



Nordic
Innovation

NOMAD MaaS roaming final report

Appendixes

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Appendix 1: Reading Guide

Due to the project's long duration, changed of partners, experts, scope, and work programs, it has been challenging to make the project reports consecutive and consistent.

This report is building on the previous reports given by the project in:

- November 2020: Nordic Smart Mobility Project Status Report
- November 2022: NOMAD Report and New plan - Version 2 as submitted

The end reporting to Nordic Innovation is divided in four parts:

- NOMAD End Report
- Annex 1: A representative use case description
- Annex 2: Financial Report
- NOMAD Final Report – description and project results
(this report)
 - Appendix 1 to 6.

Appendix 2: Glossary

Clearing	If a multimodal journey is paid as a total to the MaaS agent, clearing defines the service to ensure that each mobility service provider gets the correct payment for their contribution to the combined journey.
DRT	Demand Responsive Transport
FRAND	Acronym for fair, reasonable, and nondiscriminatory - is often used in relation to technical standards that are developed through an open, consensus-based, and industry-led standardization process.
MaaS	Mobility as a Service.
MaaS agent	A digital service provider delivering multimodal journey planning, booking, payment and navigation to end users. The MaaS agent is ideally a one stop shopping service for combining ground and sea based mobility services into attractive multimodal journeys from door to door.
MaaS roaming	NOMAD (Nordic Open Mobility and Digitalization) is a research and innovation project funded by Nordic Innovation and coordinated by ITS Norway that aims to develop an open, pan Nordic mobility system for MaaS solutions. The project explores the concept of roaming as a means to inspire to service agreements between MaaS operators that will benefit individual travelers and organizations, and that will support parallel developments in open data standards within the Nordic region.

MDMS	Multimodal Digital Mobility Services. An EU regulation expected to be adopted in 2023. Planning and buying tickets for journeys that combine different modes of transport can be cumbersome for travellers in the EU. To compare different options, many use digital services such as route planners and ticket vendors. This initiative addresses challenges for these services and implements Action 37 of the sustainable and smart mobility strategy. It aims to better integrate public transport and rail services to achieve seamless multimodal passenger transport, delivering the EU Green Deal.
MMTIS	Multimodal Travel Information Services. EU regulation EU 2017/1926 on open mobility data for scheduled and on demand modes of mobility
Mobility Service Provider	A mobility service provider delivers mobility services for sale to end users. It can be public transport but also private mobility actors. Modes can be scheduled or available on demand.
Multimodal travel	Multimodal travel uses different modes of transport to produce a seamless door-to-door travel experience.
NAP	National Access Point. An integral part of the MMTIS regulation. Each nation shall operate a NAP and ensure that open mobility data herein is complete and at a high-quality level.
NeTEx	NeTEx is a CEN Technical Standard for exchanging Public Transport schedules and related data
NOMAD	NOMAD (Nordic Open Mobility and Digitalization) is a research and innovation project funded by Nordic Innovation and coordinated by ITS Norway that aims to develop an open, pan Nordic mobility system for MaaS solutions. The project explores the concept of roaming as a means to inspire to service agreements between MaaS operators that will benefit individual travelers and organizations, and that will support parallel developments in open data standards within the Nordic region.

Nordic Innovation	Nordic Innovation is an organization under the Nordic Council of Ministers. It aims to make the Nordics a pioneering region for sustainable growth by promoting entrepreneurship, innovation and competitiveness in Nordic businesses. Nordic Innovation support the Nordic prime ministers' vision that the Nordic region will become the most sustainable and integrated region in the world in 2030.
ODIN	The ODIN project aims to accelerate and coordinate the work necessary to create a unified market within the mobility sector in the Nordics. The work started as a project coordinated by RISE ICT Viktoria (Research Institutes of Sweden) funded by the Swedish Transport Administration and the Swedish Innovation Agency. Current members include Danish Traffic-, Housing- and Construction Agency, Entur, HSL, LMJ, Norwegian Railway Directorate, Rejseplanen, Samtrafiken, SFMCON, Swedish Transport Administration, Traficom and Fintraffic.
PTA	Public Transport Administrator/Authority
PTO	Public Transport Operator
SIRI	SIRI is a standard for exchange of information between servers containing real-time public transport vehicle or journey time data.

Appendix 3: The Concept of Roaming

Roaming is mostly known from the telecoms industry where the use of a mobile phone outside its home mobile phone networks reach, is called roaming.

In the Nordics and the rest of Europe we are reminded about roaming when we cross a border. Here the visited mobile phone operator are required to inform of the roaming charges in effect.



Figure 1 Call "home" through mobile operators roaming services.

An example of a roaming call can be a call home to family from abroad (fig 1). Here the mobile phone call is picked up by the visiting operator's antenna and sent through international phone transit services through the home operator and connected to the receiver's mobile phone.

In principle you can use the phone abroad in the same way as home. The difference only is the extra roaming charges allocated based on whether it is voice, SMS or data.

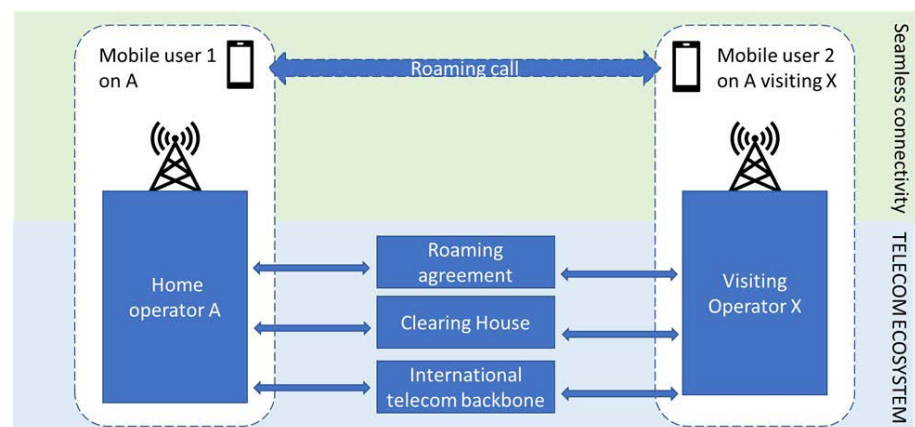


Figure 3 Roaming requires home and visiting mobile phone operators to establish a shared infrastructure.



To facilitate seamless communication through mobile phones when away from the home operators network reach, the participating operators need to be interconnected.

Mobile phone roaming is facilitated by the international telecom backbone which even before the advent of mobile phones supported international phone calls.

International calls using fixed line phones use existing equipment and the cost of the call will go to the owner of the account for the associated phone number.

International calls using fixed line phones use existing equipment and the cost of the call will go to the owner of the account for the associated phone number.

International calls using mobile phones use the mobile phone owned by the caller and the cost of the call will go to the home account for the mobile phone number.

Roaming agreement: The roaming agreement is a bilateral digitized agreement for how subscribers from one mobile phone operator can initiate and receive calls while within the other mobile phone operator's area of coverage and in particular the roaming tariffs associated.

Clearing of roaming calls: As all mobile phone operators want to allow their users to call from anywhere in the world there is a multitude of roaming agreements in place. If everybody had to settle each bilateral agreement the cost of settlement would be cumbersome and result in as many invoices as each operator had agreements with.

The Mobile operator ecosystem has realized the need to use a common clearing house to clear the many roaming calls across the world.

In principle operators send in digital lists of calls per mobile phone number and references to the roaming agreements for the charges associated. The clearing house clears all the calls and associated roaming charges. The result of a clearing means that each operator then will pay to or get an amount from the clearing house depending on which of the total value of incoming and outgoing roaming is the highest.

Roaming charges differ drastically depending on which roaming agreements are in effect between home and visiting mobile phone operator.

Lower inter-operator prices, better conditions for consumers

The new Roaming regulation sets lower wholesale charges, the cost to operators for using networks abroad to provide services to their customers when they are abroad. The wholesale caps are set at levels that ensure that operators can sustain and recover the cost of providing roaming services to consumers at domestic prices:

- For data services, the new regulation sets the following wholesale caps: 2 €/GB in 2022, 1.8 €/GB in 2023, 1.55 €/GB in 2024, 1.3 €/GB in 2025, 1.1 €/GB in 2026 and 1 EUR/GB from 2027 onwards.
- For voice: 0.022 €/min in 2022-2024 and 0.019 €/min from 2025 onwards.
- For SMS: 0.004 €/SMS in 2022-2024 and 0.003 €/SMS from 2025 onwards.

Lower wholesale charges benefit consumers, as they should ensure that all operators are able to offer competitive roaming subscriptions in line with the 'Roam like at home' principle.

Figure 4 EU regulated inter-operator roaming caps New Roaming rules for travellers in the EU (europa.eu)

The EU implemented caps on roaming charges as the market was not willing to regulate it self on the rather high retail cost of roaming before regulation. The initiative is called "Roam like at home"

The result is that mobile operators have implemented tariff schemes where roaming for some countries are part of fixed price subscriptions or charged within the caps set by the EU.

MAAS Roaming Concept

MaaS roaming is a vision based on the concept of mobile phone roaming.

The idea is to use your favorite local MaaS agent app to plan, book, pay and navigate trips even extending the domain covered by the local MaaS agent – or even starting and ending in visiting MaaS agencies domains.

Your local MaaS agent app can be brought along and will carry the travel plan and associated tickets and/or booking references for validation or unlocking a shared mobility service. Bringing the local MaaS app along on a smartphone is in fact enabled through the low roaming charges for data between the Nordic mobile phone actors.

Before travelling:

The user of a local MaaS app search for a trip where at least the start or destination address or stop point is outside the domain served by the local MaaS agent.

The local MaaS agent figures out which visiting MaaS agent(s) covers the complete travel plan and sends out a request for suitable travel plans according to the users specification (Departure, arrival, returning, how, how many, price max).

The visiting MaaS agents returns with a set of possible travel plans for the segments within their respective domains and handover points + associated costs.

The local MaaS agent presents the travel plans to the end user.

The enduser selects one and buy the complete trip in one transaction.

The Local MaaS agent commits the parts of the journey from participating MaaS agents on behalf of the user and sends relevant documentation, tickets, seat reservations, unlocking procedure etc. to the user through the local MaaS app.

Travelling:

The local MaaS app holds all relevant information to navigate the complete trip from door to door and back again for return trips. This includes digitized ticket references for easy validation.

In case of delays, disturbances, lost connections etc the local MaaS app will be updated with the dynamic data covering the trip. Alternative travel plans can be found and bought if necessary.

After travelling:

For DRT modes of transport final charge of rental including extra time/km etc. will first be possible after end of use of the service.

The local MaaS agent keeps all details for the trip for potential complaints handling through customer service.

Extra services: A MaaS agent can offer a range of services on top of the standard consolidated planning, purchase and navigation process.

1. Assist in getting compensation for delays or cancellation in the travel chain
2. Offer an insurance covering delays or cancellations before and during a trip covered by the insurance. The Insurance will cover expenses necessary to reroute through other means of transport to avoid or minimize delay on arrival to destination.
3. Customer support on various levels.
4. Services for users with special needs. Even though the participating mobility actors may cater for special needs this does not cover the transfer between modalities.

The MaaS roaming business case:

For mobile phone roaming the nature of communication between the parties cannot be circumvented.

Historically the telecom actors have set the roaming prices rather high compared to the actual costs of providing the international connection and only regulation has forced roaming prices down in select parts of the world.

The market conditions for MaaS roaming are somewhat different. Public transport tickets are typically fixed prices set by regional or national authorities. As such the price for the journey is not dependent on your country of residence. The same goes for private modes of mobility purchased on demand.

Also in contrast to mobile phone roaming, you can buy the tickets directly from the mobility actor

In Denmark a third party MaaS agent cannot charge more than the listed price for a public transport ticket according to current legislation. (It may charge less)

The big question is how to compensate for the services delivered by a MaaS agent. Some of the Nordic multimodal travel and ticketing services are publicly funded through government or public transport authorities (Entur(N), Rejsekort&Rejseplanen(DK) and Resrobot(S)). Some are privately funded and operate on commercial conditions (TRAVIS, Stockholm and Whim, Helsinki).

The situation is somewhat similar to multimodal air travel planning and booking. You can book directly with an airline but you can also book the same trip from a digital travel agent. The airline is likely only showing its own options and potential partner combination. The good travel agency will show you what the whole market can offer based on your preferences.

It seems that a viable way is for the shared mobility system actors to acknowledge the value of MaaS and MaaS roaming and be willing to compensate the issuing MaaS agent for its sales and marketing services within the value chain.

The whole agenda is to make it easier to opt in for use of shared and more sustainable ground and sea modes of transport than always the private car or inter Nordic air travel.

Examples of Roaming Charges for Mobile Telephone

Roaming charges differ drastically depending on which roaming agreements are in effect between home and visiting mobile phone operator.

Lower inter-operator prices, better conditions for consumers

The new Roaming regulation sets lower wholesale charges, the cost to operators for using networks abroad to provide services to their customers when they are abroad. The wholesale caps are set at levels that ensure that operators can sustain and recover the cost of providing roaming services to consumers at domestic prices:

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Lower wholesale charges benefit consumers, as they should ensure that all operators are able to offer competitive roaming subscriptions in line with the 'Roam like at home' principle.

Figure 34: EU regulated inter-operator roaming caps. [New Roaming rules for travellers in the EU \(europa.eu\)](#)

The EU implemented caps on roaming charges as the market was not willing to regulate itself on the rather high retail cost of roaming before regulation. The initiative is called "Roam like at home"

The result is that mobile operators have implemented tariff schemes where roaming for some countries are part of fixed price subscriptions or charged within the caps set by the EU.

Roaming charges for calls from/to outside the EU and associated countries in Europe are still high and caution should be made to limit use of both voice, SMS and mobile data transfers.

All prices are per commenced minute. The call fee is DKK 0.50 per call made to or received from Denmark, except in the EU where you do not pay call tax.

Prices from Abroad to Danish numbers (outside EU)	Prices
Nordic countries:	
Faroe Islands and Greenland	5 kr. ~ 0,67€
Other Europe:	
Albania, Andorra, Bosnia and Herzegovina, Cyprus (Turkey), Belarus, Kosovo, Macedonia, Moldova, Monaco, Montenegro, Serbia, Turkey and Ukraine	8 kr. ~ 1,07€
Other World 1:	
Australia, Bahrain, Canada, United Arab Emirates, Hong Kong, India, Japan, China, Kuwait, Malaysia, New Zealand, Oman, Pakistan, Saudi Arabia, Singapore, South Africa, Taiwan, Thailand, Tunisia, United States and Vietnam	12 kr. ~ 1,60€
Other World 2:	
All countries not listed under the other zones (except Syria, where you cannot call or receive calls)	24 kr. ~ 3,20€

Figure 35: Example on roaming charges from abroad to Denmark using the Yousee mobile operator www.yousee.dk

Figure 35 shows examples from the Danish mobile operator Yousee, where each commenced minute has a roaming charge from 0,67€ to 3,20€ from abroad to Denmark..

