



Trafi

Finnish Transport Safety Agency

Regional activities and FOTs:
Connected and automated
driving trials in Finland

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Topics

- Adverse conditions testing of AVs
- Robot shuttels from trials to deployment
- Possibilities of 5G
- Hybrid-communication development



3.11.2018



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Adverse conditions testing of automated vehicles

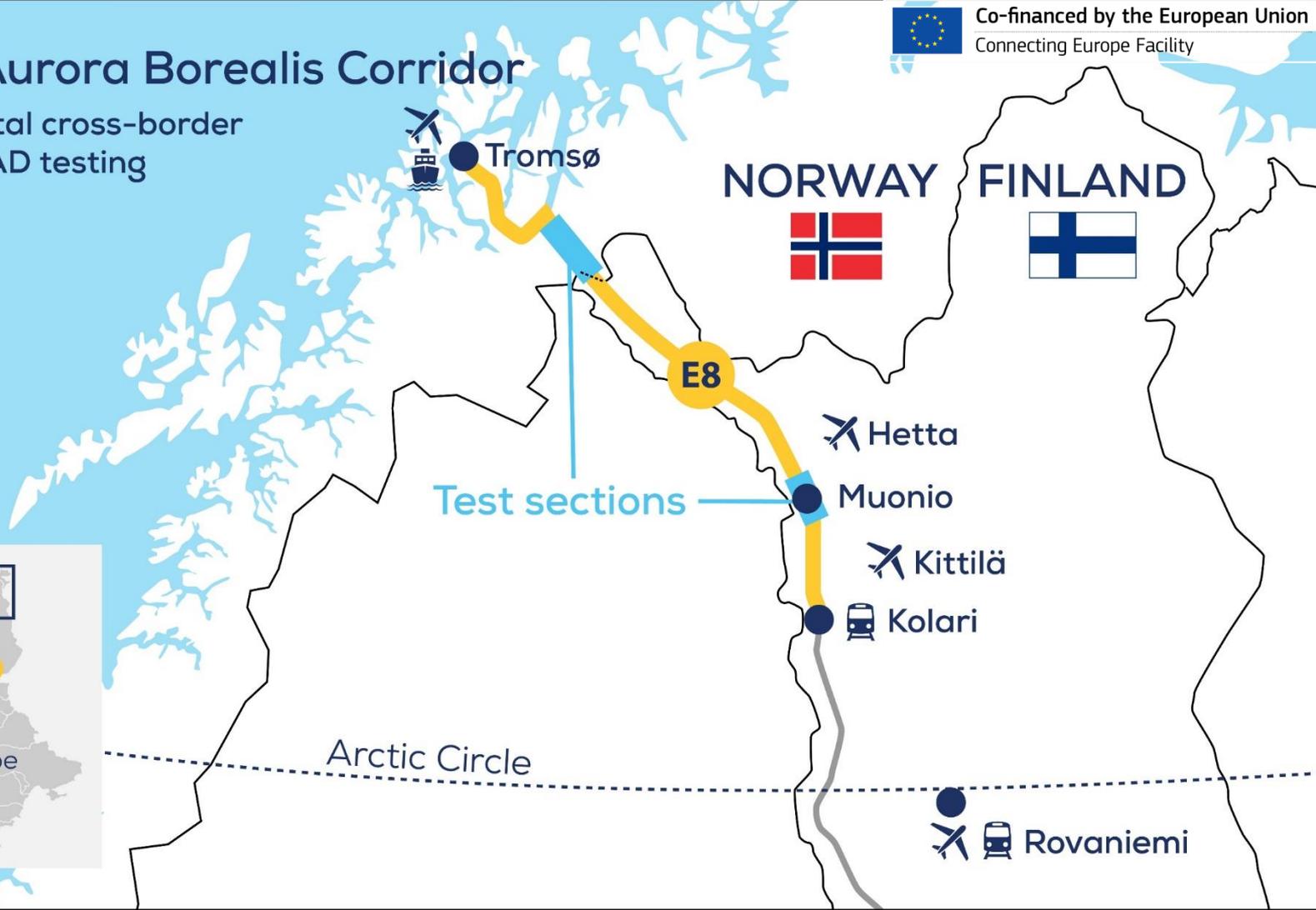
*Responsible traffic.
Courage and co-operation.*





