Objectives

1. **Invisible lanes and road markings**

   ➢ How to plan near-future manoeuvres?

   ➢ How to position the vehicle in the lane?

2. **Turbulent snow wall that blocks visibility completely**

   ➢ How to reliably detect other road users?

   ➢ How to localize accurately?

3. **Icy and slippery roads**

   ➢ Requires adapting actuator control
   to very different environments

**Extending Automated Driving
in adverse winter weather**
with ADD Enablers

VTT (Ⓗ) **BOSCH**

ika | **RWTH**AACHEN UNIVERSITY   ΕΠΙΣΕΥ ICCS

Hi-Drive

Objectives

The tests are carried out in the North of Europe

Joint effort with Bosch and ICCS providing
Hotspot Map and cellular network availability
for VTT's demo vehicles

Automated Vehicles supervise a route when
heavy snowfall completely blocks LiDAR sensors and
system performance degrades

Based on the cloud-based **Hot-Spot Map**, vehicles
„detect what is missing", and react to the issue by
switching localization modes in real-time

Muonio Finland

Hi·Drive
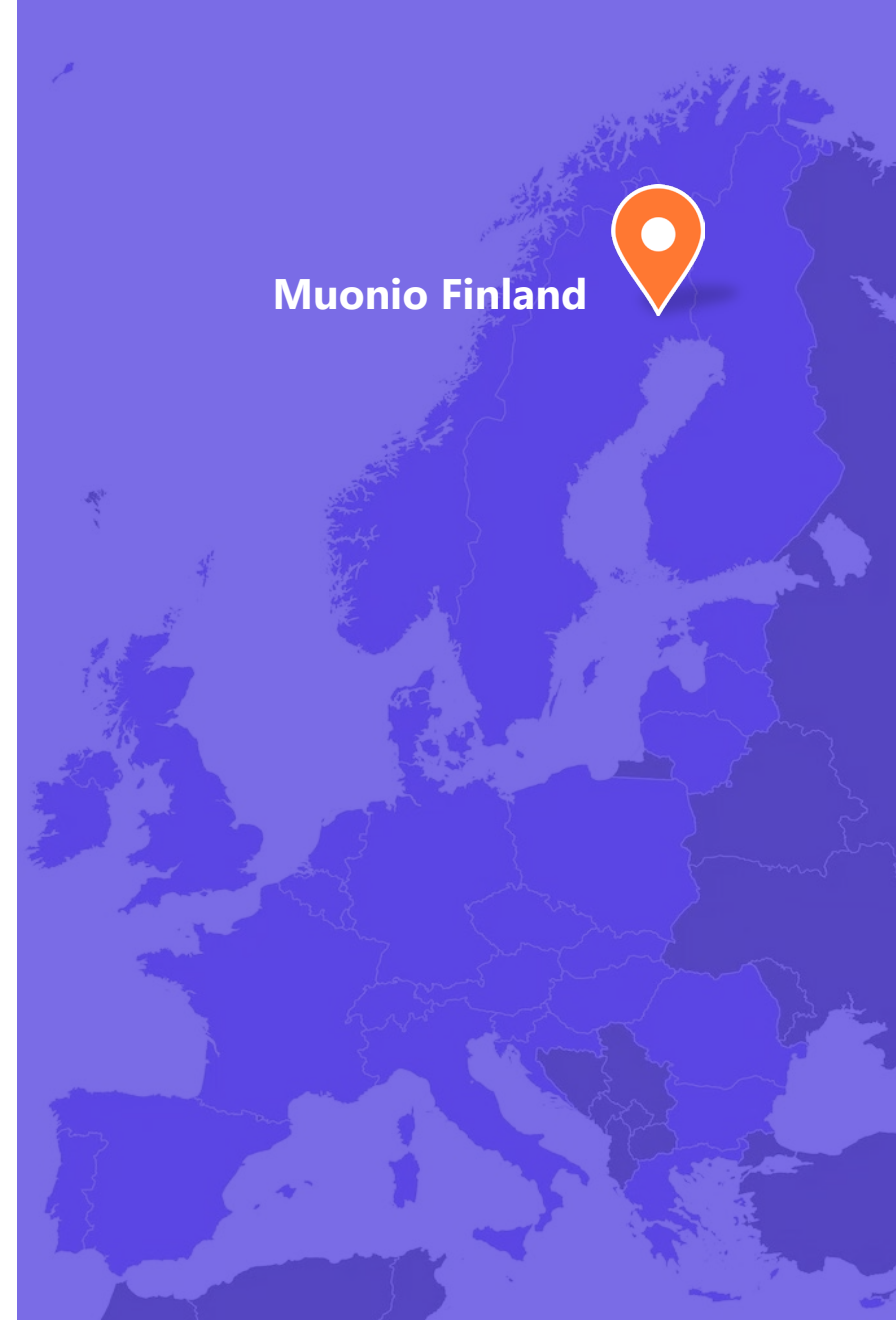
Operation Trials

OP 19.1 Positioning-based information service

- E2.3.3d *"Predictive cellular network QoS and cloud-based notification service"*
- Prediction of network availability in Fi-No cross-border

OP 19.2 Sensor fusion for localization

- E2.4.1a "Positioning based information service"
