information in the event of delays in road traffic due to weather or other conditions. Real-time information about changes on the road gives a more predictable offer to both private travel and commercial transport. TMCs act as facilitators of road use, and closer interaction with both private and commercial road users, which contributes to a more efficient road transport system with higher capacity and greater predictability.

We tend to jump to future solutions like autonomous ships and drones or electric aircraft – which all are very important mobility and future transport modes, - however the essentials and the fundamentals tends to be forgotten.

Tourism will be a growth area. More infrastructure is needed — including road transport as well as more and smarter airports, to cater for the influx of visitors, and in particular those from Asia. ITS has a huge role to play here, as is mentioned in the Joint Barents Transport Report. Mobility-related information provision to visitors from outside the region will be a particular need, and one which can be well-served by ITS.

The BEATA, BRTL and BRWGT have faced multiple challenges due to the lack of connectivity and cross-border communications. Climate change and the ever-increasing demand for efficiency, real-time information and locational services will place even more pressure on the Region's budgets. Development of cleaner, smarter and safer technologies for transport and mobility will become even more important for the Region.

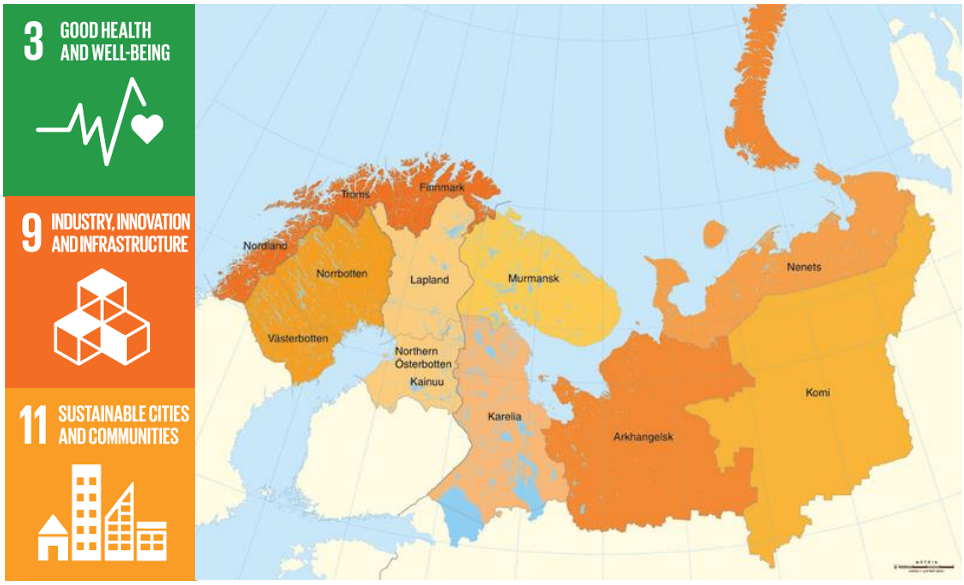


Figure 9© Source: Arctic Centre, University of Lapland

5.1 Climate

Research projections suggest that in the Barents Region there will be a larger-than-average temperature increase in winter, an increase in annual precipitation and river flows, less snow and greater damage by winter storms and avalanches. More frequent and intense extreme weather events are harmful to infrastructure. Climate change is also projected to lead to loss of income for industry in the Barents Region as road accessibility becomes more difficult. ITS is not the only solution but it can help provide short- and long-term results.

Today, the transportation sector is the biggest source of carbon dioxide emissions in the Barents Region. It is important to increase the usage of renewable fuels and sustainable solutions in the transport sector. The usage of various renewable energy fuels, storage and distribution by both rail and roads has to undergo proper evaluation and research.
Many transport-related challenges can be directly transferred to the UN's sustainability goals. The goals can be modified and directly translated into core ITS actions to improve safety and security in a sustainable way.

ITS actions to UN's sustainable goals

The UN has formulated a series of sustainability goals. ITS and mobility map to several of these, in particular the following:

- Goal 3: ITS can support road safety through automated road signals and signs, providing secure, connected rest areas for goods vehicles and their drivers, providing communications about dangerous goods movements and improving air quality by smoothing traffic flows and so reducing emissions.
- Goal 9: ITS can support more intelligent infrastructure and improve communications. It can monitor and make safer critical infrastructure such as bridges and tunnels, as well as accident black-spots. It can provide weather warnings and automate border crossing procedures.

- Goal 11: ITS can contribute to more sustainable urban mobility and public transport. Increased connectivity and solutions such as Mobility as a Service (MaaS) and C-ITS will help to improve mobility while moderating the overall numbers of journeys generated.