E8 - the Aurora Borealis Corridor

European digital cross-border
corridor for CAD testing



Arctic Challenge R&D program 2017 – 2019

1. **Posts and poles for guidance and positioning:** What landmarks, such as delineators and reflective posts, or snow poles and plot access marks, support automated driving? Where should these be located? What should they be like?
2. **C-ITS hybrid communication – Safety Related Traffic Information:** How could the C-ITS Day 1 hybrid services improving traffic flow and safety be implemented on the main road 21 and Highway E8 Aurora Borealis Corridor between Kolari, Finland and Tromso, Norway, and what is their technical operability? What Day 1 services should be implemented in the Aurora Borealis Corridor?
3. **Communication infrastructure:** How does the remote control and monitoring of vehicles work in 4G and in the first stage of the 5G network in good/poor weather and road conditions? What minimum requirements should the communications network meet to enable remote control of automated vehicles?
4. **Positioning of vehicle:** In what way and how accurately could a vehicle be positioned to fulfil the needs of automated driving at northern latitudes where no edge markings or roads can be recognised? How can different methods be applied to special locations and situations, such as blind spots or glare?

Results are verified with automated vehicle tests.

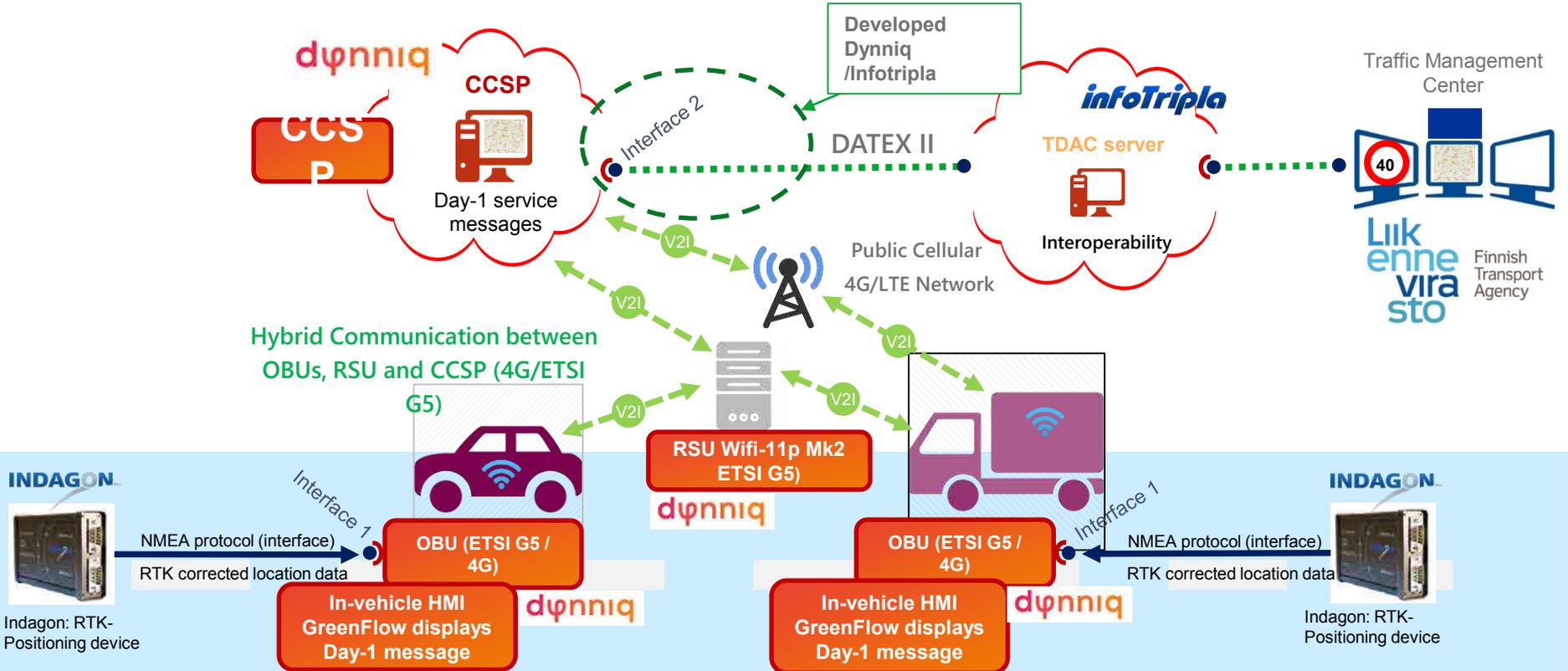




Martti, the robot car developed by VTT Technical Research Centre of Finland, is the first automated car to have driven fully autonomously on a real snow-covered road. On top of that, it also succeeded in making a new speed record of 40 km/h on the Aurora E8 intelligent road in Muonio, probably setting a new unofficial world record as well.