It seems that the market tries to maximize prices to the consumer for roaming charges between countries/operators. Also, that there seems to be a disconnect between the roaming charges and the actual cost to the operators involved.

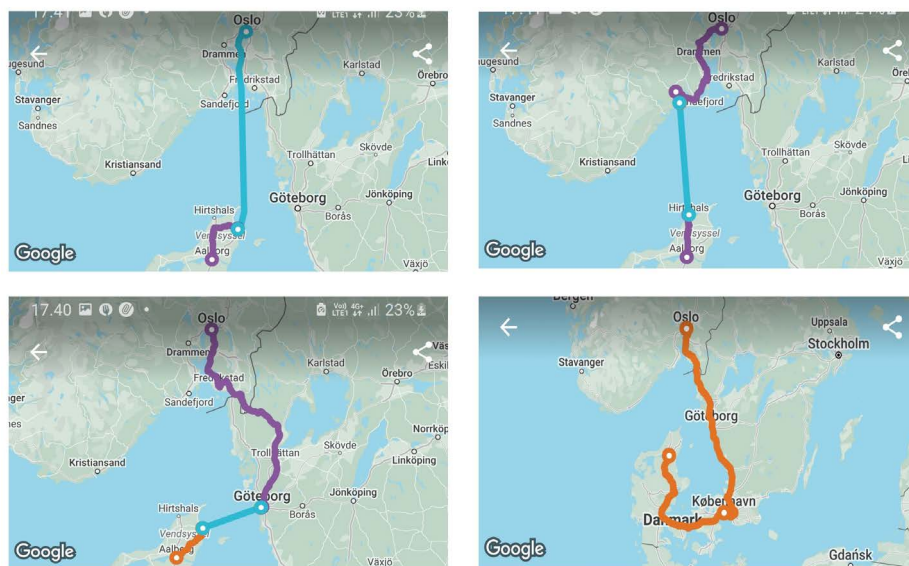
The capping regulation by the EU enforces a more reasonable pricing compared to the cost of providing the service. The aim is to ensure free movement in Europe also when it comes to use of mobile phone and indeed mobile data.

Appendix 4: Multimodal Travel Planning for MaaS

Multimodal travel planning for more than one MaaS domain for scheduled modes of transport.

Multimodal cross border travel plan options may use different border crossing points and data from two or more National Access Points.

Oslo (N) – Aalborg (DK): 4 cross border travel plans –
3 entry points to Denmark – 2 plans using Sweden for transit



Source: Maps from a search in the Rome to Rio App

Figure 32: Multiple Cross border journey options

Going from Oslo to Aalborg there are many multimodal travel plans either directly between Norway to Denmark via multiple ferry connections or via Sweden and again multiple options for ferry and bridge crossing to Denmark.

It is not always enough to combine planning from the origin and destination MaaS domain. To have a complete set of possible travel plans the travel planning tool needs data from all potential NAPs – here Norway, Sweden and Denmark.

The crossing point between the MaaS agents can be different for the travel plan options and include more crossing points to and from transit MaaS domains.

For buying the travel segments the participating MaaS agents need to agree on who books the cross-border ferry segment as it might be defined in both countries NAP's.

The Home MaaS agent will at this stage know which roaming MaaS agents are involved in buying which segments of the journey. Also note that a crossing point does not necessarily have to be on a border. Using train through Sweden the cross-border point from Norway could be Gothenburg for train services and Malmö for the cross-border point to Denmark.

The complete travel plan including the roaming part can be delivered by a common cross border multimodal travel planner service with access to all mobility data in all relevant countries.

Another way is that each MaaS agent can include roaming MaaS agents mobility data in cross border searches. In this way each MaaS agent have access roaming MaaS agents in all neighboring countries and its journey planner engine can absorb especially all possible scheduled modes of services relevant for multimodal journey planning.

Multimodal ticket in the cloud – a joint cross border service allowing for universal validation of a single token.

A challenge for multimodal and even cross border ticketing is validation. The itinerary may include segments from private and public modes of service.

Today ticket validation is not standardized. Each PTA and private operator have closed non standardized systems to represent and hold digital tickets and how to validate them.

In figure 33 you want to go from A to B and has found a travel plan using the modes X, Y and Z. To travel accordingly, you have to buy three tickets in three different ticketing systems. The ticket identifier or token is also only known within the reach of each ticketing system. To complete the purchase, you need to open accounts in up to three different ticketing apps, plus order and pay for tickets, which you hope will match the overall travel plan you have pieced together using one or more travel planner app(s).

Payment will be in the currency of the home country of the mobility service providers. In this example at least two of the segments are in another (Nordic) country. If you would like to know the total price, you have to know the actual exchange rates and add the prices in your local currency.

In a MaaS roaming scenario planning booking and payment is made in one go using a "home" MaaS agent.

In the air travel industry, the reservation systems act as holders of multimodal travel plans and associated tickets for each leg of the journey. Reference to the ticket and itinerary + who issued and sold the tickets reside in the so called PNR (passenger name record). It is possible for the holder of the air ticket, associated carriers and other parties to refer to the PNR simply by a 6 digit code and the last name. A similar service is needed for Multimodal and especially cross border tickets

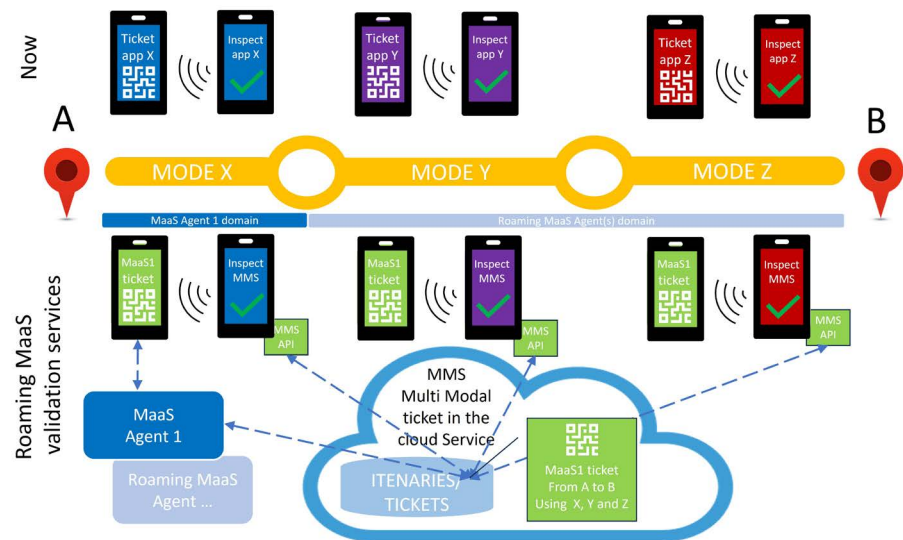


Figure 33: From incompatible validation methods to a unified method.

In such an approach a record is opened in a Multimodal ticket in the cloud service (MMS).

The MaaS agencies involved in selling the ticket is listed and so is the multimodal travel plan with actor references from the MMTIS registers.

The whole record is referenced to using a barcode including information on which MMS is holding the ticket for the journey.

For validation of tickets the validation equipment needs access to the ticket in the cloud. This can be established using a dedicated app or an API for integration into existing validation control systems. Indeed, mobility actors may decide to use this ticket validation service, even for single or multimodal tickets within their own span of operation.

By using online verification, it is possible to check for fraud. The controller may have access to the itinerary on the passengers, consent in case there is a need for help or other assistance for modal shifts, delays, cancellations etc.

The Multi Modal ticket in the cloud service can cover all Nordic countries, Northern Europe or indeed whole of Europe.

A side effect of this approach is that it is possible to get a ticket to public and private transport everywhere whether it is for two stops or a chain of 5 modes of transport through several countries from your favorite MaaS agent and its roaming partners.

Using an approach like this, each actor gets much greater reach and most importantly the users of train, bus, ferries and other shared modes of mobility services can indeed deliver a complete service close to the ease of car navigation.

Digital access to driver's license information in order to ease third party booking and payment of shared or rental cars by all MaaS agents.

Today users of shared or rental cars must sign up with each actor from which they want to rent a car. This includes verification of ID, valid driver's license and potentially also verification of ability to pay. Having to go through this process for all new mobility actors is cumbersome both for the end user and for the mobility service actor.

The validation of a driver's license ID is typically done using a picture of the driver's license. This only shows that the end user had a driver's license at sign up.

It would be helpful if end users only had to document a valid driver's license once to a MaaS agent of his choice. The information is stored in the MaaS account and end users accept that the MaaS agent may verify validity of the driver's license anytime a car share/rental request is processed.

When an end user wants to rent/share a car in a roaming MaaS domain, the home MaaS agent passes the necessary documentation forward for the end user which then can bypass sign up procedures for the desired mobility service provider.

Appendix 5: Copenhagen Simulation Workshop

The workshop was organized in three main steps: a pre-workshop online survey to invited workshop participants; the physical workshop in Copenhagen on April 17th, 2023, including three separate sessions and a concluding panel debate and summary brief; and a post-workshop survey to workshop attendees.

Workshop data collection methods

To fully capture the knowledge, attitudes, intentions, problem understanding and solving of the workshop participants and their organizations' behaviour related to MaaS roaming in the Nordics, we used a combination of qualitative (e.g., video recordings, pictures, session notes) and quantitative data collection methods (e.g., surveys/polls).

The data collection methods comprised:

- Pre-workshop online survey distributed to workshop invitees with assumed insight and interest in issues regarding MaaS development recruited from the NOMAD-team's network.
- Three workshop and data collection exercises:
 - Session 1 - Plan & book cross-border travel simulation, group exercise: Workshop room video recordings of in-group cooperative activity; recording of number of web sites visited, tickets/transactions, travel time, and cost for the simulated travel in a group-records form.
 - Session 2 – How to reach MaaS roaming in the Nordics individual exercise: Online recording of responses and written comments via mentimeter instant mobile phone polling tool; room video recording to capture verbal comments and discussions.
 - Session 3 - MaaS Roaming a reality – how?, group exercise: Workshop room video recording of in-group cooperative activity, recording of group ideas and suggestions on post-it stickers placed on an flip-over sheet and photographed; post-exercise group presentation and plenum discussions photographed and video recorded.
 - In addition, a concluding panel debate was carried out and video recorded.
- Post-workshop online survey distributed to workshop attendees immediately after the workshop.

Pre-workshop online survey

An online survey distributed to workshop invitees in April 2023 based on the contact list generated by the NOMAD-team of potential experts and other people with assumed insight and knowledge about MaaS in the Nordics.

Survey method

The invitation to participate was sent to 281 persons by e-mail, of which about 250 were valid e-mail addresses (excluding invalid addresses, people who no longer work in the organization, or people who could not respond as they were on leave or holiday). A total of 68 people responded to the invitation and completed the survey, equalling a response rate of about 27%, which can be considered quite normal for such a type of survey, topic, and respondent pool. Among the 68 respondents, 24 people (about 40%) later attended the workshop in Copenhagen.

The purpose was to probe potential workshop participants':

- familiarity with the concept of MaaS,
- whether MaaS has been much discussed in their organization,
- whether MaaS can be considered an important issue in their organization,
- if their organization had been cooperating with other actors to establish MaaS solutions nationally and/or in the Nordics, and
- if their interest in MaaS had been increasing or decreasing the last five years (i.e., compared to before the Covid19-pandemic).

Respondents could rate their response to the statements on a scale from 1 (e.g., Not at all important) to 5 (e.g., Very important).

In addition, respondents were asked to state their degree of agreement/disagreement with 6 statements expressing potential benefits of a functioning Nordic MaaS, and 6 statements about potential obstacles or disadvantages. In this part of the survey, respondents could rate their degree of agreement on a scale from 1 (Do not agree at all) to 5 (Very much agree)

Survey results

Below some selected results from the survey are shown in figures 8 through 11.

On average, the respondents reported good familiarity of MaaS as a concept (96% either very or quite familiar); that MaaS had been much discussed (86%) and considered an important issue (79%) in their organization; and that interest in MaaS had increased over the past four years prior to the survey (64%). In addition, the majority reported being involved with other actors in establishing MaaS operations in their own country (74%); and nearly half with actors in other Nordic countries (43%).

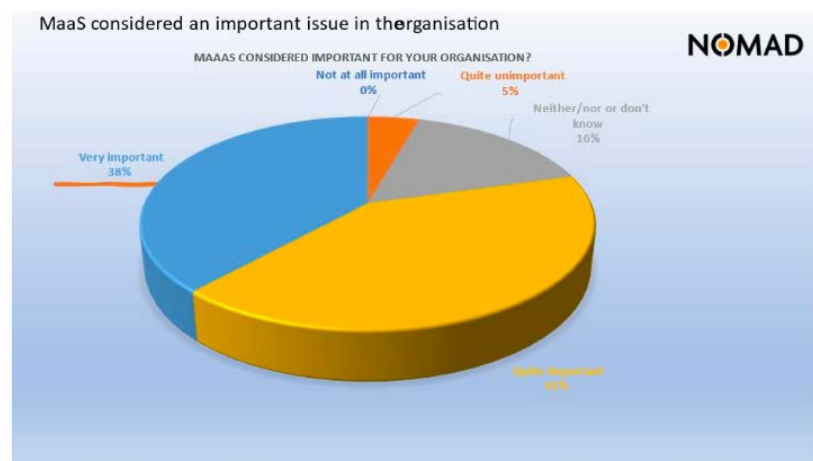


Figure 2

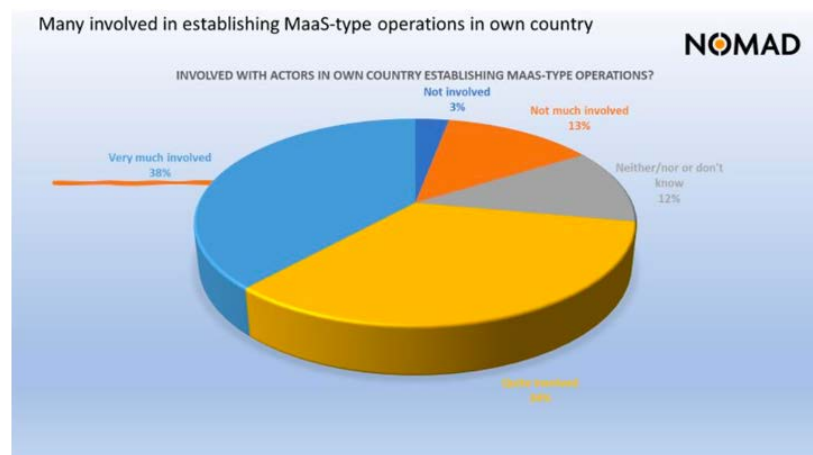


Figure 3

Also, a majority of participants recognise several benefits of MaaS in the Nordics, with on average agreement (very much or agree somewhat) with statements expressing benefits, ranging from 62 to 37% (average 51%); while a somewhat lower share also recognize several obstacles to MaaS roaming in the Nordics, ranging from 54 to 31% (average 40%) in agreement with the statements.