6. General trends within ITS

Numerous reports have been generated at the national level by various countries which detail trends and ambitions with regards to ITS. There is little point in reproducing them all here, as there are both significant similarities and differences. Therefore, the following is a list of general trends which affect the Barents Region.

- Digitalization, autonomous and automated vehicles and vessels
- Connectivity/ Cooperative ITS (C-ITS)
- Sustainable mobility (zero or low emission)
- Mobility as a Service (MaaS)

It is crucial for the Barents Region to keep up to date with the most important trends and drivers in ITS. In 2019, digitization of the transport sector was still an important driver within smart city projects.

The transport strategy in the region should be based on continued zero or low-emission mobility, collaborative systems and more integrated and efficient data-sharing platforms.

Safety and security

A subject that should be taken into consideration and which is not covered in this report is safety and security relating to cross-border freight transport in the Baltic Region. The general focus should be on the safety of drivers, other road users and vehicles. Technical inspections, documentation at border crossing points, best transport corridors (instant information about weather and road conditions), driver fatigue and rest areas are important considerations and yet easy to fix.

Figure 10 ©NXP

6.1 C-ITS

Cooperative-ITS or Connected-ITS, describes an environment in which the transportation/mobility infrastructure and all of the stakeholders in it — roads authorities/TMCs, vehicles and individual travelers — are connected and produce, share and receive data.
Vehicles will become data nodes on the road network, gathering local information and sharing it with other vehicles and network managers. This information can include weather/dangerous driving conditions, traffic conditions, intentions (where the individual vehicle is on the network and where it is intending to get to) and so on.

Vehicle to vehicle (V2V) enables cars to communicate directly with each other using the 5.9GHz frequency and the ITS-G5 protocol. They will primarily exchange data packages called Cooperative Awareness Messages (CAM) which contain GNSS coordinates, speed, direction and much more. A vehicle will transmit its CAM up to 10 times per second, and by receiving CAMs from other nearby vehicles it can try to avoid collisions.

It is anticipated if C-ITS is implemented in future this feature alone would reduce traffic deaths and serious injuries by 70%. Because of this, the European Commission issued the Delegated Act on C-ITS in the spring of 2019, trying to make the technology mandatory in new vehicle models. However, strong pressure from the telecom industry and its lobbyists managed to stop the new law in the EU Council the following summer.

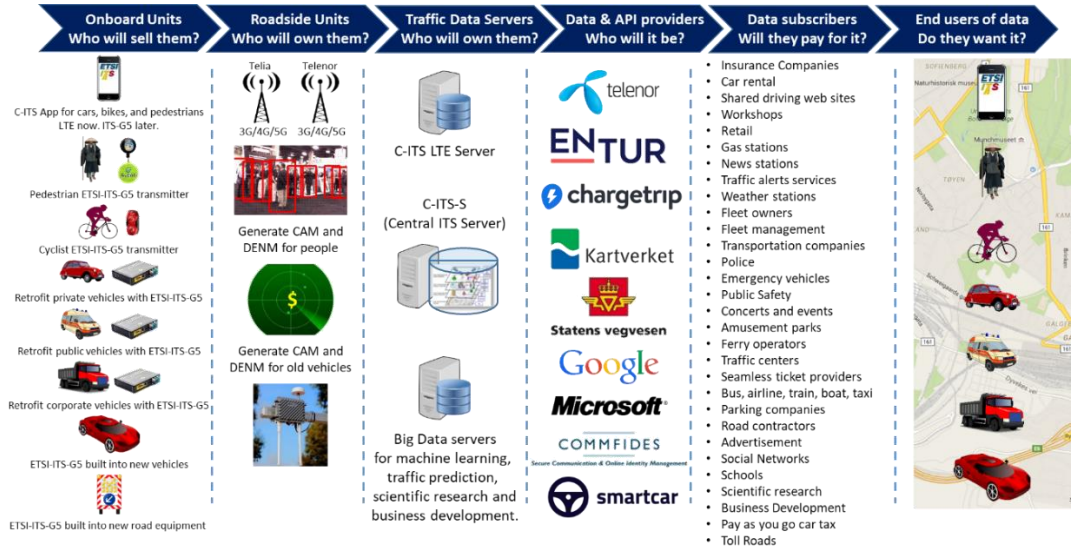


Figure 11©Aventi

6.2 5G

The next, fifth, generation of mobile telephony heralds a step change in terms of a connected society. By comparison with previous generations, 5G will bring unprecedented bandwidths and near-zero latencies. It will be the door-opener on the Internet of Things, which will provide a vast number and variety of the objects in our lives with connectivity and the means to communicate their statuses and intentions. The huge uplift in the numbers of sensors in our surroundings will increase the levels of intrinsic knowledge of objects and

devices, positions, status/health and so on. This will revolutionize mobility by providing previously unattainable levels of data.

