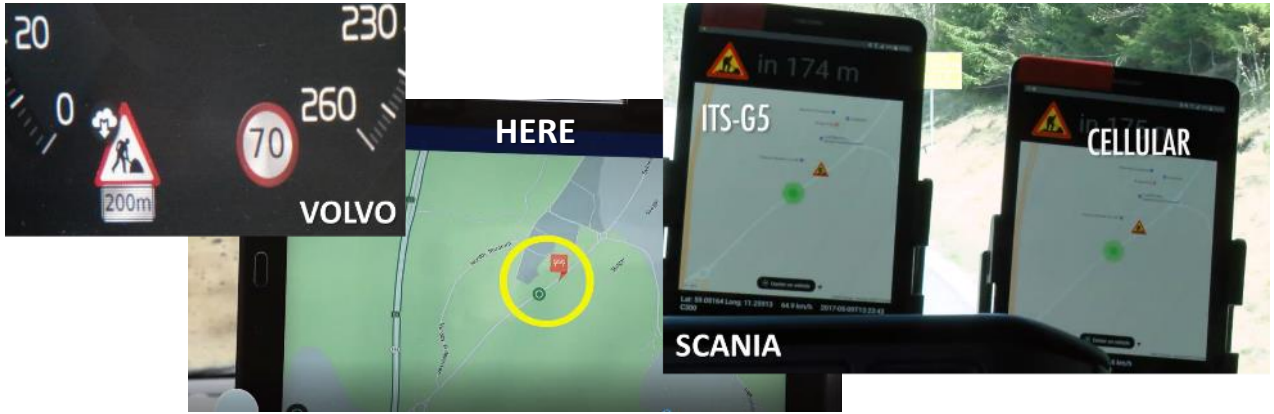
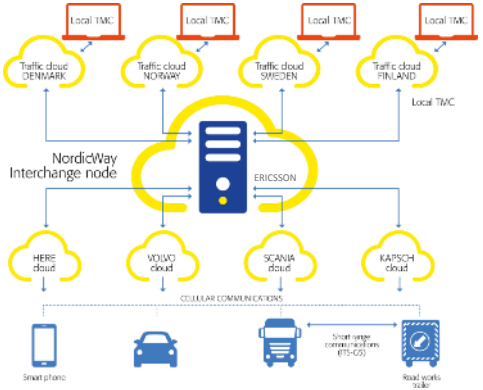


Nordic WAY



NordicWay

Cellular C-ITS Corridor
Final results & lessons learned

Risto Kulmala
Project Coordinator, Finnish Transport Agency

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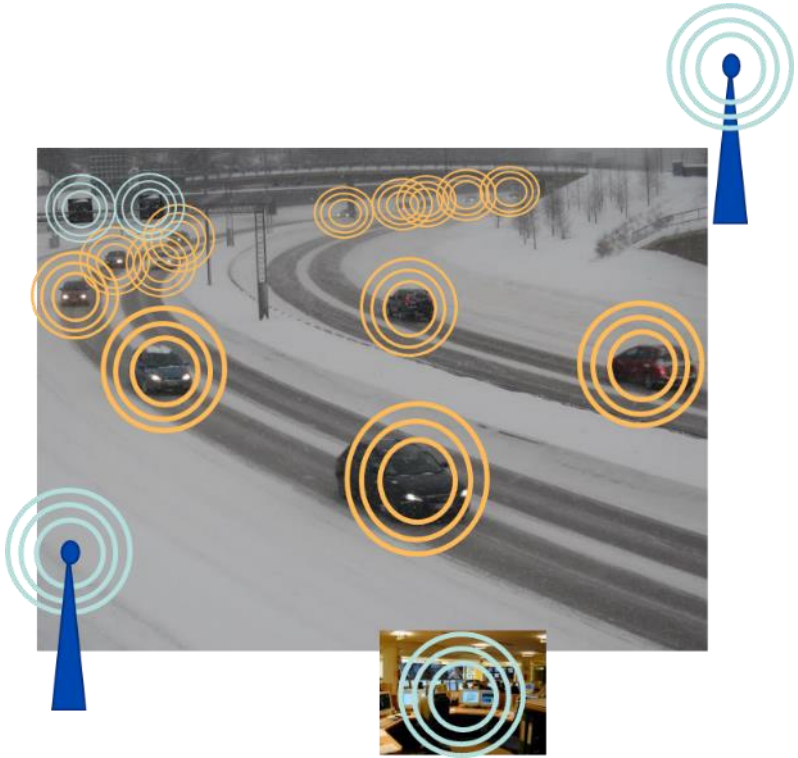
Objectives