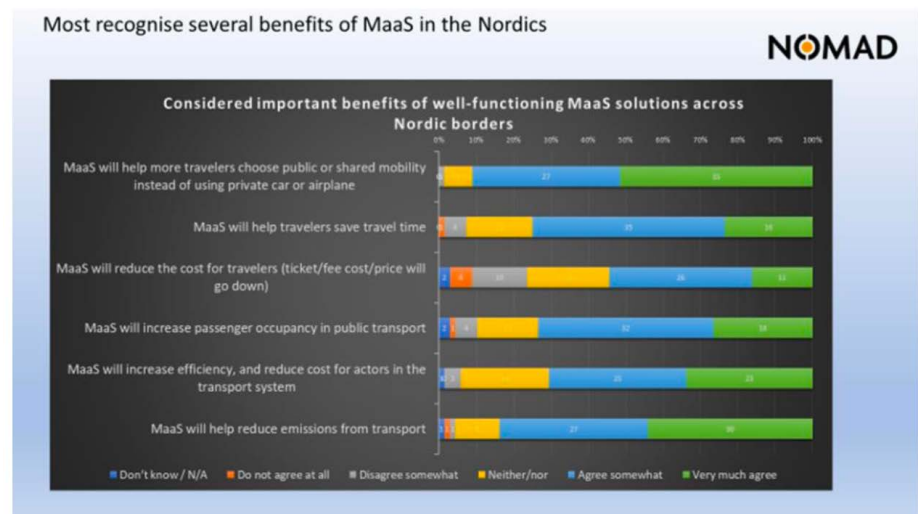


Figure 4

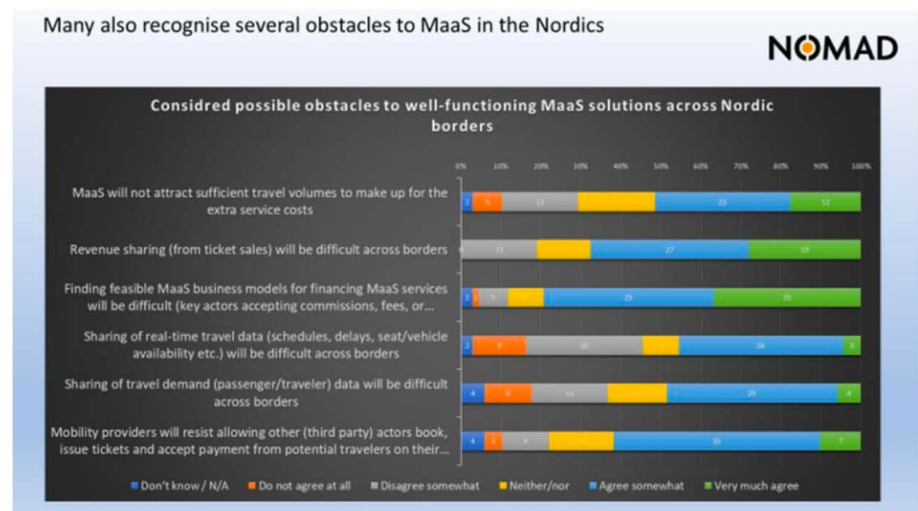


Figure 5



To summarize, the survey shows that respondents and the organizations they represent are quite familiar with MaaS as a concept; suggesting that the respondents have knowledge and understanding of MaaS and about the implications of a functioning MaaS roaming system. For the purposes of the following workshop, it was also important to establish that the potential participants had a basic prior knowledge of MaaS and the issues at hand when participating at the workshop.

Survey participants reported that MaaS had had been relatively much discussed, along with MaaS being considered an important issue in their organizations, and that interest in MaaS has increased over the past four years. Altogether, it suggests that MaaS is a matter of engagement and priority in these organizations, of which many can be considered important change-actors in terms of supporting MaaS roaming development in the Nordics.

The survey results also reveal that most of participants' organizations were reported to take part in establishing MaaS-type operations, beyond being simply interested in and discussing it. First and foremost, engagement was reported with others their own country, but also a considerable share with actors in other Nordic countries. That suggest that there is already considerable activity with establishing MaaS-type operations going on among these organizations, and even some cross-border activity taking place. In all, these reported ongoing cross-actor engagements can contribute positively to a beneficial development environment for pan-Nordic MaaS roaming establishment.

The latter is also supported by the fact, that overall - the respondents recognize several benefits of a functional Nordic MaaS, both for the travellers, the transport system, and the environment. On the other hand, they also, although to a somewhat lesser degree, recognize some hurdles and difficulties both from a business and cooperative angle, but also regarding obstacles to sufficient uptake of MaaS roaming by the travellers.

To conclude, one can interpret the survey results being quite positive for the future development of a functioning MaaS roaming in Nordics. Considerable attention and interest in the concept are reported, and already cross-actor engagements regarding MaaS operations appears to be in effect. Moreover, the opportunities and benefits appear to outweigh the obstacles and drawbacks, at least to some degree.

It should, however, be noted when interpreting the results that the survey results presented are based on a relatively low number of respondents (68). Furthermore, we recognize that the respondent sample is a convenience sample drawn from a respondent pool of people/organizations in the NOMAD-team network, which may be more than average interested and possibly positive to MaaS in general, compared to the general MaaS-relevant organizational environment. As for the people who responded to the invitation and completed the survey, there may be a similar response bias by people who are on average more involved and interested in MaaS, and possibly more favourable to MaaS development, than the non-respondents.

Workshop introductions

The workshop started with two introductory presentations on

- a) the NOMAD-project, project goals and components, and
- b) the concept of MaaS roaming in the Nordics, including the roaming concept, NAP-issues, EU regulations, and opportunities and challenges with achieving MaaS roaming.

The purpose of these presentations was to familiarise the participants about the current MaaS roaming situation and introduce important concepts and issues at hand for the workshop sessions.

Workshop Session 1: Planning, booking and payment of multimodal cross border journeys as is

Following the presentations participants were divided into seven groups (Group 1-7). The groups were composed to represent a mix of nationalities and sectors/type of actor (e. g., MaaS operator, public transport, government entity, private transport provider, ITS-provider, research and consulting etc.). Each group had a moderator from the NOMAD-team to explain the tasks, organise and augment the discussions, and take notes.

The purpose was to have participants experience the time, effort and challenges connected with planning and booking cross-border travel using currently available online travel planning tools, without having the benefit of cross-border MaaS roaming tools.

Session 1 method

The session 1 group task entailed simulating planning and booking of an imaginary private travel route for a couple departing from central Jönköping, Sweden, arriving a given hotel location in Skagen, Denmark. The participants were allocated in groups of 5-6 people. Each group was asked to act as if they were helping the Swedish couple to make the best travel plan and best price.

Use case – Extended weekend

A couple from central Jönköping (S) want to spend a weekend in Skagen (DK). They don't want to drive in a car.

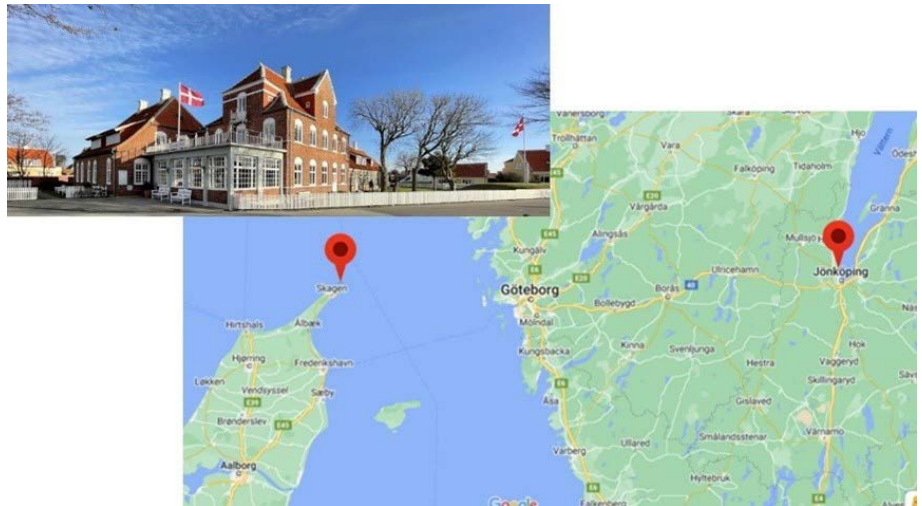


Figure 6 Use case multimodal cross border journey

They want to arrive in Skagen Friday May 5 in the evening to stay and have dinner at 19.30 at Brøndums Hotel.

Return From Skagen Monday morning May 8 after check out at Brøndums Hotel 10 AM

What is the best travel plan to accommodate this nice getaway using scheduled modes of transport and what will be the price?

The goal was for the couple to arrive before a specified time of day (evening event) by using any available online planning and booking tools. The announced group task objectives were to find the quickest and least costly travel route and minimizing the number of ticket bookings/travel legs to reach the destination in time. The travel planning was restricted to using scheduled transport modes only, excluding private car and airplane.

An observer at each table registered the discussion and especially which digital tools were used to plan the journey.

Session 1 observations

General observations: The exercise apparently generated great involvement from all group members, and people were using both mobile phones and PCs to solve their tasks and were discussing options and solutions vividly during the exercise. Many group members were displaying at least some degree of frustration of the difficulty of the task.

Other observations: Car ferries are considered an integral part of road networks also in the mobility data for digital road navigation. Hence the GPS for car navigation will present routes using car ferries.

Cross border travel by car

NOMAD

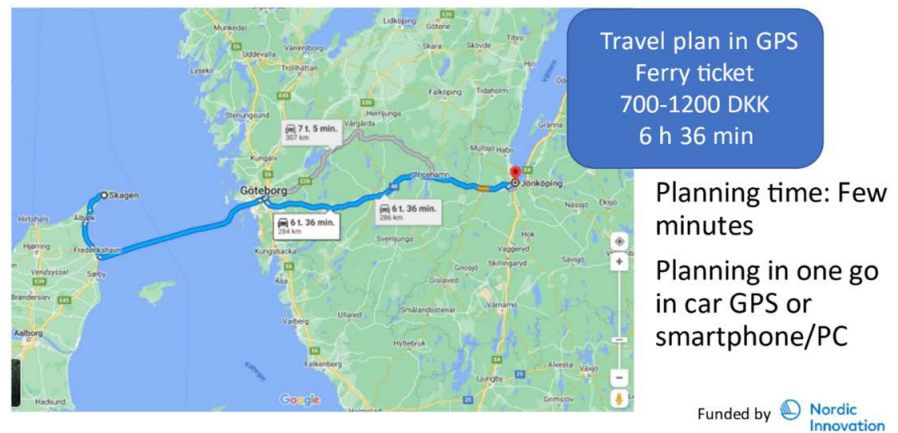


Figure 7 travel plan using a car and GPS navigation

You cannot assume the same for ferry connections as an integral part of a multimodal travel chain using scheduled modes of transport. This means that the first suggestion can be way more expensive and take longer time than a connection including a ferry transfer

Cross border by public transport

NOMAD

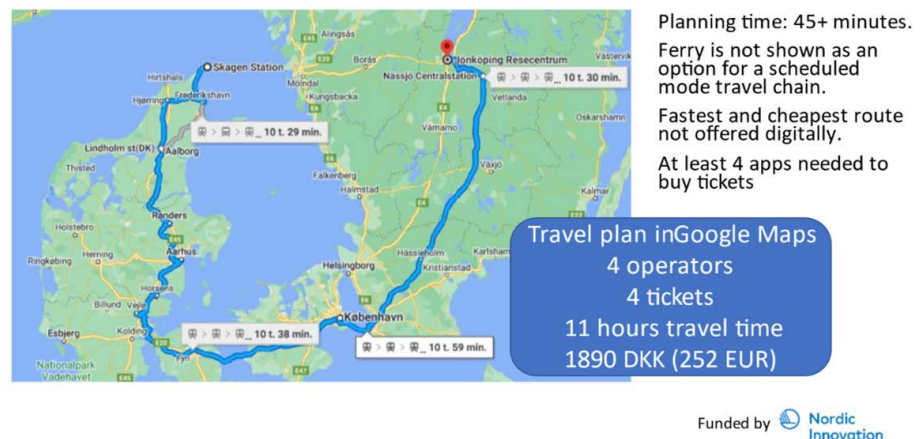
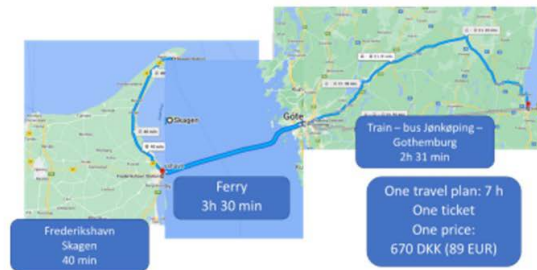


Figure 8 Cross border journey planning using public transport

Future multimodal cross border MaaS

NOMAD



MaaS routing optimization
using all land and sea modes.

Planning in one go
All combinations in one view
One ticket transaction.

For this case: same journey
time as for a car. Plus same
price or cheaper for two
persons

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Figure 9 Multimodal cross border journey planning simplified by MaaS

In a future true multimodal MaaS ecosystem all modes of scheduled modes of transport on land and water whether operated as public transport or private operators will be shown based on the user's preferences (fastest, cheapest, minimum modal shifts, most sustainable etc.)

For the weekend getaway the independent MaaS agent would show an option utilizing the same ferry as for a car travel plan. The time turns out to be comparable with using a car and the price is way cheaper than both car travel and the suggestion presented using today's digital mobility data.

Session 1 findings

Table A.1 shows the results from the session 1 group exercise.

Table A.1:

Questions	Results/comments, Group 1-7
How many apps/websites did you consult?	6, 6, 7, 4, 6, 7, 4. Average of 5.7 apps/sites consulted
App names (ex. most often named)	Google maps, Google Search, SJ, Stena Line, RejseplanDK, taxi-sites, DSB, Vy, Reis, Västtrafik, Here, Net-Ferry, Flixbus, Rome to Rio, OMIO, Resrobot,
How many purchases were involved	3,4,3,3,4,4,4. Average 3.6 tickets
Total travel cost	Outbound: On average 700-800 NOK, ranging from 1060 SEK/7 H, to 704 SEK/11 H.
How was the experience? (the exercise ran for 45 minutes)	Fun. Depressing. Frustrating. Sucks. Takes a lot of time, not simple. Possible to find info, but takes time, and requires resources and pre-knowledge of travels. Do not know if one has found the best solution. Planning quite easy, buying tickets is more complex. You need to buy tickets from 4 operators/agencies. Tickets in two currencies, so ticket currency conversion is an issue. Only two ferry departures. The ferries linking the countries do not share their data with travel planners. How to handle delays and minimize risk – no guarantees and liabilities.

Would you embark in this journey?