5G also offers the potential to achieve vehicle autonomy without the need for a bespoke communications solution in the form of ITS-G5. This work is still at a nascent stage but will reach maturity in a very short space of time.

GNSS and connectivity

It will take time before 5G is fully implemented. Until then, much of mobility will continue to rely on existing technological solutions for applications such as navigation and positioning. GNSS, the principal navigation/positioning technology, has been shown to be susceptible to jamming and spoofing. This has potentially extremely dangerous consequences, especially as autonomous vehicles become more common.
The Barents Region is a good location for testing the robustness and integrity of both existing and future connectivity solutions.

6.3 AI

Artificial Intelligence (AI) involves a generation of machines which, by comparison with those in the past, demonstrate self-learning capabilities much more like those of humans. As they are able to learn, their accuracy and decision-making capabilities become much more accurate and sophisticated.

AI is already used in speech recognition systems. It will be used increasingly in imaging systems, giving greater autonomy and reducing the required levels of human intervention/interpretation, and will be an important factor in the safe operation of autonomous vehicles.

6.4 MaaS

MaaS involves the seamless, infinitely adaptable delivery of mobility, together with associated information and payment services, across all modes of transport. All of this takes place in real time or predictively, wirelessly, securely, and with the end-user being unaware of the potentially huge number of behind-the-scenes stakeholders and facilitators.

MaaS is different from previous generations of mobility because, as its name underlines, individuals do not have to own their means of travel, such as a private vehicle. They buy time on a network. It requires very accurate, real-time information from all stakeholders — infrastructure owners and operators, transport service providers across all available modes, and individual travellers.

Figure 12
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7. Multimodality

This report has mainly focused on ITS on road, with specific actions for road and logistics transport.
ITS Norway is an association that works multimodally. All three transport agencies sit on our board and we work closely with various transport clusters and other organizations. To achieve best performance and maximum efficiencies, it is important to think of the full transport network in terms of all its multimodal forms on land sea and in the air, and to include autonomous/drone technology.

7.1Maritime ITS

Together with SINTEF Ocean and the Norwegian Coastal Administration, ITS Norway has initiated an activity to create a strategy for and coordination of Maritime ITS. There is interest in the need for digitization in the maritime sector, standardization and addressing increasingly stringent environmental and security requirements.

In addition, the opening of the Northern Sea Route would see trade routes from Europe to Asia and America reduced by thousands of kilometres. This highlights the importance of the Barents Region as the northern hub of global maritime traffic.

Sustainable mobility plans and strategies will increase the development and implementation of autonomous ships and zero-emission vessels and testing them in Arctic conditions is also beneficial for the region.

7.2 Aviation

Aviation traffic in the Barents Region remains relatively light — it is principally north-south, in and out, as distinct from within the Region. However, the increases in tourism and efforts to positively dissuade young people and talent from migrating away from the region mean that east-west connections are to be evaluated and tested more.
Electric planes and taxi drones may have an increased influence in the future.

7.3 Electric planes

The Norwegian Chair of the Steering Committee of Barents Euro-Arctic Transport Area (BEATA) has aviation on its agenda during its two-year period. Aviation is important to the region not just for year-round tourism and general value creation but also for the health sector.

Programs for developing and testing electric planes and taxi drones have been increasing in quality and quantity. With today's battery technology and certification standards, the effective range of such craft is about 350-400km. This makes Barents Region and especially the well-developed Norwegian regional northern network of airports well-suited for testing. Many of the routes carry few passengers and are short flights for which small aircrafts are ideal.

Electric planes are also a low-emission option thus fulfilling the climate aspect, and Norway has an aim to electrify all of its domestic flights by 2040.

7.4 Remote tower services

The need for remote tower systems in aviation is increasing. Many small airports are no longer manned 24/7, and remote systems have become a necessity. Many larger airports have long periods of time with very little traffic, and big variations in traffic volume during the day. Many of these could also benefit from remotely operated tower systems.

The remote towers technology is an important capability which enables a sustainable aviation service in the rural areas of the Barents Region, many of which are in the Arctic. Remote towers provide the opportunity to build a robust knowledge hub for tower operators that are currently stationed in small towers in rural communities.

When fully rolled out the remote tower's technology will ensure more cost-effective airport operations and better accessibility to regional airports. Operating from Bodø, Norway the world largest remote tower center will operate a total of 15 towers. Avinor intends to continue investing to make the service available to more of its airports.

7.5 Drones /UAVs

Drones, also known as Unmanned Aerial Vehicles (UAVs) can fly under human control or, in certain conditions, autonomously.