Aurora Arctic Challenge System Setup



Two Day-1 messages to be tested (=use cases):

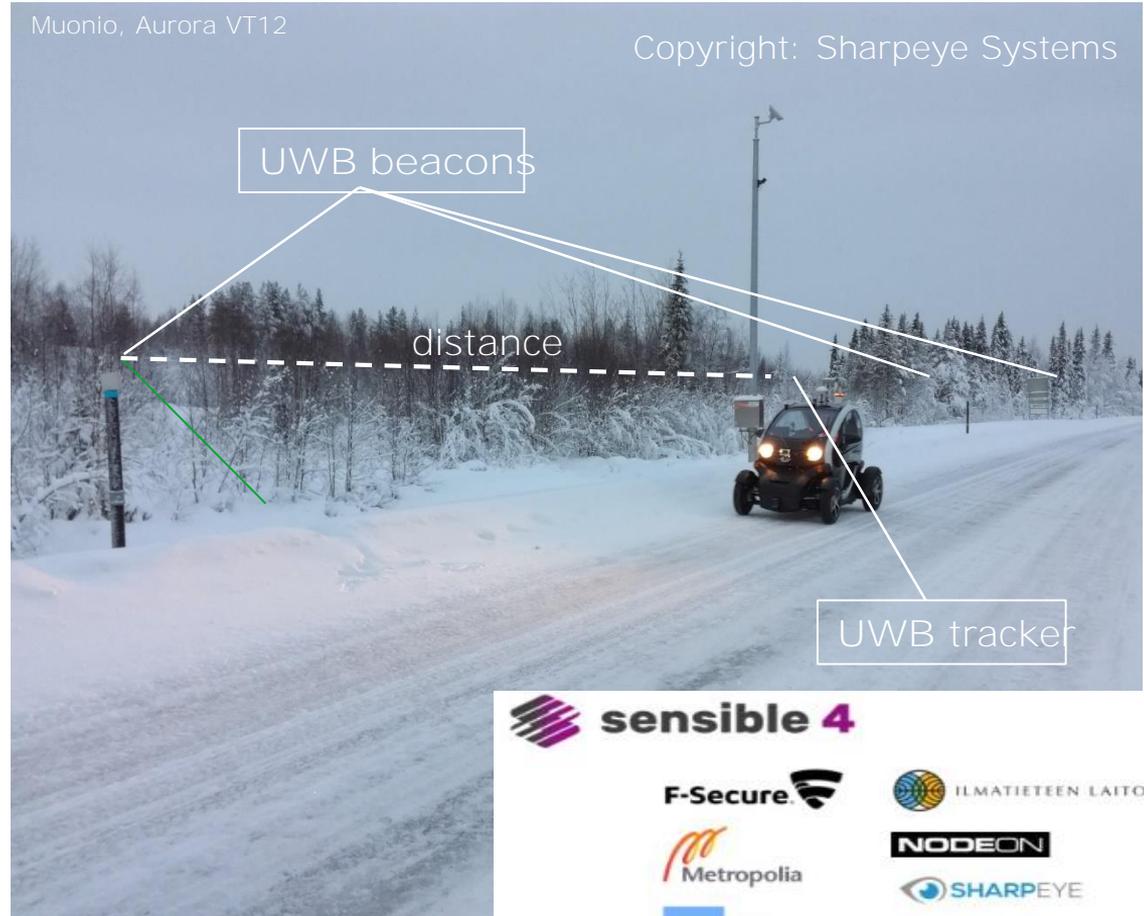
-  • **“Dynamic” Slow or stationary vehicle(s)**
-  • **Road works warning**

