



Nordic
Innovation

NOMAD MaaS roaming final report

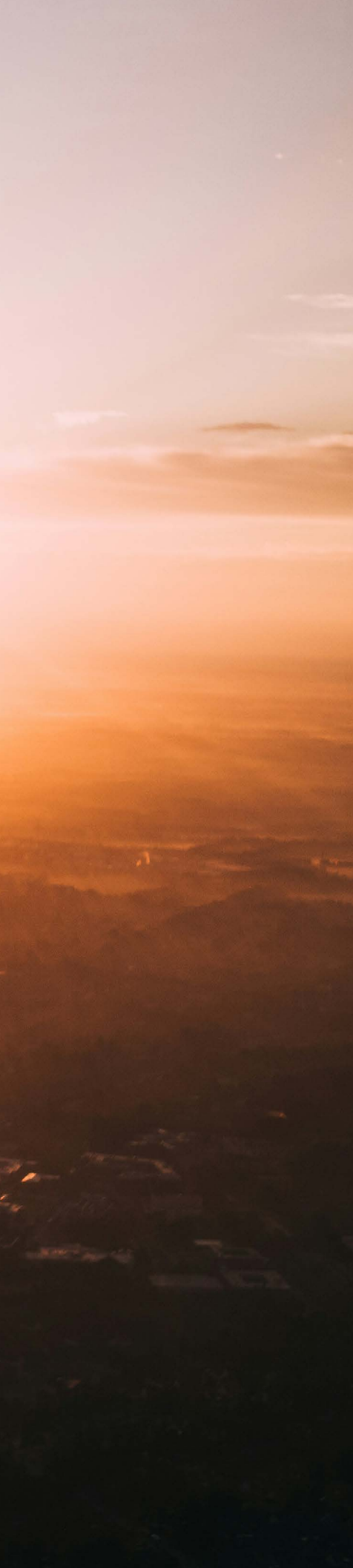


The Nordic Open Mobility and Digitalization (NOMAD) project partners are ITS Denmark, ITS Finland, ITS Iceland, ITS Norway, ITS Sweden, TØI and RISE. The project is co-funded by Nordic Innovation and Capital Region of Denmark.

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1. Introduction and Background

1.1 Introduction

In 2011, Siim Kallas, Vice-President of the European Commission, then in charge of transport, gave word to what many found frustrating at the time:

"Why can't I yet plan or book my journey through Europe – switching from air to rail or sea, to urban or road transport – in one single go and online?"

Bank and telecom operations had for decades flowed free over national borders and independent of national service providers. By agreeing on a set of industry standards and contracts supported by similar national regulations, these industries offer their customers cross-border and cross-provider roaming services. The tremendous simplification for the users has not jeopardized competition between the service providers, but rather grown the market potential for all.

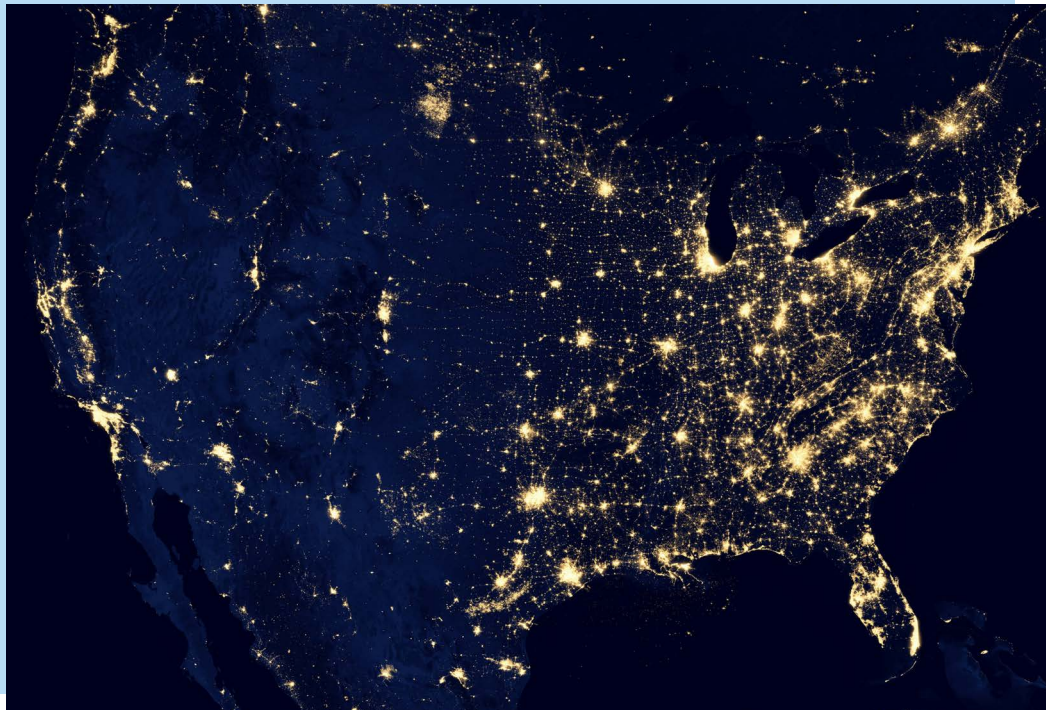
The airline industry was quick to pick up on this model. Today, anybody can easily book and pay for flights anywhere globally, no matter how many airline companies are involved – thanks to standardized platforms, norms and four major reservation systems with global coverage: Amadeus, Galileo, Sabre and Worldspan.