In most cases NO or only if it was not possible to use a car for some or all of the journey. (1 yes, but with substantial time buffer allowed)

Recommend someone to drive the couple from Jönköping to the ferry in Gothenburg.

Why or why not?

Why: Only if a car is not possible. Would go if the plan includes plenty of buffer time. I know the countries, so would feel safe. Only if my wife tells me to do it.

Why not: Too long time and cost. Too overwhelming to find tickets and cost, too many changes of modes. Need to register with several operators to book and pay. Need time buffer with so many modal shifts, to minimize risk - you will take a car & ferry. Too much travel time for a weekend getaway.

Participants reported the exercise as fun, but difficult and frustrating, too time- consuming and complicated. Most would not, or probably not, embark on this journey, as it would be too time and cost consuming, with too many mode exchanges with need for a long time-buffer, and because of the hassle involved with registering and booking with several operators. In sum, this exercise illustrates the difficulties and extended efforts involved with planning and booking intra-Nordic travel using existing solutions without travelling by a car or plane.

Workshop session 2: How to reach MaaS Roaming in the Nordics

After group session 1 the participants were presented some important concepts and assumably required steps or visions to reach MaaS roaming in the Nordics. The material presented is described below:

The steps to reach MaaS roaming

Cross border multimodal planning booking, payment and navigation requires that all parties adhere to the same standards for the mobility data required to find optimal travel plans.

This exercise assumes that the actors in the Nordics will live up to a set of EU regulations regionally and or nationally and from there extend the reach to neighboring regions/countries by collaboration between public and private MaaS agents.

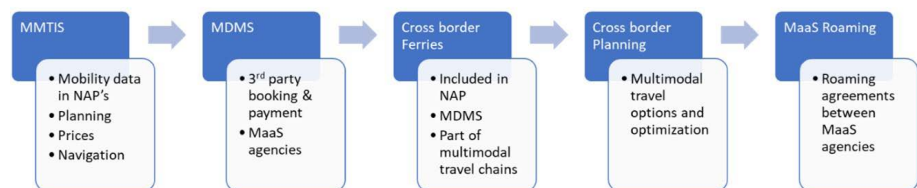


Figure 10 The steps to reach MaaS roaming

Open Mobility data Through NAP's

The first step is to ensure that all mobility data necessary for multimodal planning, pricing and navigation is published by all actors in the Nordics following same standards.

National Access Point – Common standards

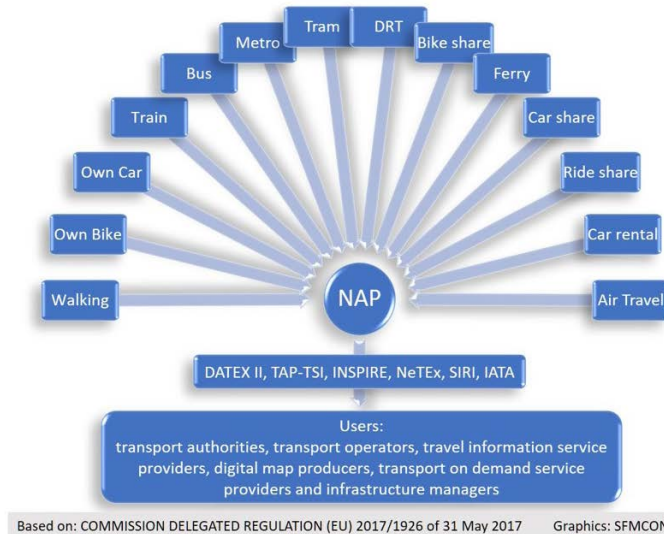


Figure 11 National Access Point – Open mobility data

This is already in progress mandated by the EU regulation EU 2017/1926 for Multi Modal Travel Information Services (MMTIS).

National Access Points are established in all Nordic countries. The MMTIS regulation contains a plan for which mobility data should be available when.

National Access Points in EU - Master Plan

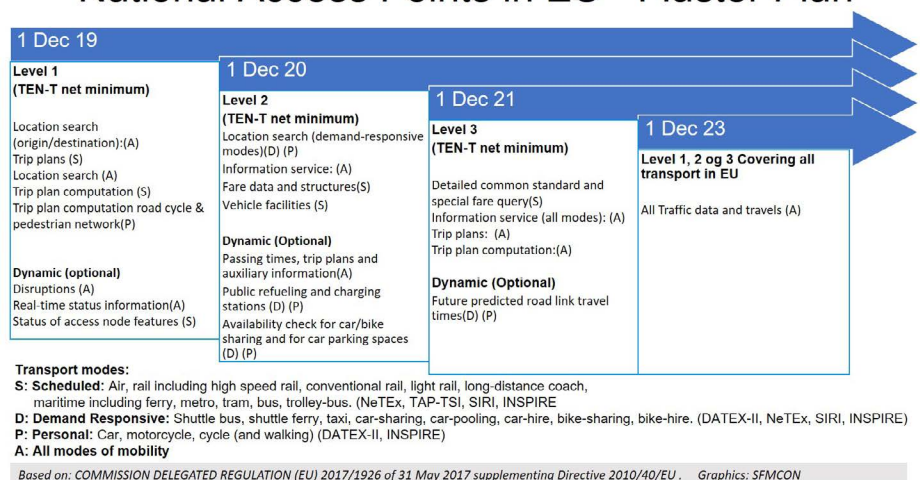


Figure 12 Plan for populating the National Access Point

In principle all mobility data for all transport in the EU shall be available from Dec 1, 2023.

However, it is unlikely that any country delivers according to the schedule. While public transport has mostly been published it remains to be seen when the Nordic authorities can report mission accomplished for the whole scope of the regulation.



Figure 13 National access points throughout the Nordics

Compliance with the same standards means that the only difference between the various services are the coordinates of where to access the services and the currency of payment.

The Nordic NAP's fully populated will allow for multimodal travel planning, price information and navigation on a national level. Users of NAP mobility data such as multimodal travel service providers can even by combining data from more NAP's produce multimodal trip plans extending national borders.

Multimodal Digital Mobility Services

Having access to multimodal travel plans, prices and navigation the next step is how to handle third party booking, payment (ticketing) and associated customer services.

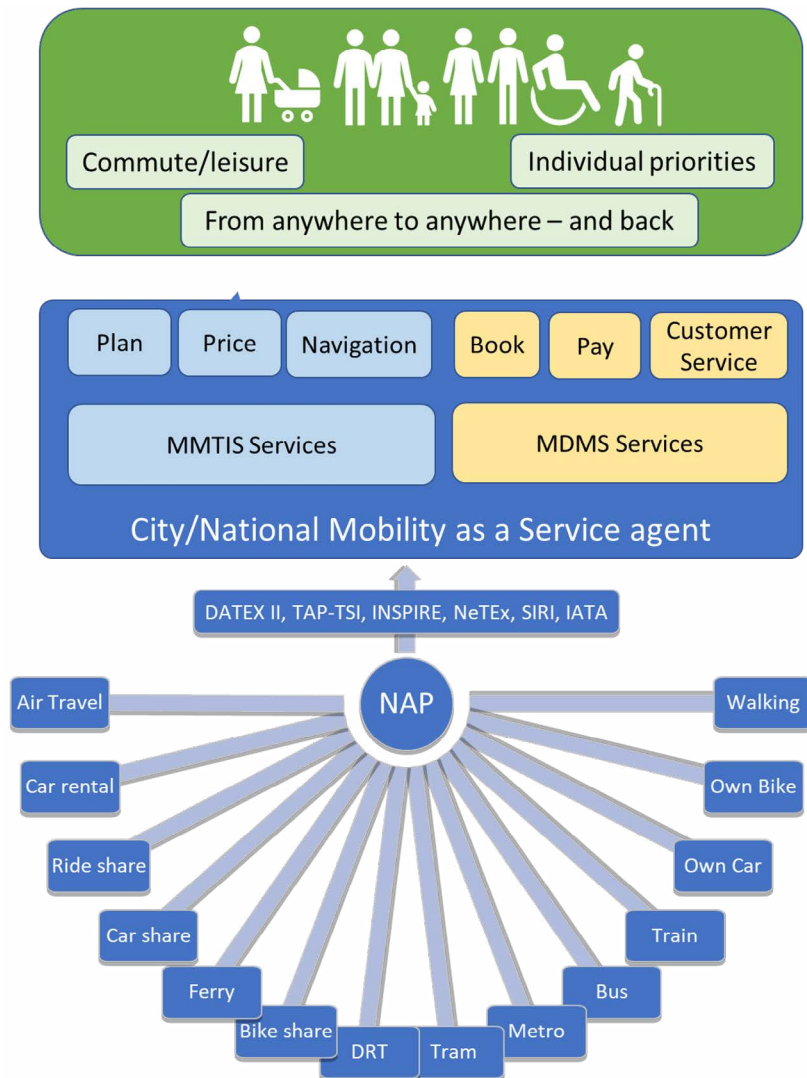


Figure 14 MaaS agent utilizing MMTIS and MDMS standardized services

Multimodal Digital Services, the EU regulation expected to come into force is intended to create a level playing field for third party booking, payment and associated services for all mobility actors whether public or private.

Adhering to these mandated processes and standards a new generation of regional/national MaaS agents can indeed include all modalities within their reach in journey plan suggestions based on all relevant parameters. End users can book and pay for multimodal trips in one transaction. The MaaS agent ensures that all tickets and reservations are confirmed and paid for.

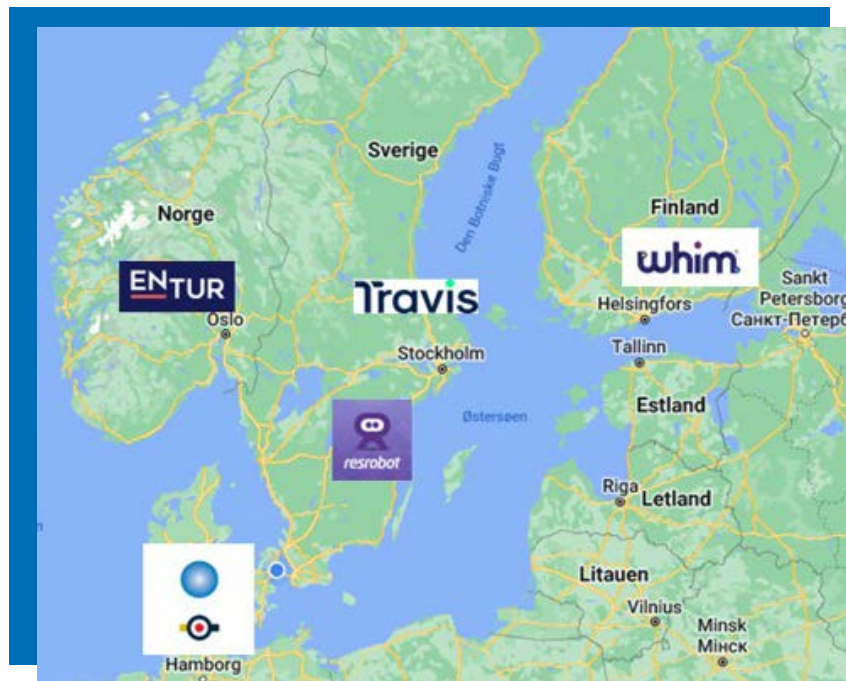


Figure 15 Obvious candidates to conform to the MMTIS and MDMS regulations

As all MaaS agents use the same standards for interacting with MaaS actors the only difference is the coordinates of where you enter or exit modalities or make modal shifts.

In the Nordics regional or national MaaS agents, whether public or private, will have to conform to the MMTIS and MDMS regulations.

Here it is assumed that Rejsekort & Rejseplanen (Denmark), Entur (Norway) Resplus and Travis (Sweden) and Whim (Finland) will support the mandated mobility standards and API's and become true national or regional MaaS agents.

At this stage it will be possible to plan, book, pay and navigate multimodal trips throughout the reach of each national or regional MaaS agency.

Cross border Ferries

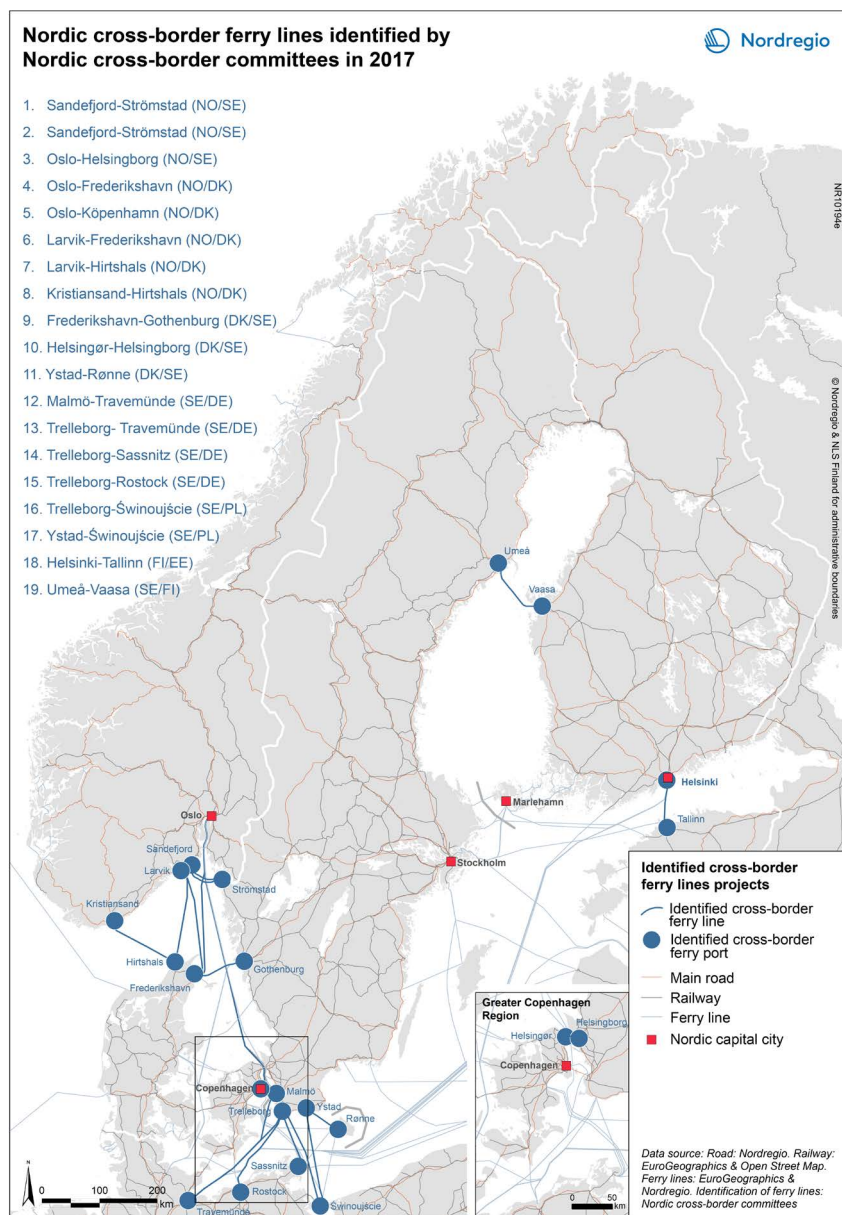


Figure 16 Main cross-border ferry lines as identified by North Regio,
<https://nordregio.org/maps/nordic-cross-border-ferry-lines/>

Going from Sweden, Norway and Finland to Denmark or Estonia and further on to continental Europe using ground transport requires a water crossing by ferries or the Øresundsbron. Most of the crossborder ferries has one port in Denmark.