- Pilot deployment of C-ITS (Cooperative ITS) utilising cellular networks as the basic communication infrastructure
  - technical performance of communication solution, especially latency
  - impacts, benefits, costs
  - user acceptance
- Prepare for large-scale deployment of cellular C-ITS
- Facilitate automated driving and MaaS services



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Partners

Country	Denmark	Finland	Norway	Sweden
Beneficiary/ Implementing body	Danish Road Directorate	Ministry/ FTA Trafi	Norwegian Public Road Administration	Swedish Transport Administration
Service providers		HERE Infotripla	Volvo Cars	Ericsson Kapsch TrafficCom Scania Volvo Cars
Project Office, Evaluation	Genua	VTT	SINTEF	SWECO

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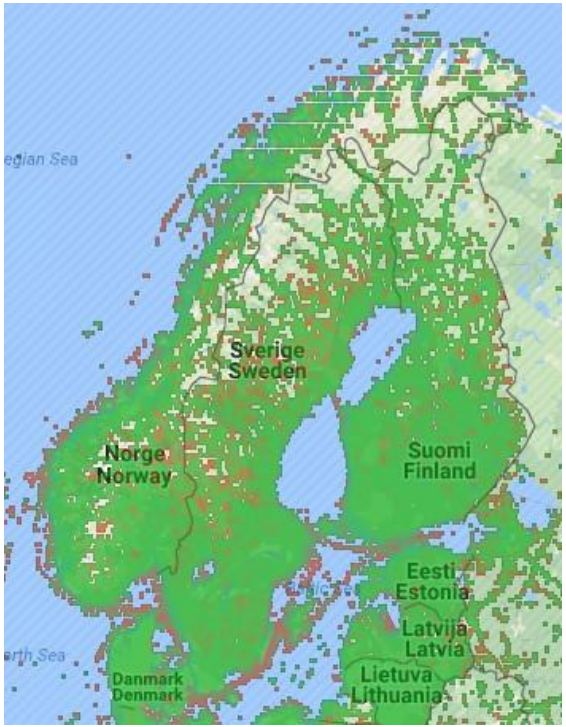
Scope – rationale

- Long road networks and low traffic volumes
- High coverage of cellular 3G/LTE connectivity
- High level of and ambitions for road safety
- ITS Directive Priority action c) safety-related traffic information
- Incidents often main origin of congestion
- Close ITS cooperation DK-FI-NO-SE since1995



- High-potential for Day1 C-ITS hazard warning services utilising already existing cellular networks throughout Nordic countries