Aurora Arctic Challenge test road section - Highway E8

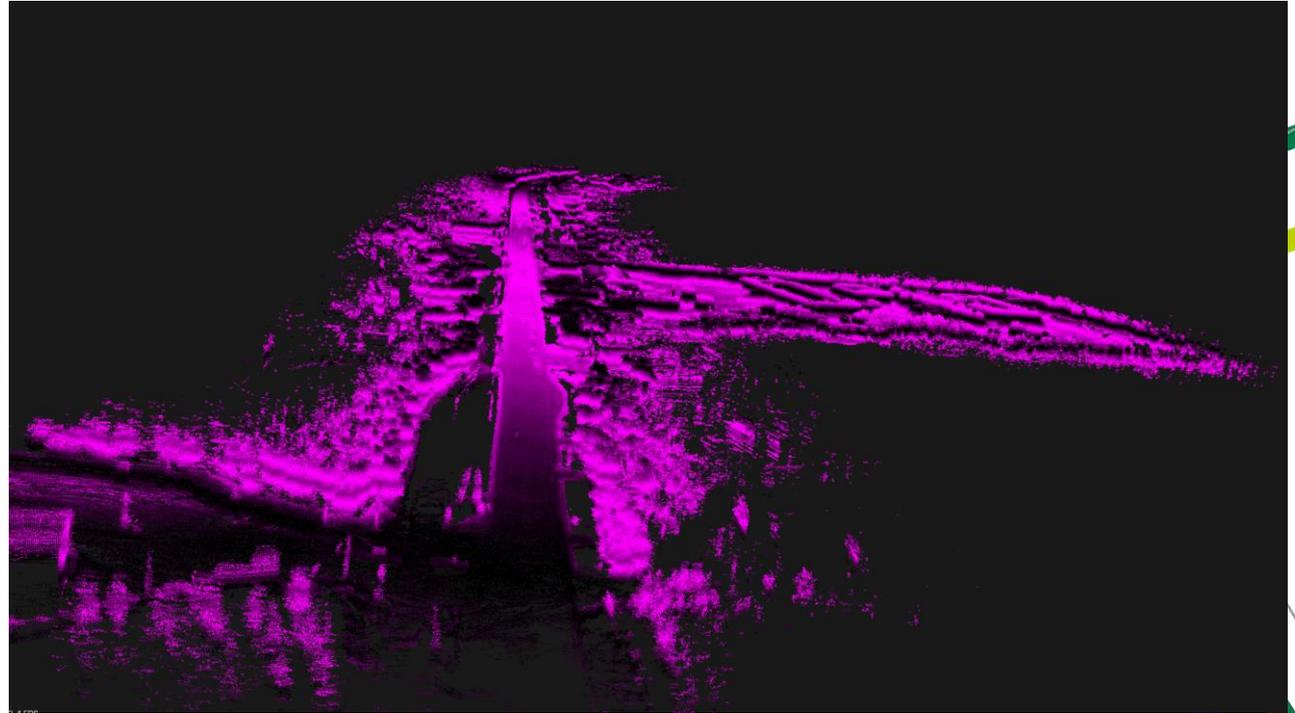


UWB test set-up:

- UWB beacons installed on both sides of road (40-80 meter distance between beacons)
- Tracker measures distances to beacons and information is used on navigation
- Distance between first and last beacon was 520 – 680m depending on test
- The distance measurement error is independent of distance.
- Weather does not affect for UWB range or accuracy based on these tests
- At higher speeds (>55km/h) positioning accuracy is getting worse with current test setup.



Lidar + inertia case: Rural winter conditions



Lidar position accuracy was measured in longitudinal and transverse directions to



Y = +/-
10mm
X = +/-
200mm



1. Posts and poles:

Reflectors made of aluminium and encapsulated in plastic selected for further testing. Angles of reflective surfaces and vehicle movement further tested.

2. C-ITS hybrid communication

Short range (ITS-G5) radio communication managed to sent safety related warning information to the driver in cold arctic conditions

3. Positioning:

Combination of a 3D laser radar, 3D map and an inertial and satellite navigation system - centimetre accuracy in any weather.

UWB radio beacons - edge of the road located with an accuracy of a few cm in varying winter conditions.