The international ferries are an integral part of the road infrastructure also digitally. Not so for use of multimodal travel planning. Here only some of the ferries are registered digitally as a scheduled mode of service.

An example was the case of going to Skagen from Jönköping. Google map did not recognize the Gothenburg-Frederikshavn ferry as an option for a multimodal travel plan.

When including the cross-border ferries in the National Access Points they have to be registered as capable of transporting people without cars and be considered a scheduled mode of service both for people with and without cars. It should also be registered if bicycles can be taken on board.

Having populated the NAPS with mobility data from cross border ferries, the basic data are available for true multimodal cross border planning.

Cross Border Planning

The regional and national MaaS agents

The next step is to find the best journey plans for crossing borders whether on rail, road or by ferry.

As described the MMTIS regulation includes some provisions for how to extend reach of multimodal travel plans

Each Multimodal travel information provider a.k.a. MaaS agent is obliged to help other MaaS agents to make multimodal travel plans for the parts of the travel plan covering the geographic reach of more than one MaaS agent.

This includes hand over points between the MaaS agents involved.

To find the possible and optimal cross border travel plans based on start and end points and timings for arrival/departure is a bit more complicated. It requires the use of route planners, that have access to all static and dynamic plan data for the possible regions countries which have relevant travel plan options.

An example is a travel plan between Norway and Denmark. Dependent on the location of the start and end points the travel plan suggestions can include ferries directly between Norway and Denmark and/or use mobility services going through Sweden and from there either use ferries or Øresundsbron.

It seems there is a need for access to a multinational multimodal route planner and navigation tool to assist the participating MaaS agents to deliver optimal cross border travel plans. This resembles the planning and navigation support in a car GPS which indeed can deliver cross border travel plans based on user preferences.

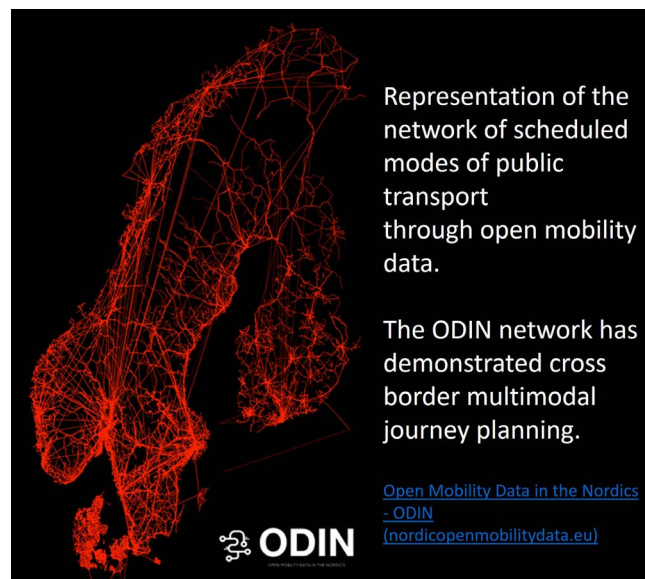


Figure 17 The complete grid of scheduled modes of mobility in the Nordic ref:

[About ODIN - ODIN \(nordicopenmobilitydata.eu\)](https://nordicopenmobilitydata.eu)

[The ODIN project About ODIN - ODIN \(nordicopenmobilitydata.eu\)](https://nordicopenmobilitydata.eu) has demonstrated multimodal cross border journey planning using OTP OpenTripPlanner (Open Source) from any to any location in Norway, Sweden, Finland and Denmark.

Having reached a conclusion on how to establish optimal cross border travel plans and navigation support, it is possible to find a suitable travel plan.

Now the only remaining part is to book and pay for the individual modalities necessary to use the selected travel plan.

MaaS Roaming

MaaS roaming

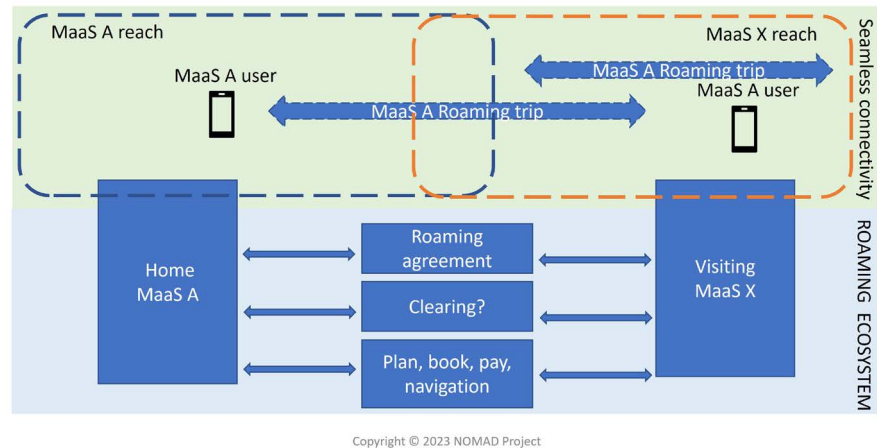


Figure 18 MaaS roaming and related exchanges between participating MaaS agencies

To enable MaaS roaming there must be a roaming agreement between the MaaS agencies involved in selling a cross (MaaS) border multimodal travel plan. The roaming agreement includes the commercial and technical provisions under which two MaaS agencies cooperate.

Also clearing of the total end user payment for the services has to be established. This also includes handling of different currencies. A trip going from Norway, through Sweden to Denmark may involve payments of segments of the multimodal trip in NOK, SEK and DKK. If bought through a Norwegian MaaS agent the price to the enduser will likely be in NOK, whereas the participant actors in Sweden and Denmark should be paid in their local currency.

For each cross-border trip planning, booking, payment and navigation a standard set of exchanges of relevant data is established between the home MaaS agent and the participating MaaS agents covering elements of the end users travel request.

The roaming MaaS concept means that as long as at least one MaaS agent has a booking and payment agreement with a Mobility service actor, the mobility services are bookable through all other MaaS agents with roaming agreements.

Alternatively, each MaaS agent would have to establish bilateral commercial agreements with all actors say in the Nordics to get the same level of coverage.

Individual assessment exercise

After the introductory presentation explaining the visionary steps to reach MaaS roaming the participants were invited to carry out the session 2 individual task. In this session the participants were asked to assess several statements which the NOMAD-team considered as being important steps towards achieving MaaS roaming in the Nordics. They were shown four steps or visions they were asked to assess in terms of 1) the relevance to their organisations' works and 2) if their organisation is working hard on the step-in question. Participants were asked to assess to which degree, on a scale from 0-10 (0= strongly disagree, 10=Strongly agree) the presented step or change was a) relevant to their organization, b) something their organization was working hard on (to achieve). Then participants were asked to assess the likelihood of two alternative scenarios, A and B, as shown in table y.3. on a scale 1= Very unlikely/Impossible to 4= Very likely/Certain.

The participants were instructed to use their mobile phones and enter their responses via mentimeter instant polling software. For each of the statements, immediately after giving their assessment response, participants could leave their comments about a) how their organization was addressing the issue, and b) what their concerns were, or c) any other questions or comments they had. Their responses and comments then appeared instantly visible to all participants on the main presentation screen.

Session 2 observations

The exercise also generated a high degree of involvement by participants. Almost all participants entered responses to the steps/visions and scenario questions, and in most cases, they also left comments. A higher degree of assessed relevance to participants' organisations and reported effort on the matters were reported in the first primary steps (no. 1 and 2), indicating that some of this basic work is already being carried out. The number of comments left on the first visions compared to the last ones, also suggest that this is the case.

Session 2 findings

Some examples of the results of the Session 2 mentimeter exercise are presented in figures 25 and 26 below.

Step 1: National Access Points

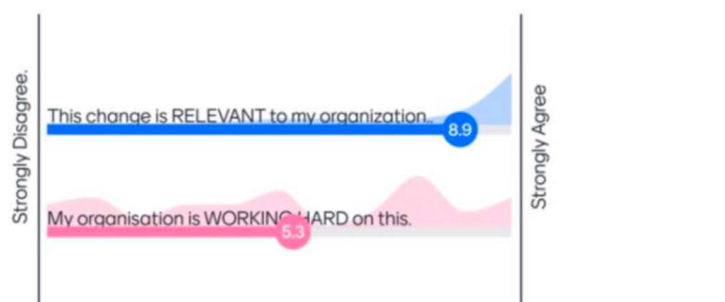


Figure 19 Example of steps/visions presented, with participant average scores

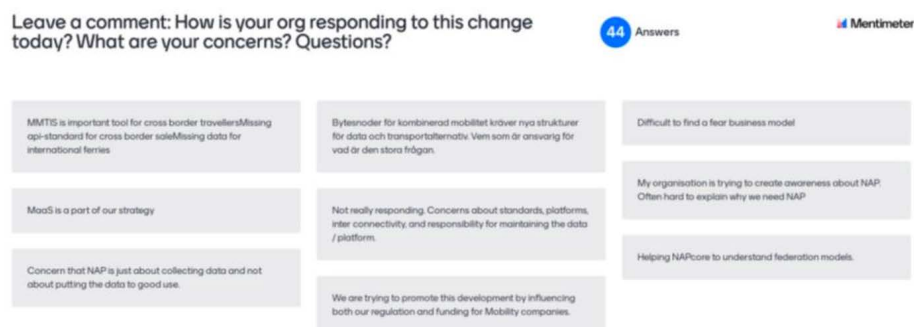


Figure 20 Examples of comments left by participants

The figures show responses to the first step/statement: National access points (NAP) are populated with all scheduled and demand-responsive travel modes (n=36). Based on **Error! Reference source not found.** responses it appears that the proposed change (NAP), on average, is deemed highly relevant for the participants' organisations (score 8.9 on a 10-point scale), and that organisations are to some degree working hard on the matter (score 5.3). **Error! Reference source not found.** shows some of the 44 comments left by participants on this step, for instance, "NAP being a part of our strategy" or "My organisation is trying to create awareness about NAP. Often hard to explain why we need NAP."

The five statements/steps towards MaaS roaming realization, formulated as visions and assessed in session 2, are listed in the table with the associated assessment means scores in table A.2 below

Table A.2: Assessments of crucial steps/visions

Vision	Change relevant to us	Working hard on it	N Responses
1. National access points (NAP) are populated with all scheduled and demand-responsive travel modes	8.9	5.3	36
2. National and regional MaaS agents comply with MMTIS and upcoming MDMS regulations	8.7	4.5	34
3. Cross-border ferries are included on an equal basis with land based private/public travel in travel plan suggestions	5.8	1.5	36
4. Routing agents for all MaaS operators cover the entire Nordic travel area region, and travel routes between any points are optimized, including exchange points between MaaS operators near Nordic borders	7.1	2.8	34
5. MaaS roaming is achieved between two MaaS entities (either inside the same country or across international borders) that agree on service offerings, technical set-up, revenue sharing, and customer enquiries	7.7	3.0	30

Scale 0-10 (0= strongly disagree to 10=Strongly agree)

The table shows that the participants, on average, consider that the proposed visions/changes (1.-5.) are quite relevant for their organisation. The participants agree to a lesser extent that their organisations are working hard on the proposed matter, possibly with an exception regarding NAP establishment (vision 1).

Considering the type of participating organizations, these results make sense because:

Step 1 involves all mobility actors.

Step 2 requires the MDMS regulation in place and then compliance by all.

Step 3 involves ferries and NAP's.

While step 4 and 5 only requires work for the MaaS agents collaborating. It is transparent to the mobility service providers; they just might achieve more usage/passengers. (This is also an aspect which should be measured/addressed in future projects).

Participants were also asked to assess the likelihood that to different scenarios were likely to occur in the future, A. Multilateral financial agreement, and B. Single MaaS agent market- takeover. Their assessments of the likelihood are shown in table A.3:

Table A.3: Assessments of likelihood of two alternative scenarios

How likely this scenario is assessed to be	Degree of agreement	N Responses
A. Multilateral financial agreement: Stakeholders agree on a financial scheme in which revenue is shared among all parties including service providers and third-party agents (e.g., service providers giving third-party actors a fair fee for making a journey come through).	2.5 (55% find it likely or very likely)	33
B. Alternative scenario: A single MaaS agent covering all modes and all countries in the Nordics emerges. All administrative, technical, and financial complexities are handled internally. All established local and national MaaS agencies lose revenue.	2.7 (56% find it likely or very likely)	32

Scale 1-4 (1= Very unlikely/Impossible to 4= Very likely/Certain)

On average, the participants' assessments of the development described in the scenarios are being considered slightly more likely than unlikely (score 2.5; 55% find it likely) regarding whether they believe a multilateral financial agreement/scheme will become a reality in the future (scenario A), revealing some degree of uncertainty about this issue. They find it somewhat more likely than unlikely (score 2.7; 56% find it likely) that a single MaaS agent/actor, covering all modes and Nordic counties, will emerge and in effect take over the Nordic MaaS market (scenario B).

Workshop session 3: MaaS Roaming a reality – how?

After completing the session 2 task individually, the participants reconvened in their groups for the last group exercise, in session 3. The purpose of session 3 was to have participants imaging a departure from an ideal MaaS future scenario and together explore the possible pathways from the current state to the future scenario, resembling a form of backcasting-exercise. They were then presented a future scenario background framework shown in Appendix 3.

The scenario description was condensed and presented as shown in the text box below:

Scenario: MaaS Roaming 2029

In 2029, there are at least 4 National/regional MaaS players in the Nordics. They show all actors who have data in NAPs National Access Points. MDMS has created an open marketplace for selling mobility services and thus a sound business foundation for MDMS/MaaS agency operation including MaaS roaming.

Roam-like-home for MaaS: *You can plan book and pay for mobility services for any journey in and between the Nordic countries using your "home" MaaS app.*

Figure 21 MaaS roaming a reality in 2029. How to get there?

Based on the 2029 scenario, three questions were posted for participants to consider:

1. How did MaaS roaming between the Nordic MaaS actors become a reality?
2. What were the stumbling blocks and how were they resolved?
3. Did we manage to take market share from short distance air travel and use of the private car?





Participants were then instructed to start with a 5-minute individual brainstorm on identifying challenges to be overcome. One group member per group was asked to use Post-it sticky notes to write up key words or phrases, using one topic per note. The group members were then asked to discuss and group the result of the brainstorming, and then list the problems for which solutions need to be found, and possible solutions.