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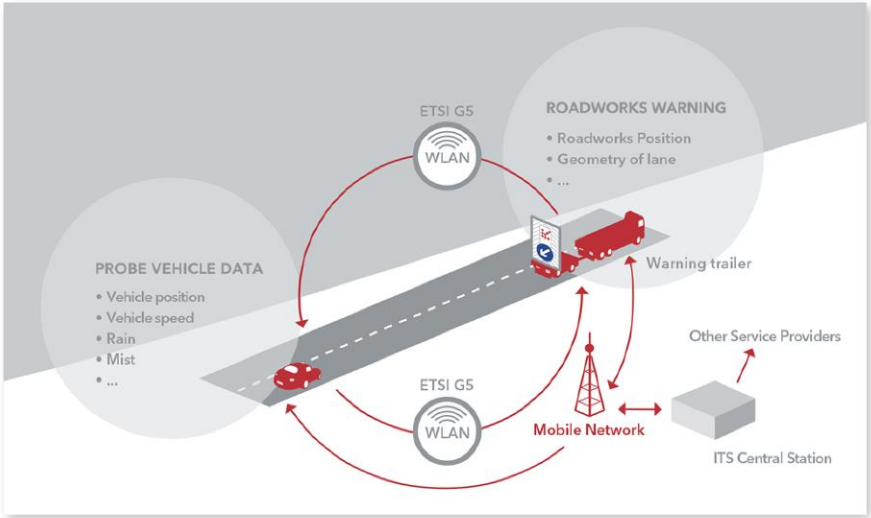
Scope – hybrid communications

- Hybrid communications – combination of direct/short-range and medium-/long-range
  - Cellular medium-/long-range the basic solution for ”total” road network coverage; short-range implemented in ”hot spots”
  - Development of standards, processes, interoperability, security etc. – focus in short-range/ITS-G5
  - Aim: provide the missing cellular medium-/long-range elements with special focus on cross-border interoperability



Cooperative ITS Corridor 2015

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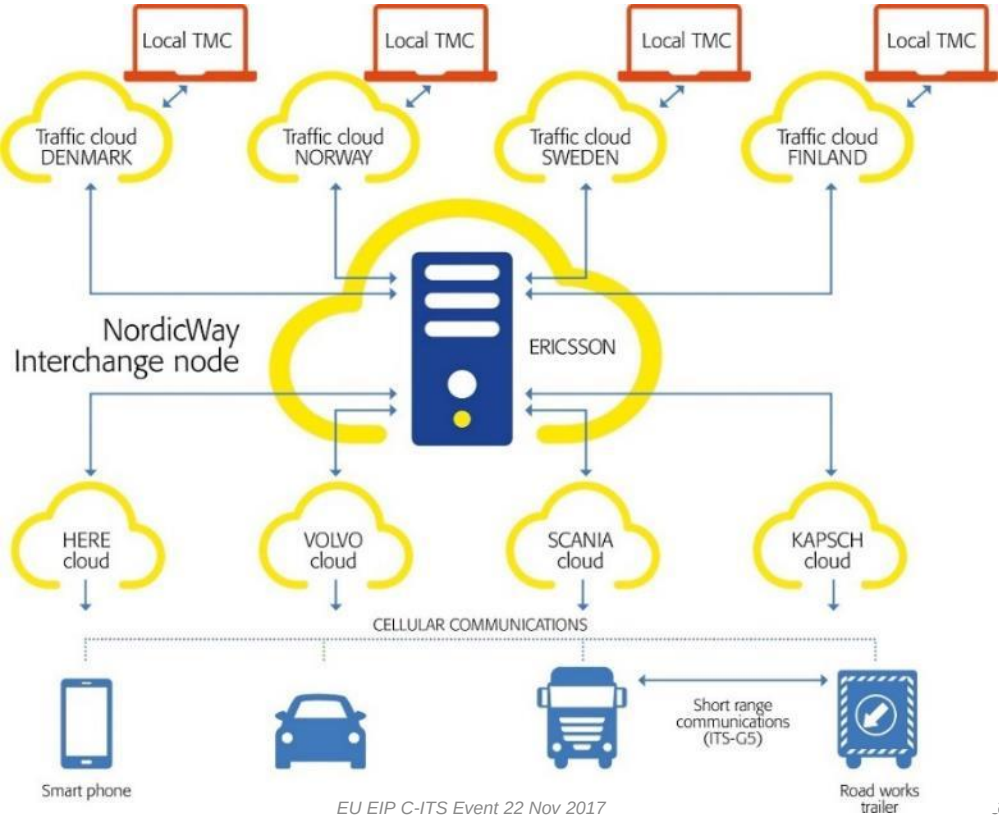
Key result 1 – The architecture