In other vehicle trials automated vehicle researched a speed of 40 km/h on snowy roads **filtering snow dust from radar sensors' observations**





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Robot shuttles from trials to deployment

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SOHJOLA

2016 - 2018

Challenges & lessons learned

- For automated electric buses, conditions are still a limiting factor
- Close and interactive cooperation between authorities and testing organisations is crucial already in the planning phase
 - In urban settings, city transport planners should be involved as early as possible
 - Including police in the discussions from the start
- Real urban environments are always more complicated to test in than expected
 - Illegal parking issues, lots of pedestrians and cyclists

Automated remotely operated bus technology

- Developing software platform for remote control of robot buses
- Using 5G network as an enabler technology
- Real-time sensor data
- AI assisted human-machine communication
- Development of a remote control room
- Exploring how autonomous vehicles could be fitted to existing mobility ecosystem
- Evaluating future business potential
- Assessing the user experience of both passengers and remote operators

PARTNERS



Tekes

DEMOS
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aiGO public transportation pilot project

aiGO automated test vehicles in open pilot at Kivistö, Vantaa 7.5 - 11.7.2018. Pilot is open to public and free to try. It aims to be operational Monday - Wednesday every week from 10 am to 2 pm. Please check our twitter channel @sensible4td for daily timetables and other updates.

sensible 4 GIM Robotics HYBRIA KYTY
 EIKU design LAMK HAMK TAMPERE UNIVERSITY OF TECHNOLOGY
Lahden ammattikorkeakoulu
Lahti University of Applied Sciences HÄMEEN AMMATTIKORKEAKOULU
HAME UNIVERSITY OF APPLIED SCIENCES
 ESPOO ESBO HÄMEENLINNAN KAUPUNKI Vantaa



Metropolia Robot Bus @AutomatedbusFI · May 14

Historical Moment in Kivikko, #Helsinki RobotbusLine 94R starts operating 14th May 2018 by @metropolia as addition to @HSL_HRT public transport services. More @automatedbusFI #robobus @mySMARTLife_eu Public vote design for the bus, check spark.adobe.com/video/VL2JZrvZ...



Photo: M

10.31.18

Muji just made a driverless shuttle bus, and it's a minimalist wonder on wheels



BY MELISSA LOCKER 1 MINUTE READ

Muji just made autonomous vehicles slightly more chic. The minimalist Japanese company has teamed up with Finnish autonomous driving company [Sensible 4](#) to create the Gacha shuttle bus, an autonomous vehicle that it claims is the first in the world designed to function in all weather conditions.



FABULOS – pre-commercial procurement of novel transport solutions

End goal: automated minibus service as part of the Helsinki public transport system

- Feedback from the open market consultation:
 - Combine the service with parcel delivery.
 - The need to become totally driverless to keep the cost down.
 - A hybrid solution offers the best chances. It is flexible, works with vehicles that already have type approval and is affordable and easy to scale up.
 - The need to serve new areas where traditional public transport is not economically sustainable.
 - Ticketing should be done with existing methods.
 - Sufficient ridership and related revenues are essential.



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Leading country in 5G
technologies deployment

*Responsible traffic.
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Becoming leading country for 5G

- 5G Momentum test ecosystem to enhance and foster development of 5G trials in Finland
 - Covering all aspects including transport
- 5G Spectrum auction concluded in 10/2018
 - 3 operators to deploy 5G technologies and to develop networks