Finally, the groups documented their findings on flip-over sheets populated with Post-it notes, sorted by topic. A chosen group member then presented the group's findings in plenum, followed by a 5 short Q&A session to each presenter/group. The session was concluded with a summary brief by the session moderator. Group discussions and presentations were videotaped, and posters photographed for documentation and analysis.

Session 3 observations

As in the first session this group exercise also created vivid discussions, and several creative, but insightful, solutions. There were quite different opinions on how to reach Nordic MaaS roaming among the groups, some were able to envision a sequential timeline of critical events or components/actions/activities needed, while others were primarily focusing on barriers and opportunities presented in a more brainstorming type of format organised by theme/issue. Only one of the groups were to present an (confirming) answer to question 3 about taking market share, which seemed to be either difficult to answer or not discussed sufficiently due to time constraints.

Session 3 findings

Figure 29 shows an image of the session output posters with post-it note attached

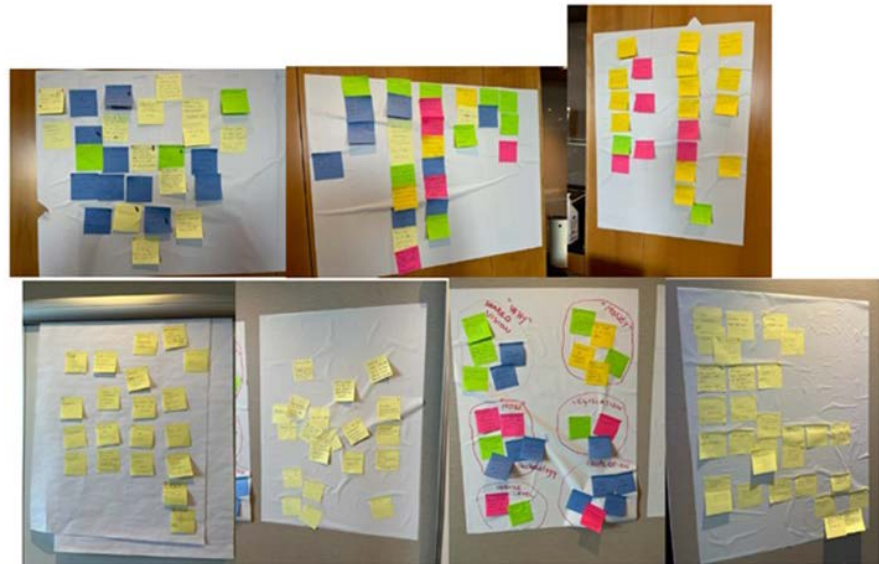


Figure 22 Raw output from workshop session 3.

Figure 30 shows the findings from the group task in workshop session 3, and the results are summarised. A more detailed description and analysis is included in Appendix 3.



Figure 30 Summarized findings from workshop session 3

Figure 30 places key events identified by the workshop participants on a geographical scale and a timeline. At the top of the figure there is the landscape level, which represents developments on a global or EU-scale. In the middle is the Nordic scale, and at the bottom what can happen within a potential NOMADS 2 project. The red diamonds represent challenges. The blue arrows and flags represent processes and the green flags achievements. The figure is created by combining and condensing answers given by the different groups to the back-casting exercise.

The main takeaway from the figure is that there are barriers and threats to a future MaaS-roaming system, both from technical issues, such as non-harmonized data, but also political factors such as incompatible ticket systems, different institutions and tax systems, as well as the ever-present threat of uncontrolled introduction of autonomous vehicles and global commercial actors. There are also many solutions and processes that may facilitate an international MaaS-roaming system; many located at the Nordic scale. These both include technical and political developments, such as harmonization and agreements, and the establishment of a common Nordic “national access point”. This could lead to a commercial MaaS solution at this scale. For a possible NOMAD2 project the key events are the establishment of a common vision and a common Nordic drive/project which includes key PTAs. This can help sketch out a MaaS or Nordic NAP solution.

Workshop panel debate

After the three workshop sessions, a panel debate was arranged with four experts representing main actors in MaaS: private mobility/MaaS provider; local public transport MaaS provider, national public transport/MaaS provider; and MaaS research and development expert. The purpose was to discuss and reflect upon issues that had been addressed during the workshop and get a deeper insight in the challenges and opportunities within MaaS development in now and in the future from leading practitioner actors' point of view. The debate was videotaped and concluded with a brief summary address by the panel session moderator.

Following the panel debate the events of the day were summarised by the NOMAD workshop hosts, including an overview of upcoming activities in the project.

Panel debate observations

The following main issues were discussed:

Going multimodal and cross border mobility services is way too complicated as demonstrated and felt by the participants at the workshop. In contrast there is no difference in planning a car trip whether it is a local trip or a trip crossing several national borders in the Nordics and beyond. In no time you get directions and information on how long it will take.

The Nomad project has found that it is technically possible to use the mandated open standards to enable true cross border planning, booking and payment in a single application in the preferred language and payment in the local currency.

The planning part is now well regulated, and the National Access Points in the Nordics already publishes at least the public transport data in mandated transmodel formats. The private scheduled modes and demand responsive modes will likely be available in the NAP's shortly if not already.

The price information, booking, ticketing and payment is still up for regulation, however the MDMS regulation is on its way to create an open and level playing field for combination of all mobility modes in a one stop planning and payment experience.

A few specific questions we asked and answered in the debate:

Why does MaaS roaming matter for a public transport authority?

MaaS and MaaS roaming makes it easier to discover how any public transport authority can deliver parts of multimodal travel chains sometimes even originating from another country. As such public transport becomes an integral part of a pan Nordic grid of mobility options.

Why should a public transport authority bother with the relatively few cross regional/national journeys compared to the many local journeys?

The local PTA is an important part of any longer and international journeys. Today many journeys are lost to the private car simply because it is much easier to plan and navigate long trips using GPS data. As it becomes practical to plan and navigate any journey whether local or even cross-border use of the combined grid of mobility services will likely increase.

Is MaaS roaming the only way to achieve seamless cross border mobility in the Nordics? It is necessary to make use of the published mobility data from the NAPs and showcase cross-border third-party booking and payment., with reference to the national multimodal planning and payment schemes (rejseplanen/rejsekort, Entur). This entails moving from one travel plan per country to opening up for access to all modes in all the Nordic countries.

Post-workshop online survey

A few days after the workshop an online survey distributed to workshop attendees in a similar manner as the pre-workshop survey. The purpose of the post-workshop was to get feedback from participants on the content, relevance, and experiences from workshop, and if the workshop had changed their knowledge and opinions, understanding of the main issues, and intentions to work towards establishing Nordic MaaS roaming, or increased the likelihood that they and their organizations would be more involved in establishing MaaS roaming operations in the Nordics in the future.

Survey method

The survey invitation was sent via email to the 44 people attending the workshop, of which 12 responded, yielding a response rate of 27%.

The survey contained 12 statements regarding possible effects for the participants of having attended the workshop. The respondents could indicate their degree of agreement to the statements on a scale from 1 (Do not agree at all) to 5 (Very much agree).

Survey results

The two figures 31 and 32 below show the average responses to the 12 statements. Due to a low number of completed responses (12) we are depicting the results both by number of responses and percentages, and divided them into categories "do not agree", "neither/nor" and "agree" only. In general, the results show that, on average, the participants agree to a large extent that the workshop participation had given them a better understanding of important issues related to Nordic MaaS roaming, about what needs to be accomplished, and who needs to cooperate, and the implications of upcoming regulations of MaaS roaming.

Moreover, they were also reporting being more motivated to work with MaaS, and that the likelihood that their organization would get involved with Nordic MaaS roaming had increased. In addition, they agreed it gave them an important networking opportunity, and just about all found participating worth it considering the cost and time spent.

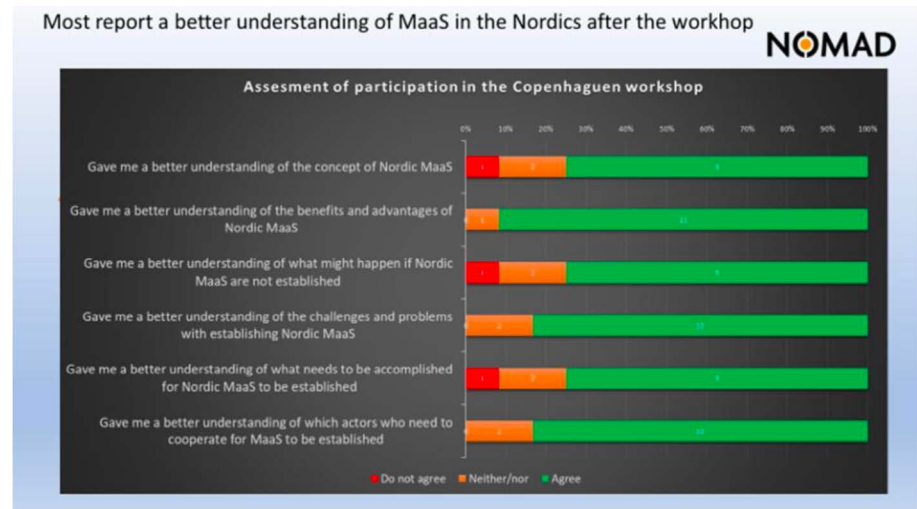


Figure 23 Post workshop survey findings

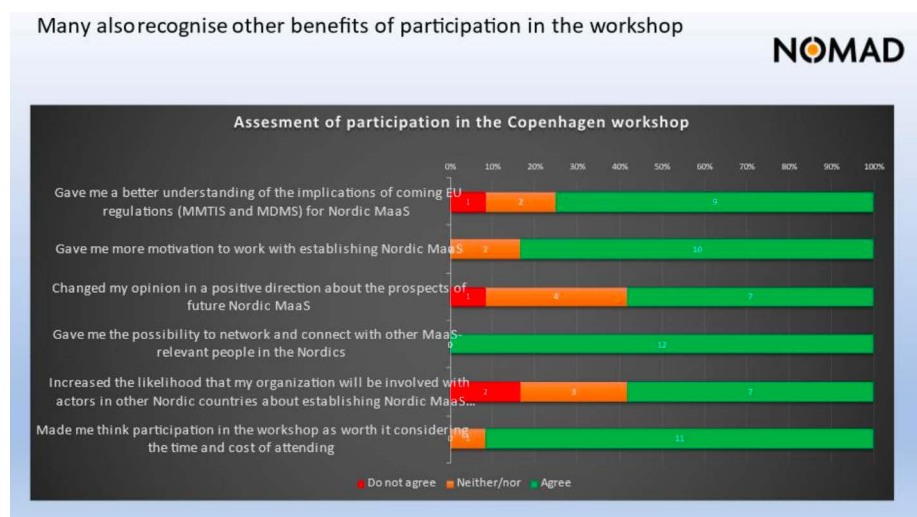


Figure 24 Other benefits from participation in the workshop

When interpreting the results, a similar potential response bias as named under the pre-workshop survey should be kept in mind also for the post-workshop survey. In addition, a sample of just 12 completed responses, is a very low number to base definite conclusions on.

Appendix 6: Multinational Stakeholder Workshop Survey

Background

In this appendix the results from the online survey conducted as a part of the NOMAD workshop March 23, 2020 is presented.

The invitation for the workshop was primarily sent to Nordic actors, focusing on the Copenhagen region, but also with representation from other cities and countries.

Country distribution of respondents is shown in table 1.

Table 1. Which country do you work in?

	Frequency	Percent
Denmark	17	42.5
Finland	5	12.5
Norway	7	17.5
Sweden	8	20
Other	3	7.5
	40	100

In the total sample there were 20 respondents each indicating that they were representing public and private sector. When we crosstab the sector representation with the countries we see that there is approximately even distribution between public and private sector for the Nordic countries (figure 1). The representatives from outside the Nordics were all from private sector.

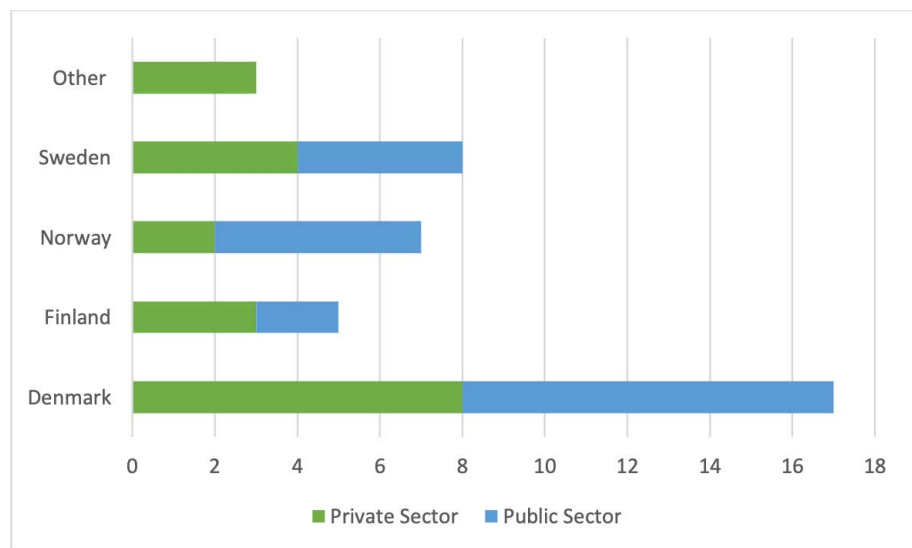


Figure 1. Crosstab country of workplace with sector.

We further asked where the respondents, which best describes their work (table 2).

Table 2. Which best describes where you work?

	Frequency	Percent
Municipality	2	5
Other Public Authority	10	25
Partnership organisation	1	2.5
Public Transport Authority	3	7.5
Public Transport Operator	1	2.5
Research Institute	3	7.5
University	1	2.5
Consultancy	4	10
ITS or similar association	2	5
Technology developer	7	17.5
Traffic Management Organization	1	2.5
Transport Service Provider	5	12.5
TOTAL	40	100

Table 2 shows that the participants were representing a wide variety of actors. The most frequent answers apart from the bag term "other public authority" were, technology developer, transport operator and consultancy.

A reoccurring issue that in part can be addressed by a MaaS roaming service is managing payments and reimbursements for business travel. We asked the participants on their experience with their present travel reimbursement schemes and rate the answer on a scale from 1 to 4. Where 1 is disagree strongly, and 4 is agree strongly (Table 3).

Table 3. At present managing payments and reimbursement for business travel is complicated?

	Frequency	Percent
1	1	2.5
2	9	22.5
3	12	30.0
4	18	45.0
Total	40	100.0

Cross-tabulating these responses with sector for employment shows little systematic variance between the answers and sectors.