- Architecture designed to:
  - Fit with North European road transport system
  - Be border agnostic
  - Be relation agnostic
  - Accomodate hybrid C-ITS communication
  - Build on standards
  - Make use of existing structures to shorten time to full C-ITS implementation
  - Be scalable to European level
  - Support further development



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Key result 2 – The ”standards”

- Messages: DATEX 2 used for all messages routed
- Messages: DENM profile and message specification adopted to Cellular Communication (for hybrid use)
- The NordicWay Interchange Node (delivering C-ITS Day 1 SRTI messages) using already existing standards AMQP 1.0 (queueing protocol), TLS (security) and DATEX 2 (messages).
- Geo-referencing, we need to pick one method

- Key learning: Standards are not enough. Much effort needed on profiling within standard (in particular DATEX 2)

AMQP = Advanced Message Queuing Protocol

TLS = Transport Layer Security

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Key result 3 – Ecosystem enabler

Ecosystem requirements and ambitions:

- Very different organizations (authorities, service providers, vehicle OEM´s, comm providers,…) can participate within the same ecosystem
- Very different driving forces behind these organizations (road safety, profit from services, profit from vehicles, …)
- The solution allows for all kinds of relations between organizations involved, each relation with its own business agreement
- All roles within the organization can be subject to competition (authority exceptions?)
- The ecosystem should be inclusive – easy to join and select your preferences – and stimulate business
- This requires an architecture that is “relation agnostic”
- The ecosystem supports short time to deployment (open for aftermarket solutions, easy to join, …)
- The ecosystem should support further innovation (beyond Day 1,5 services)

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Key result 5 - Maturity

- C-ITS is happening today. Digitalization is a major driver in industrial development and in citizens life. SRTI is today subject to disruptive development
- If “road transport”, and in particular responsible authorities, want to retain its position, it cannot wait for development to be made
- A key achievement of NordicWay is to build and demonstrate a fully interoperable C-ITS ecosystem based on mature technologies and available standards
- Already existing services, devices and users can be connected to the C-ITS clouds which makes it possible to scale up C-ITS services faster

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Key result 5 - Scalability

- Scalability is a design requirement for NordicWay, reflected in the architecture
- The next step is to work further on the architecture, as a single Interchange Node may not fulfill the requirements of all stakeholders, and a more federated architecture consisting of multiple Interchange Nodes can be required
- NordicWay results are open!

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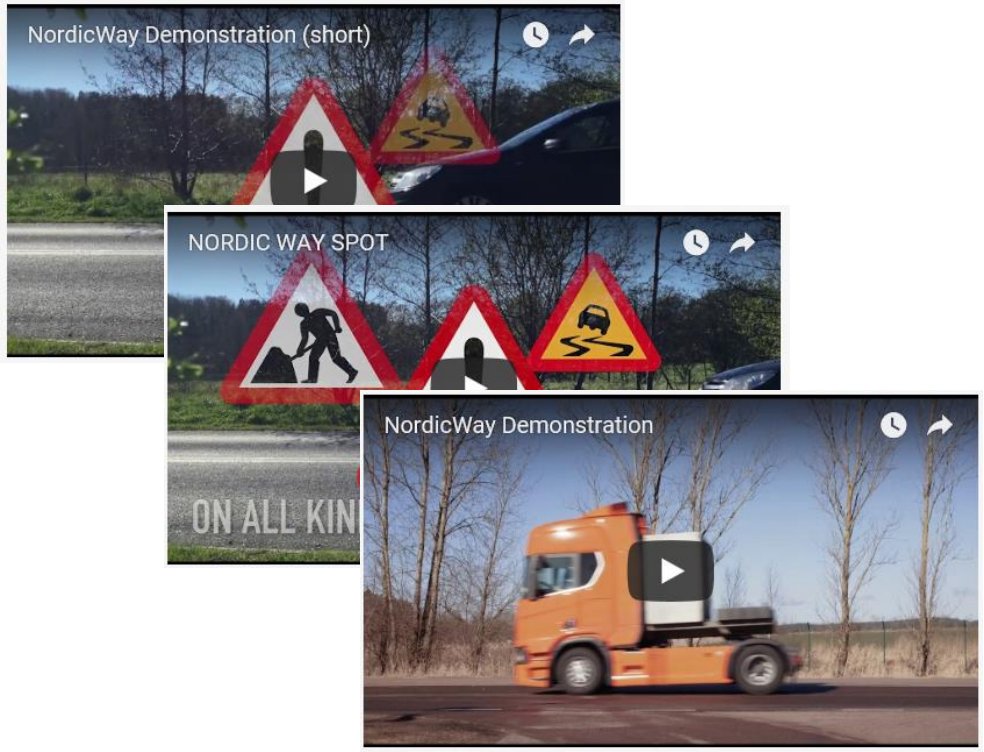
Key result 6 - Demonstrations