They come in all sizes, with all kinds of different flying capabilities and possible use cases. They are not only associated with military and security applications; other sectors will experience great growth.

Figure 13©DJI

There are over 4000 registered operators in Norway who can use drones in a commercial business. Many of these use drones in northern or arctic regions.

The Barents Region and the Arctic Sea are perfect for testing UAVs. There is the challenge of flying and navigating drones in extreme conditions and remote areas. Companies in Stavanger are looking at the possibility of replacing using drones instead of helicopters to carry freight and supplies to offshore platform, and this will also be possible in the Barents Region.

Drones are in a special position in that they can operate with low response time, with reduced risk and at acceptable or reduced cost. This is especially true in search and rescue operations or for other risky assignments.

The Barents Region should look at how to harmonize its regulatory environment for UAVs. It will be important to involve telecommunication networks, as without being connected to a broadband network drones can fly but not transmit or receive data in real time.

Cross-border transport with drones is today an unspecified area as there is little coordination between European states when using drones.

The current air traffic systems do not adequately take into account drones, but this is addressed in a larger EU program called "U-Space".

Simple testing with drone flying between Estonia and Finland has been carried out, but in very low volumes. Through Avinor, Norway will be one of the first countries in Europe to receive drone traffic management systems during 2020, so testing cross-border drones will be possible under the current BEATA presidency.

7.6 Rail

Rail transport has a special role to play in the Barents Region and there have been many suggestions for increasing, developing and upgrading rail links to and from harbours and across borders. The JBPT has a good overall report on the various railway projects in the Barents Region and the increasing implementation of drones will again change this part of the transport sector.

Today's outdated rail technology is being replaced by the European Rail Traffic Management Systems (ERTMS) - a digital signalling-system common to all European countries. For travellers, ERTMS means a more stable railway with greater punctuality, increased safety and better capacity.

Figure 14©JBTP

8. ITS Norway suggests tangible recommendations for the Barents Region

It has been a real pleasure to work with this report and gain insight into the various aspects of the region. ITS Norway is happy to sit in any reference group and provide more input to the further work of the transport sector in the area.

Based on the information gained from interviews, email exchanges, calls and meetings, and detailed in this report ITS Norway suggests the following actions, measures and deployments:

1. Evaluate in a workshop in 2020 and carry out the relevant ITS pilots and ideas listed in this report and make a priority list of which pilots/actions to start with. Before further planning, the pilots need to show how they involve real-user interactions (living lab organization) and have a thorough value proposition.

2. Conduct a similar Transport21-like report for the Barents Region that includes industry, R&D and authorities. BEATA could incorporate this Barents Transport21 report to the JBTP and it could serve as an ITS input to the region.

3. Join the ITS World Congress 2021 in Hamburg at the Nordic Pavilion. Build awareness around the Barents Region, explain the possibilities, and reach out to authorities, politicians, research and academic environments and the EU.

4. Hire a person to facilitate ITS piloting in the region for a period between one and three years. The ITS facilitator will work with the public authorities, the BEATA and other stakeholders to initiate and carry through ITS projects, establish and maintain the knowledge base and raise the awareness of ITS throughout the region. The ITS facilitator could be managed by an ITS association under the BEATA structure to make it a neutral approach and to have full access to the association's vast ITS network.

5. Create a comprehensive ITS knowledge base for the Barents Region for all types of projects, mobility, logistics, cooperating systems and TMC-related projects including historical and on-going projects. This action will be very beneficial for future reports and activities in the Barents Region.

6. A workshop to discuss each country's policy and regulation issues. This should explore how these do/will hamper ITS deployment, and how they can become drivers for change and implementations — especially where numerous organizations, regions and countries are involved.

7. Investigate further cases for both the maritime ITS sector/autonomous ships and rail under a multimodal umbrella for the Barents Region. This is strongly recommended to be continued by the BEATA.

9. Abbreviations and references

ITS	Intelligent Transport Systems
AI	Artificial intelligence
CaaS	Corridor as a service
C-ITS	Cooperative ITS
V2X	Vehicle to everything
V2I	Vehicle to infrastructure
TMC	Traffic management center
CEN	Comitè europeen de nomralisation. Euoropeian standardisation organ
ETSI	Euorpean telecommunication standard institute
MaaS	Mobility as a service
Era-Glonass	A Russian automated emergency response system that provide rapid assistance to motorists in an accident
TIR	A multilateral treaty to simplify and harmonise the administrative formalities of international road transport.

9.1 Recourses

This study documents the findings and recommendations associated from various interviews, phone calls, visits and emails conducted, to support the task.
Overview of experts and others that have given input in the preparation of the Barents ITS Report.

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