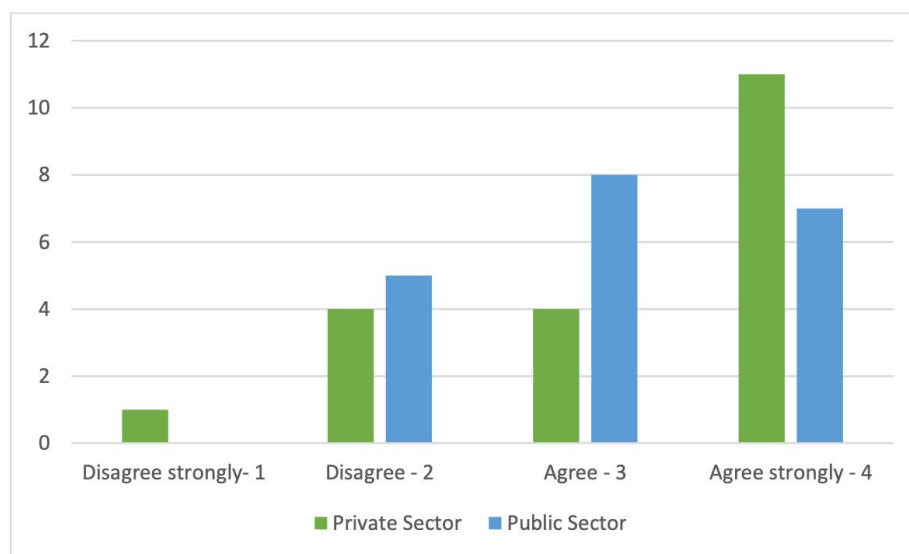


Figure 2. Crosstab managing payments and reimbursement for business travel is complicated with sector of employment.

Business travel

The participants were presented with a user story for a possible MaaS-roaming user labelled Camilla, as shown in figure 3 below:

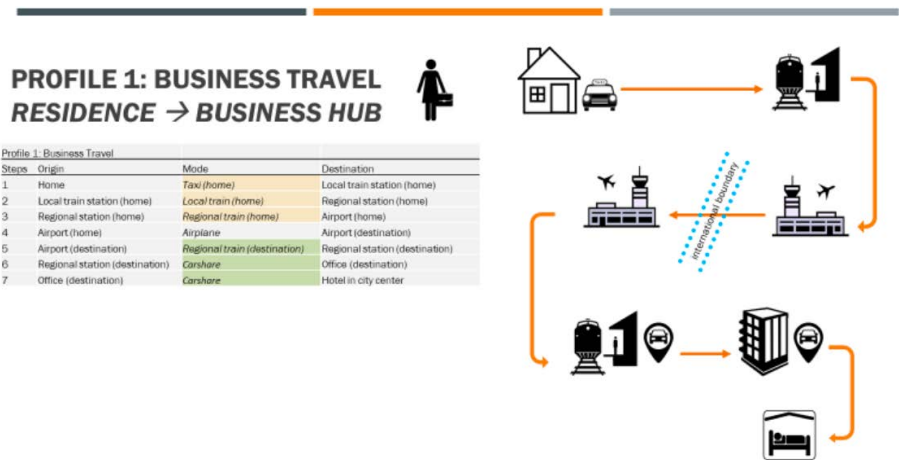


Figure 3. Camilla's business travel user story.

Camilla was to plan and carry out a trip from her residence in Copenhagen to a meeting venue in Stockholm, Sweden, using different modes of transport to reach her meeting location, and then on to her hotel stay in central Stockholm. This is a type of trip Camilla carries out on a regular business travel basis, but the destination may vary from time to time. Figure 3 shows the steps needed to carry out the trip, which participants were shown and asked to give their reactions to. In addition, the participants were shown a time and monetary cost calculation, applying a generalised travel cost method accounting for estimated costs for travel time and transfers between modes, and ticket and rental fee prices measured in NOK for Camilla's business trip.

Participants were asked to give feedback to their understanding of this story. The written answers are presented in table 4.

Table 4. Please offer your comments about Camilla's user story.

Good target setup, hope to see implementation considerations soon

I think this roaming concept is easy to understand and is a sensible approach to provide better, integrated travels with low-emission public transportation at the core.

If Camilla goes to the same Stockholm location every time she should be able to learn how to get to that location in a good way.

Optimistic regarding automatic invoicing to employer. Like it. She should take the train instead of flying ;-). Not sure I agree on the feasibility of roaming the way described, Using NAP services a single MaaS provider should be able to cover all 4 countries in one service. What is more important is how to create the open data for shared mobility services (Demand responsive modes) in NAP topped with standards for open API's for booking and paying for shared mobility services. What more exactly is the program looking for from Denmark?

In bigger organizations travel personnel and agencies often arrange at least part of the trips. Lodging is often tightly related to the trip and has an effect to last mile local transport. Combining travel and other services requiring mobility?

On the question if business travel would be easier if they could plan and book an entire multimodal trip through a single interface (table 5).

Table 5. Business travel would be easier if I could plan and book an entire multimodal trip through a single interface.

		Frequency
Disagree strongly	-1	0
	2	2
	3	11
Agree strongly	-4	27

Answers in table 5 indicate that there is a strong consensus that business travel would be easier if it could be planned and booked through a single interface.

We asked which modes that the employees at the organization uses for business trips (Table 6, figure 3).

Table 6. How often do employees in your organisation use the following modes of transportation for business trips?

	Local PT	Aeroplane	Regional Train	Inter City Trains	Taxi	Personal Vehicle	Car Rental	Micromobility (incl. Bicycle)
Often	30	19	19	16	12	18	1	5
Rarely or never	2	5	2	3	13	12	20	19
Sometimes	7	15	18	19	14	7	14	14
Total	39	39	39	38	39	37	35	38
Percent								
Often	77	49	49	42	31	49	3	13
Rarely or never	5	13	5	8	33	32	57	50
Sometimes	18	38	46	50	36	19	40	37
Total	100	100	100	100	100	100	100	100

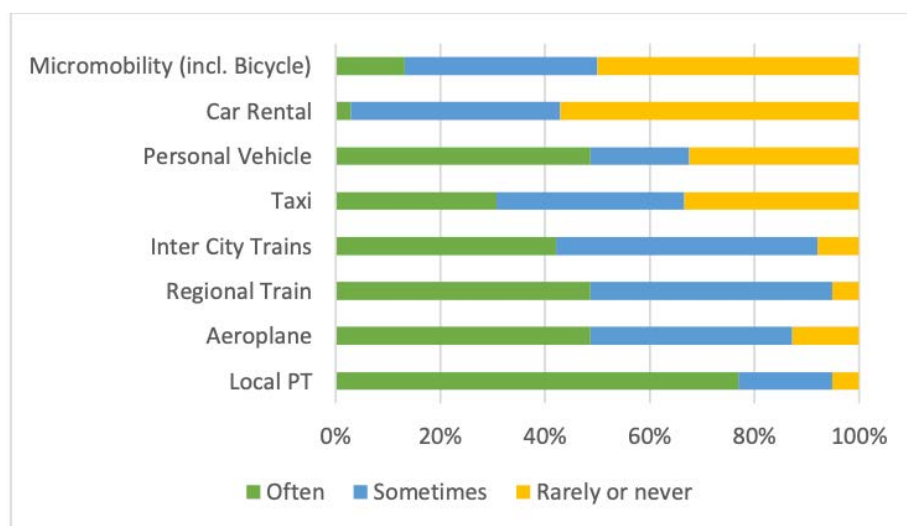


Figure 4: How often do employees in your organization use the following modes of transportation for business trips?

Table 6 and figure 4, show that micromobility, and car rental are little used modes for business trips. Local public transport, airplane, regional- and intercity trains are the most common modes. While taxi and personal vehicles are intermediate.

Looking forward towards the future there is an expectation for some change in the use of transport mode for business trips. (Table 11, figure 5).

Table 11. In the future, I believe business trips should rely on the following modes of transportation...

	Local PT	Aeroplane	Regional Train	Inter City Trains	Taxi	Personal Vehicle	Car Rental	Micromobility (incl. Bicycle)
Often	36	8	30	33	3	4	4	16
Rarely or never	0	9	0	0	18	23	17	3
Sometimes	4	22	10	7	17	12	18	21
Total	40	39	40	40	38	39	39	40
Percent								
Often	90	21	75	83	8	10	10	40
Rarely or never	0	23	0	0	47	59	44	8
Sometimes	10	56	25	18	45	31	46	53

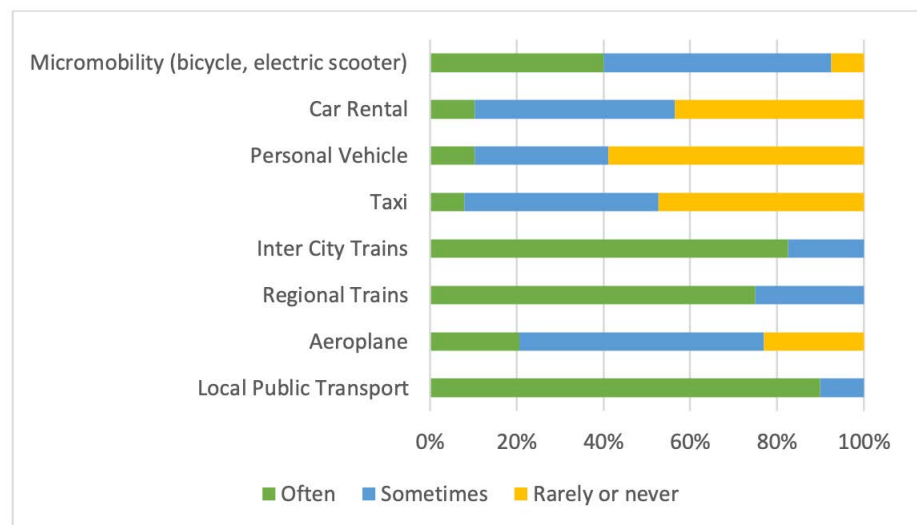


Figure 6. In the future, I believe business trips should rely on the following modes of transportation...

Table 11 and figure 6 show an expected increased use of micromobility and train, and decreased use of aircraft, personal vehicles and private cars for business trips reported by the respondents.

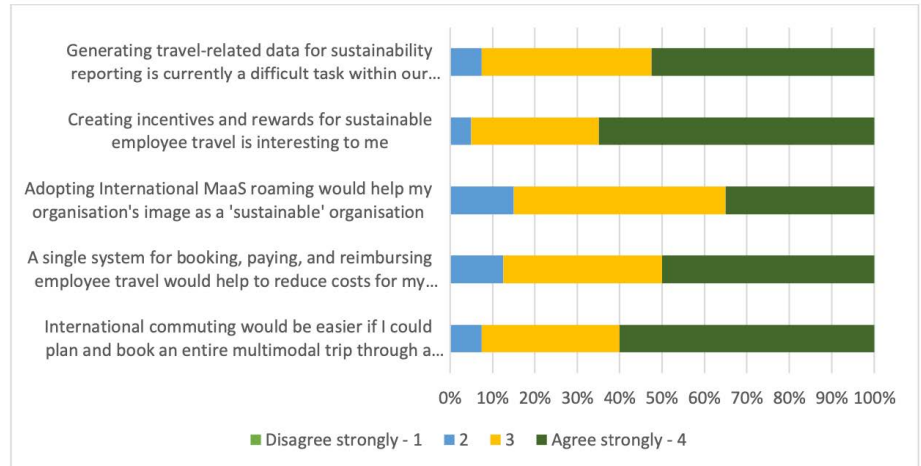
The informants were given a set of statements regarding international trips and asked to give their response on a scale from Disagree

Table 7.a. International trip statements Frequencies

	1	2	3	4	Total
International commuting would be easier if I could plan and book an entire multimodal trip through a single interface	0	3	13	24	40
A single system for booking, paying, and reimbursing employee travel would help to reduce costs for my organisation	0	5	15	20	40
Adopting International MaaS roaming would help my organisation's image as a 'sustainable' organisation	0	6	20	14	40
Creating incentives and rewards for sustainable employee travel is interesting to me	0	2	12	26	40
Generating travel-related data for sustainability reporting is currently a difficult task within our organisation	0	3	16	21	40

Table 7.b. International trip statements percent

	1	2	3	4	Total
International commuting would be easier if I could plan and book an entire multimodal trip through a single interface	0	8	33	60	100
A single system for booking, paying, and reimbursing employee travel would help to reduce costs for my organisation	0	13	38	50	100
Adopting International MaaS roaming would help my organisation's image as a 'sustainable' organisation	0	15	50	35	100
Creating incentives and rewards for sustainable employee travel is interesting to me	0	5	30	65	100
Generating travel-related data for sustainability reporting is currently a difficult task within our organisation	0	8	40	53	100



strongly – 1, to Agree strongly – 4 (Table 7 a, b, figure 6).

Figure 7 International trip statements.

Table 7 a, b, and figure 7 indicate that most of the respondents agree or agree strongly with the statements given. None of the respondents disagree strongly with any of the statements.

Table 10. Where do employees in your organization travel for business?

	Freq			Percent	
	Yes	No	Total	Yes	No
Sweden	25	7	32	78	9
Norway	24	8	32	75	10
Finland	25	6	31	78	8

International commuting - Karl's user story

The participants were presented with a user story representing an international commuter, Karl. Karl was to plan and make a commuter trip from his home in Copenhagen to his office in Malmö, Sweden, utilizing available modes of transport to get to his office, and then on to a business lunch at a local restaurant there. This is a kind of trip Karl carries out on a regular commuter basis, from and to the same location every time. Figure 8 shows the steps needed to carry out the trip. As in the user case of Camilla, participants were shown a time and monetary cost calculation measured in NOK, which participants were asked to give their responses to.

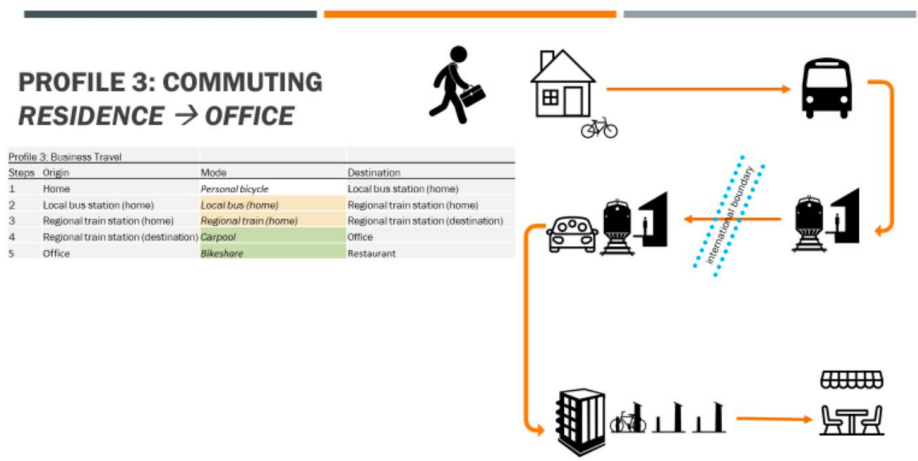


Figure 8. Karl's commuter travel user story

These were the responses to this user story.

Table 8. Comments to Karl's user story.