- Considerable efforts made on demonstrations involving all project participants
- 10 May 2017 demonstration live streamed across Europe
- Supported by demonstration in Denmark/Copenhagen
- Slippery road demonstration in Gothenburg
- All recorded and developed into information, notably videos all available at www.nordicway.net



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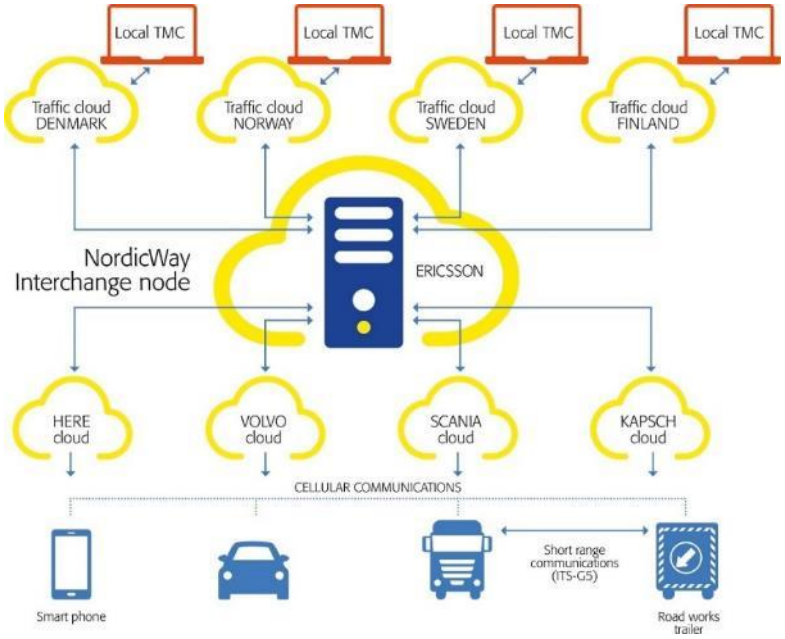
Result 7 - Latencies

- Low latencies in the order of 0.3-2 seconds obtained
  - Latency depends on mobile network version (3G, 4G)
- Interchange Node latency average 60 ms
- High reliability (message success rate 100% in Sweden)

- Delays caused by:
  - Problems in the mobile communication network
  - Problems with the servers
    - Current version of Interchange Node is a prototype, only



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Assessment in NordicWay FI pilot

- 1 270 test users involved in assessment
- Field tests from May 2016 to April 2017
  - GPS tracking
  - Questionnaires
- Extended test area marked on the map