Finland's path to becoming a leading 5G country: Spectrum auction concluded

Published 01.10.2018

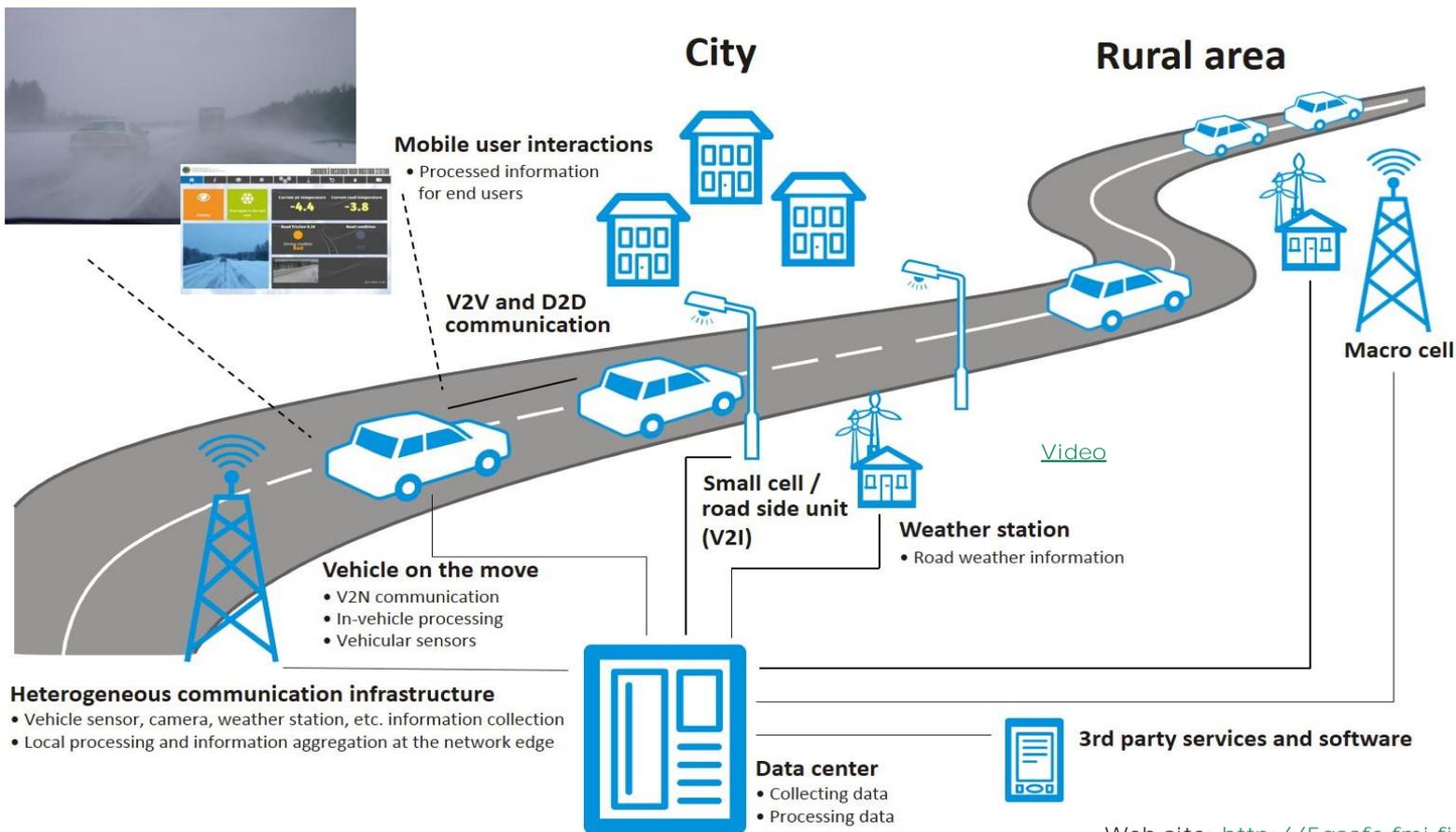


The auction on three licences within the 3410–3800 MHz frequency range ended on October 1, 2018.

Results of the auction:

FREQUENCY BANDS	WINNER	WINNING BID
3410 - 3540 MHz (A)	Telia Finland Oyj	€ 30,258,000
3540-3670 MHz (B)	Elisa Corporation	€ 26,347,000
3670-3800 MHz (C)	DNA Plc	€ 21,000,000

5G-SAFE Road safety enhancements enabled by 5G



Scania and Ahola Transport agree on semi-autonomous platooning



7 MARCH 2018

[News](#) | [Press releases](#) | [Autonomous Transport Systems](#) | [Platooning](#) | [Scania](#)

Scania announces a partnership agreement with Finnish company Ahola Transport to implement new transport technologies on Nordic roads. This marks the first customer agreement in Europe for semi-autonomous truck platooning on public roads. The partnership will also focus on developing other new transport technologies related to driver assistance.