- As you mentioned - it would be nice if you could share the calculations for savings.
- I have very limited information about the commuting preferences of most of the employees in my organization... So the answers are based purely on guesses. Also i think the number is way less than 10 % but probably more than 0%. This also applies to the former user story, though I suppose that international travel is bit more uniform across the organization
- Maybe a bit optimistic in regard of savings compared to traditional public transport. I don't expect PTOs being willing to give large discounts to MaaS operators. Also very few bus stops have facilities where I would dare to leave a bicycle.
- Not many employers will pay for their employees commute. Hence there must be an easy and convenient way to change between a private trip to be paid by yourself and a business trip to be paid by your employer.
- Our organization probably do not have international commuting at all because the locations of offices are not near border.
- Similarly good target, not really difference to previous story, except for the set of modes offered
- The case study assumes that public transport and private shared mobility operators are willing to open for third party sales. In Denmark Public Transport is obligated but not in Sweden. Other studies are working on just making it easier to use public transport with one ticket in the Greater Copenhagen fare zone ecosystem (Capital region of Denmark and Skåne in Sweden). Not really moving yet. Would like to know if there now is an opening from Skånetrafiken, DSB and DOT to open for third party ticketing.
- Why he cannot be billed instantly and only at the end of the month? Probably he would use the app for his personal travels too, since it would allow to optimizes his personal traveling. How this would be distinguished in the app.
- Would be interesting to see the trips not just from a user-perspective but also from a transport-provider perspective

The participants were asked to state how large share of their workplace's employees commute crossing international borders (table 16).

Table 11. Approximately what percent of employees in your workplace commute to the office over international borders?

	Frequency	Percent
0,0%	23	57.5
10,0%	14	35.0
20,0%	2	5.0
100,0%	1	2.5

Table 11 shows that the majority of the participants are employed at workplaces where international commuting is limited.

In parallel to the question of business trips the respondents were asked for their modal choice used by the international commuters in their organization (table 12, figure 7).

Table 12. Right now, international commuting trips in your organisation rely on the following modes of transportation.

	Local Public Transport	Aeroplane	Regional Train	Inter City Trains	Taxi	Personal Vehicle	Car Rental	Micromobility (bicycle, electric scooter)
Often	15	13	14	10	6	11	2	4
Rarely or never	10	14	7	9	23	15	27	25
Sometimes	8	7	12	14	5	7	3	3
Total	33	34	33	33	34	33	32	32
Percent								
Often	45	38	42	30	18	33	6	13
Rarely or never	30	41	21	27	68	45	84	78
Sometimes	24	21	36	42	15	21	9	9

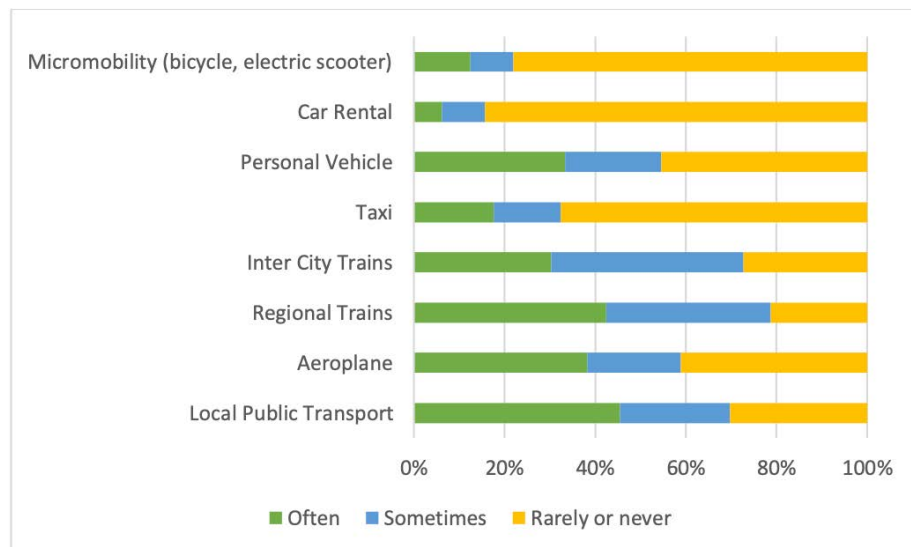


Figure 9. international commuting trips in your organisation rely on the following modes of transportation

Similar to the modal patterns used for international business trips, long distance modes, such as trains and aircraft dominate (Figure 9). The much higher share for local public transport should be understanding in the context that many are located in the Copenhagen area, where local commuting can be international. The share of personal vehicle is also relatively high. All over the number of responses to this question is lower than for business trips.

For the future there is an expectation that the use of micromobility and trains will increase, while the high share of local public transport will remain, and the use of car-based modes and aircraft will decrease (table 13, figure 10).

Table 13. In the future, I believe international commuting trips should rely on the following modes of transportation.

	Local Public Transport	Aeroplane	Regional Train	Inter City Trains	Taxi	Personal Vehicle	Car Rental	Micromobility (bicycle, electric scooter)
Often	22	7	24	23	4	4	3	11
Rarely or never	3	19	2	3	22	23	19	12
Sometimes	9	10	9	9	9	7	12	12
Total	34	36	35	35	35	34	34	35
Percent								
Often	65	19	69	66	11	12	9	31
Rarely or never	9	53	6	9	63	68	56	34
Sometimes	26	28	26	26	26	21	35	34

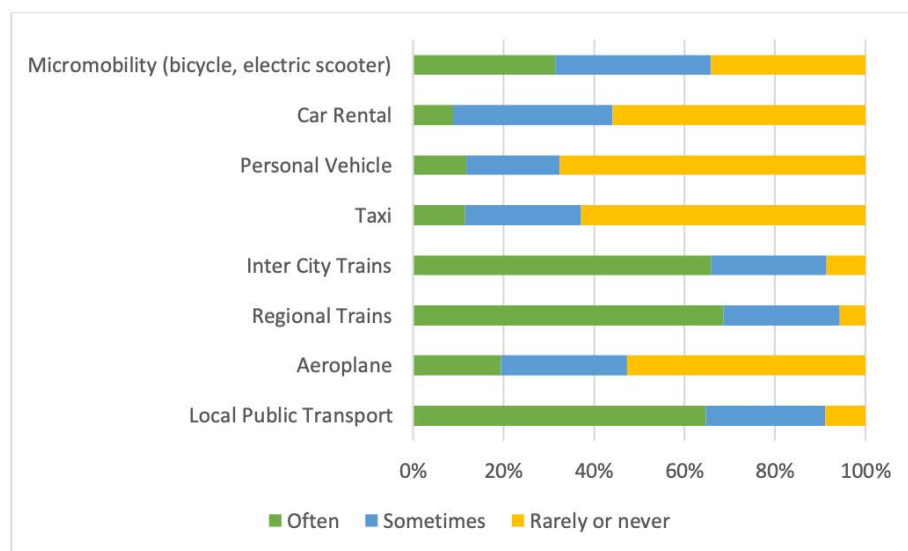


Figure 10. In the future, I believe international commuting trips should rely on the following modes of transportation.

The respondents were further asked to rank the relative importance of the following factors for international business trips (Table 14, figure 11).

Table 14. How important are the following factors when making international business trips?

	Arriving on time	Comfort	Environmentally friendly	Managing and avoiding delays	Being able to work while travelling	Route planning in advance	Reducing the number of transfers	Carrying luggage
1 - Not at all important	0	0	1	0	0	0	0	4
2	2	5	6	2	6	8	7	24
3	9	30	22	18	20	17	20	10
4 - Very important	29	5	11	20	14	15	13	2
Total	40	40	40	40	40	40	40	40
Percent								
1 - Not at all important	0	0	2.5	0	0	0	0	10
2	5	12.5	15	5	15	20	17.5	60
3	22.5	75	55	45	50	42.5	50	25
4 - Very important	72.5	12.5	27.5	50	35	37.5	32.5	5

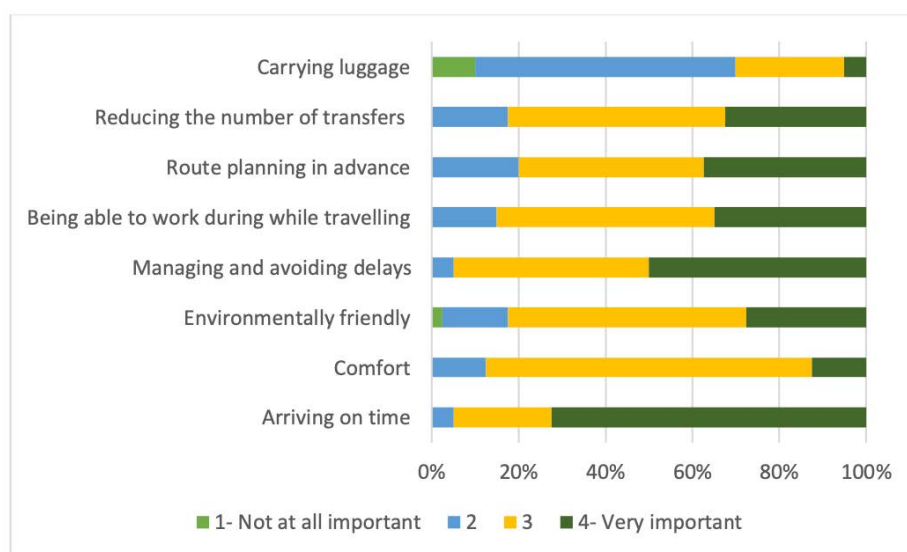


Figure 11. How important are the following factors when making international business trips?

From table 14 and figure 11, it seems that the respondents place highest importance to arriving on time, managing and avoiding delays for their business trips. Comfort, being able to work while travelling, reducing the number of transfers and route planning in advance is also important. Carrying luggage is the only statements that is seen by the majority as unimportant.

On the webinar

The respondents were asked to rate the webinar on a scale from very bad -1, to great – 4 (Table 15).

Table 15. How would you rate this webinar, overall?

	Frequency	Percent
2	4	10.0
3	24	60.0
4	12	30.0
Total	40	100.0

The majority of the respondents rated the webinar positively, with 30 percent stating that it was great. 10 percent rated it negatively.

Table 16. Do any employees in your workplace commute from the following places? (Do NOT mark the country you work in).

	Denmark	Finland	Norway	Sweden
No	16	24	24	19
Yes	6	4	5	13

Table 17. Why did you attend this workshop?

	no	yes
I am interested in participating in the NOMAD pilot as a test client	26	14
I am interested in participating in the NOMAD pilot as a transportation service provider	32	8
I am interested in participating in the NOMAD pilot as a technical service provider	24	16
I am interested in learning more about MaaS	5	35

Table 18. Additional comments on the webinar.

At this stage a webinar is not ideal, since meeting people and discussing in smaller groups might help with the process. But taking the circumstances into consideration, it is as good as can be expected.

Good job!

I expected the webinar to a little more in depth related to MaaS

I like to further MaaS - not necessarily roaming MaaS. I believe the concept have more relevant issues to be resolved Open marketplace, viable business plan, open standards and api for connecting suppliers and maaS agents.

I was hoping for discussion on technical implementation of roaming, but apparently this has been already done and this session was about getting feedback from wider range of potential users.

I was not able to answer all questions. I don't know if any of my colleagues commute international. I doubt it.

If you are just a little bit aware of MaaS this was extremely thin competence-wise. Not what I expected, I expected a deeper discussion on the effects, possibilities and obstacles.

Too much wait time.

We are currently (corona aside) looking at piloting a "Zeelo" service in Gothenburg with a prospective client. NOMAD is a possible extension to that pilot. For more on Zeelo: <https://zeelo.co/business>

Will you have EV charging as part of the roaming options. I work with EV and would like to be involved in this.

Would love to hear more about what areas you are planning / believe there should be standardization in mobility roaming

Appendix 7: NOMAD Nordic MaaS fact sheet

Issue	Denmark	Norway	Sweden	Finland	Iceland
National Access Point					
Organization	Trafikstyrelsen	Statens vegvesen, Jernbanedirektoratet, Entur	Trafikverket	The Finnish Transport and Communications Agency Traficom.	Vegagerðin (Road A.)
NAP Status	Running.du.vd.dk Currently NeTEx data for public transport is available. Next steps: Other Scheduled modes DRT modes	Running, Entur responsible for MMTIS (PT, mobility, shared, private transport). www.transportportal.no, developer. entur.org	Förenklad biljettstruktur avseende regelverk och villkor Förenklade köp av biljetter Nationella biljettsamarbeten, Återförsäljning för att nå nya kunder och sammanhang.	Running. Fintraffic Ltd is responsible for the service on behalf of Traficom. All modes of transport are included. You can find all services with categorized searching tool.	Non-exiting.
Mobility-as-a-Service (MaaS) operations					
Organisations, public (platform/app)	Rejsekort/Rejseplanen (National PT)	Entur (National PT - Entur app) Regional PTAs: Ruter, Kolumbus, Skyss, ATB (all own apps)	Regional PTAs: Nobina – Travis app Samtrafiken, Västrafrifiken, Skånetrafiken, SL	Regional PTAs: HSL (Helsinki) City of Tampere, Turku etc. The service catalogue includes a total of 3354 services, the production of which involves a total of 5652 companies or organisations. The most of those companies are	Regional PTAs: Strætó (Bus – Reykjavik capital area)
Organisations, private	N/A	N/A	N/A	MaaS Global –Whim	N/A

Third party ticket sale	No	No	No.	Yes, but not through NAP	No
PT open travel data	Yes via NAP and through Rejseplanen LAB	Route info freely available, but not travel demand data	?	Yes, through Digitransit, but you need to register. There are also other sources and more detailed possibilities like ITS Factory Developer Wiki.	Strætó gives third parties access to route system data

Public transport (PT) Organisation & Private mobility actors

Main actors: PTOs, private bus/ coach, rail, ferry companies (examples):	Stena DK-S, Mols Line Color Line, DFDS, Scandlines, Fjordline	Color Line, DFDS, Fjord Line, VY, Bus4you, NorWay B.e., GoAhead (Rail)	SkandiLines, Viking lines	PT: Matkahuolto, Members of Finnish Bus and Coach Association (158 companies) Ferry companies: Viking Line, Tallink Silja, Finnlines, Eckerö Lines	
Regional / national organisation	Regional on municipal or county level: bus, tram National: Rail (DSB), Trafikstyrelsen (Arriva-Rail), Metro	Regional on municipal or county level: bus, tram/ metro National: Rail (SJ)	Regional on municipal or county level: bus, tram/metro National: Rail (VY,SJ++	Regional on municipal or county level: bus, tram/metro National: Rail (VR) National: Matkahuolto Many of those members of Finnish Bus and Coach Association are operating at national level.	Regional on municipal level National: Rail N/A
Private mobility (examples): car/ride/ bike/scooter share	KINTO, Green Mobility, Letsgo, Drivr, Donkey, Taxa, , Flixbus,	Hyre, GetAround, Bilkollektivet, Otto,	Freeway S, Lynk & CO	MaaS Global, CGI, PayiQ (ticketing), Matkahuolto, eScooter service providers, 24 Rent Ltd, Omago Ltd. PerilleMobilityServices	Hopp, Zolo