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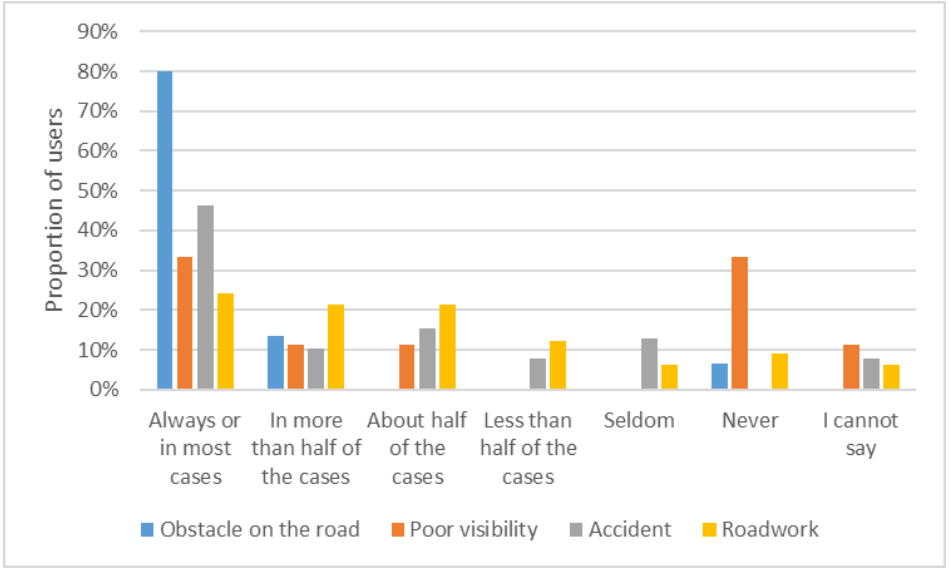
Key result 8 - Usefulness

- Often the first source of information for obstacles on the road and accidents ahead
- Additional value of service
  - More specific location of the disturbance (57%)
  - Only disturbances close to the vehicle (45%)
  - Disturbances not heard from other sources (45%)
  - Only 11% felt that the app brought no additional benefit, and 4% chose ‘I cannot say’



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Key result 9 - User uptake

- Priority of the warning types
  1. Accident
  2. Obstacle
  3. Slipperiness
  4. Roadworks
  5. Exceptional weather
  6. Poor visibility
- Suggestions for additional warnings

  Traffic jam, Moose/elk/reindeer/other animal on the road, Abnormal driver behavior, Damaged road, Police, Traffic cameras, Special transport

- Willingness to continue using the application
  - 'Yes': 95% of experienced users, 86% of less experienced users
    (Note relatively low response rate)
  - Most commonly: 'Yes, as part of smartphone navigator' (54% of experienced users and 45% of the others)
  - Only 2% of experienced users and 8% of the others would not be willing to use the app

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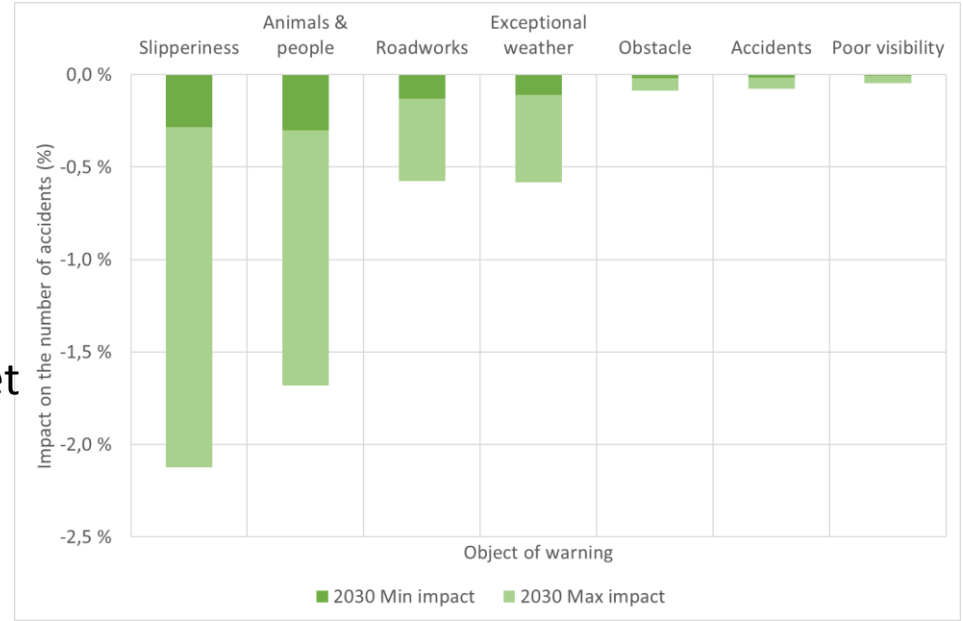
Key result 10 - Safety impact