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Hybrid communication development – C-ITS trials

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Hybrid C-ITS corridor

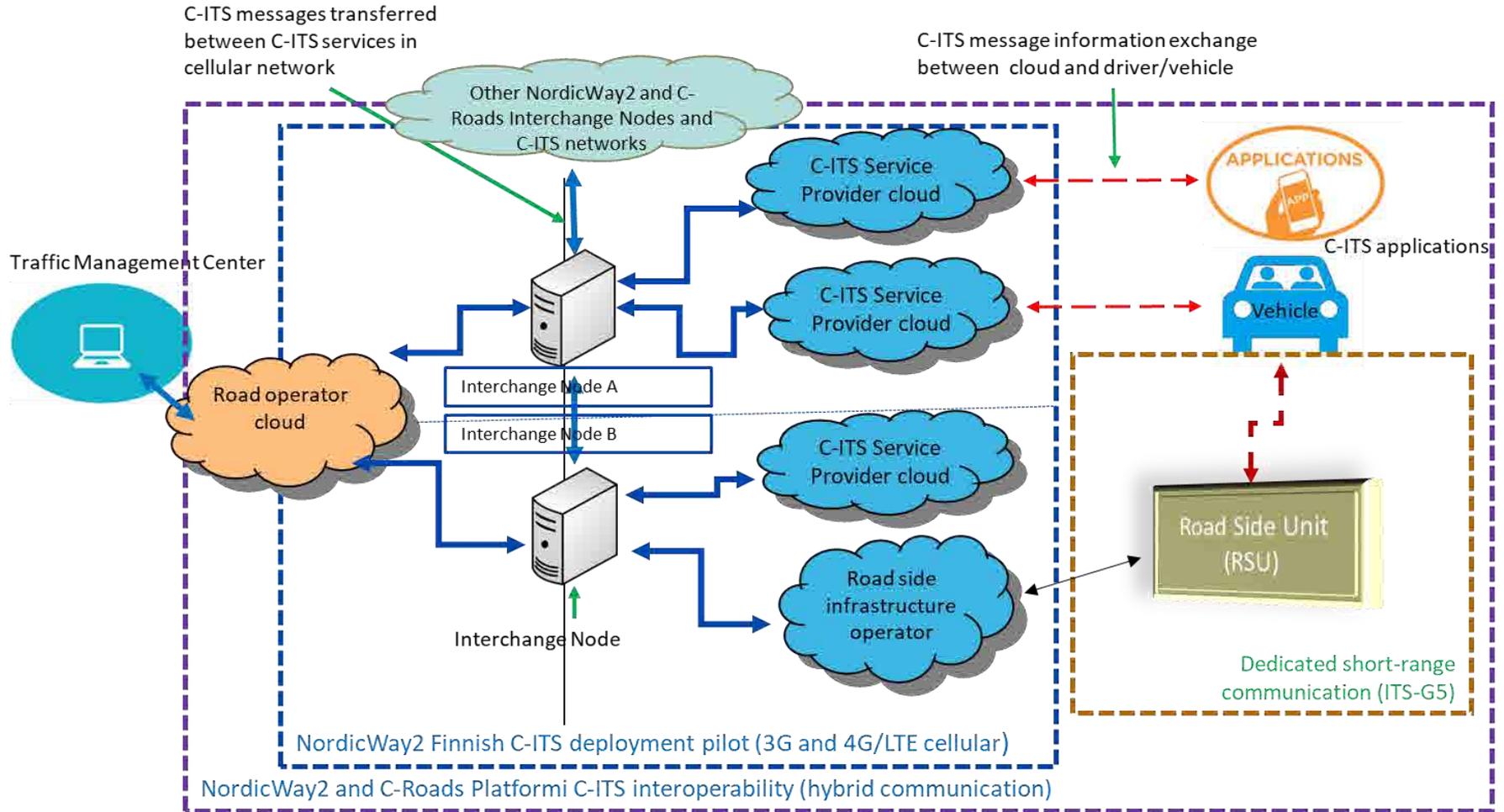
- ✓ Day 1 Safety Related Traffic Information with support of Day 1.5 and beyond services
- ✓ Interoperability demonstrated in 2017
- ✓ Ecosystem for the data value chain and stakeholders



Co-financed by the European Union
Connecting Europe Facility



C-ITS deployment pilot foundations



Rethinking transport— Towards clean and inclusive mobility

27–30 April 2020, Helsinki



Organised by:



Rethinking transport
#TRA2020