- Cloud based system to aggregate environment perception data to the back-end system

OP 19.3 Object detection

- E2.4.1a for recognising the landmarks in adverse weather
- Enhance the object detection of vehicle with using pre-recorded targets in case of turbulent snow
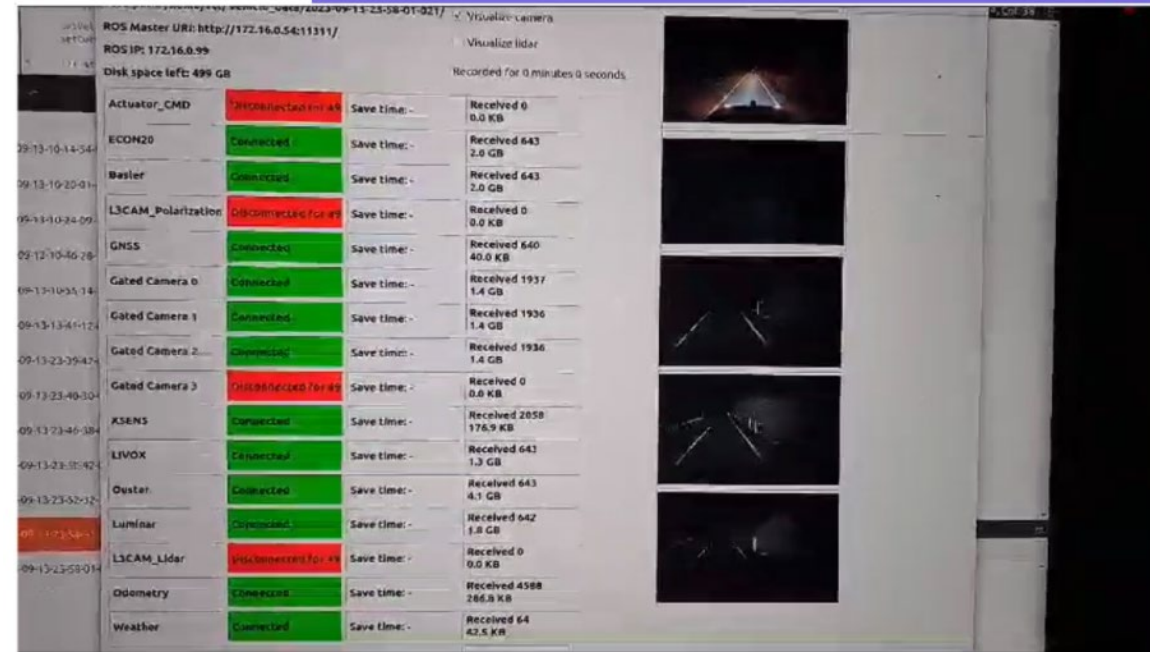
Testing and data collection

First field trial in early 2023 in Muonio, Finland

Implementation of hot spot mapping enabler

Special case is influence of snow for vehicles perception sensors:

➢ Blocks optical sensor views (camera, lidar)

➢ Produce false positives due to the above

➢ Sticks to the sensors, creating more permanent visibility blocking than water or fog

Implementation during Roadshow #1

Use of **landmark database** provided by Bosch

Bad weather scenario

➤ LiDAR sensor blinded by snow
➤ **Localization mode switched on-fly**

Automated vehicles connected to **Bosch landmark database**, and estimated how to perceive nearby known landmarks

Connectivity prediction via Hot-Spot Map

Implement ICCS/Bosch enabler for **extending automated driving without satellite position error correction signal**

ML model by ICCS predicts areas where mobile connection is unreliable or completely lost

A database provided by Bosch is used for query connectivity predictions based on its state (location, speed, etc...)