- The nine potential safety impact mechanisms of ITS considered
- Safety impact assessed based on
  - Frequency of target accidents
  - Coverage of warnings
  - Effectiveness in prevention of the accident
  - Penetration in traffic
- Overall safety impact in 2030 on target roads
  - 0.8-4.6% decrease in injury and non-injury accidents
  - 0.6-4.0% decrease in fatal accidents

Direct safety impacts for the target roads



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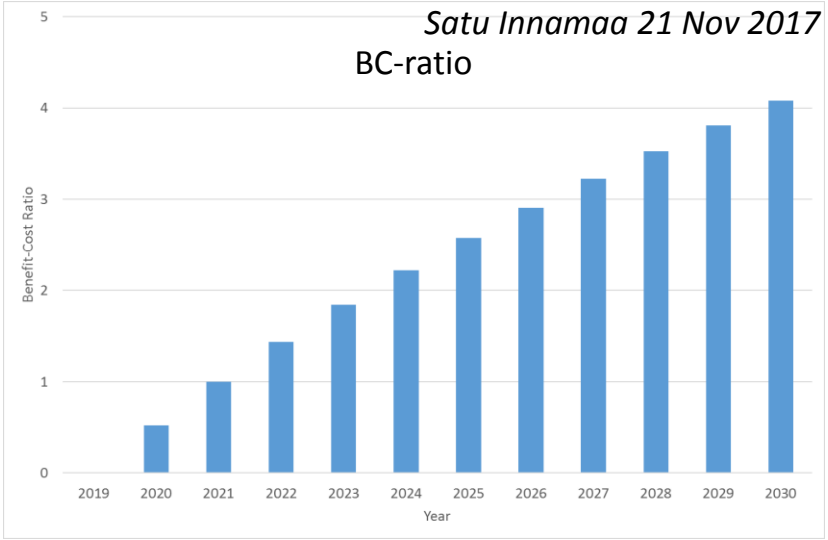
Key result 11: Socio-economy

- Benefits scaled up from 2019 to 2030 linearly
- National unit values used for accidents (fatal, injury, non-injury) and travel time (light and heavy vehicles) with 1.125% annual increase from 2019 onwards
- Costs
  - Service fee increasing linearly fro 500 000 – 750 000 €/2019 to double of that in 2030
  - Phone holder for 40% of new users each year, 5 €/each
- Discounting with 3.5% to 2019
- Benefit-cost ratio for period 2019-2030 for smallest impact and highest price: 2.3



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Lessons learned

- Interchange Node – the scalable solution for EU and beyond
- Standards not enough – profiling needed
- Mobile networks
  - Continuity across borders can be a problem
  - 4G much better than 3G for latency, prepare for 5G
- Willingness to share data
  - Not a problem for safety-related
- Simple HMI with similar look & feel important
- Well accepted among users
- Good safety impacts with high benefit/cost
- Cloud2Cloud security needs attention
- The way forward
  - NordicWay 2 – towards large-scale deployment

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Lessons 2: Remaining issues

- Interface to user: HMI
- Trust in the service
- Continuity across borders
- Precise and reliable satellite position
- Service coverage
- Dynamic routing
- What is the end-product?
- Legal: different rules in different countries

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Read all about it!

- Final report
- Final evaluation report
- Videos, presentations, etc.

- **www.NordicWay.net**

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