The aim is **to react to expected connection losses** (slower drive speed, switch localization method...) in advance

~40 km
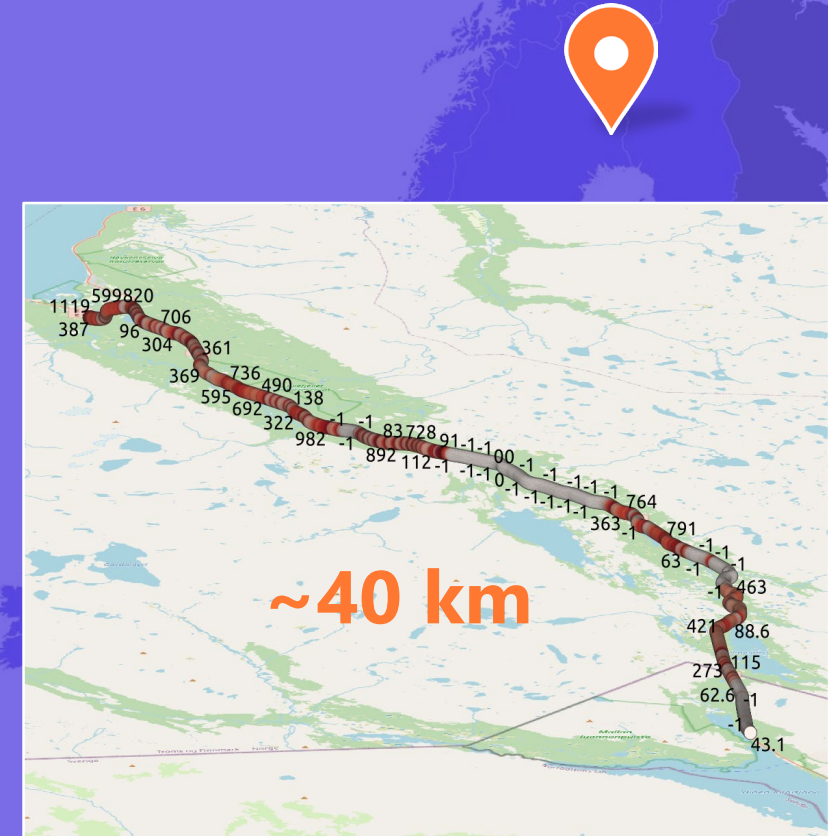
Baseline cross-border trials
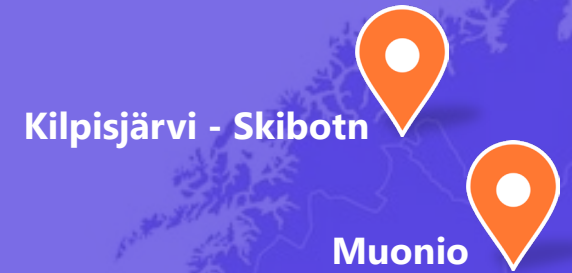## September 2023

Training data for ML models

Predict connectivity in specific world points -
collecting real-world data to match

Drive back and forth around a target area while
recording as many parameters as possible

➢ Vehicle data (coordinates, movement, ...)

➢ Network data (signal strengths, operator data, delays, ...)

Model an especially challenging area
where mobile connection can cut off completely

Kilpisjärvi - Skibotn

Muonio

Hi·Drive

Mosquitos – the fancy new edge case!

Any good research project reveals something
unexpected... ☺

Mosquito season in Northern Europe
is from May to September

A serious problem not only for windshield
cleaning but also **for sensing devices**!

During peak season vehicles are completely
blind after 50 km of driving

Hi·Drive

Next steps

Additional data collection using VTT vehicles in varying locations
to allow further development of the ICCS model, and Bosch database

Vehicle software solution for **getting real-time information**
from the Hot-Spot Map

Specific **scenarios where the Automated Vehicle** reacts
(driving behavior changes) based on the received predictions

Feed the data in common data format to the database of IKA

Prepare for next winter season:
Field studies planned on Jan-Mar 2024

THANK YOU FOR
YOUR KIND ATTENTION.

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