Nevertheless, it is still hard to place an order for a seamless journey if it involves more than one form of surface mobility and more than one nation. A seamless cross-border travelling experience is needed in order to attract air travellers and private car users to more sustainable multimodal ground and sea options for both short and long-distance trips in the Nordics.

Of all the challenges successful mobility services face, cross-border issues and business models seem the most complicated. Both problems are related to payment/ticketing and the implementation of standards. These issues evade an easy solution because public and private mobility providers must cooperate despite their inherently different business models, and cities and countries often work at different paces and apply slightly different policies, regulations and standards.

There are a lot of initiatives, projects and operations going on in Europe to overcome these challenges. The EU Commission is issuing appropriate regulations and standards addressing access and sharing of mobility data and payment and ticketing for journeys. In most countries, pilots and operations investigate different aspects of new mobility services, and the NOMAD project addresses cross-border and roaming issues between the Nordic countries. Even if roaming is NOMAD's prime target, understanding all the fundamental issues is a prerequisite for a successful project. Other initiatives and stakeholders became keenly aware of NOMAD as a peer project and soon saw it as a European signature MaaS projects. The visibility made it easy for NOMAD to access and consult the elite MaaS experts around Europe.

Can we propose a Common Information Model that will serve as a digitalization and data-sharing framework that supports the next generation of mobility services and roaming under different regulations, cultures and conditions? Solving is NOMAD's primary objective.



1.2 Executive Summary

The Nordic Open Mobility and Digitalization project – henceforth NOMAD, initiated in 2019, aims to facilitate cross-border data-sharing to enable the roaming of mobility services, focusing on Mobility as a Service (MaaS). Initially, NOMAD involved the private transport providers Kyyti, based in Helsinki, and UbiGo, based in Gothenburg, and their mobility platforms to permit roaming of each other's mobility services. The two platforms would form a "market enabler platform" for full-scale use cases involving cross-mode and cross-border journeys with real passengers.

The project faced setbacks due to the COVID-19 pandemic, resulting in a year-long pause. During the hiatus, Kyyti and UbiGo terminated operations and left the project. Despite the challenges, NOMAD resumed operations in 2021, transitioning to running simulations and verifications rather than the "live" full-scale use cases.

The primary problem addressed by the NOMAD project is the need for seamless, cross-border journeys involving scheduled services and on-demand services like taxis, micro-mobility, and carpooling. The challenge lies in compensating for services provided by different MaaS agents, whether publicly or privately funded.

NOMAD proposes a solution by standardizing interfaces between mobility providers, enabling the roaming of travel services and creating unified, user-friendly experiences. The MaaS roaming concept, inspired by mobile phone roaming, envisions using local MaaS agent apps to plan, book, and pay for trips across borders. The project is fully aligned with relevant EU regulations and is supported by the [Open Mobility Data in the Nordics \(ODIN\)](#) project's standardized and structured access to the region's National Access Points (NAPs). Further, NOMAD's vision aligns with the Green Nordic Region Strategy 2030, aiming to reduce CO2 emissions and promote sustainable, integrated mobility.

To make up for the loss of actual use cases, NOMAD has refined the research questions to address: Under which circumstances, cultural, demographic, regulatory, subsidy and authorities will MaaS roaming be viable? To answer the questions, NOMAD has organized several simulation workshops and conclaves to engage stakeholders and experts, seeking input and feedback. The events have contributed to refining its approach and ensuring stakeholder involvement in the Nordic countries and Central Europe.

In summary, NOMAD addresses the complex landscape of cross-border mobility challenges, striving to create a standardized, user-centric approach to MaaS roaming. Despite pandemic-induced setbacks, the project demonstrates resilience, aligns with EU regulations, and supports the green vision for the Nordic region.

Through the “feel the pain” workshops, NOMAD revealed the inefficiencies of today’s planning, booking, and paying for cross-border travel using only public transport options. This, in combination with the poor business models for the private on-demand providers makes it clear that today’s multimodal travel options cannot compete with aviation and private car journeys.

In sum, the findings have clearly confirmed the NOMAD hypothesis that international, multimodal, business and commuter travel would be easier, cheaper and more attractive if it could be planned, booked, and paid for through a single interface. Adopting international MaaS roaming will make cross border travel more sustainable and make it easier to report travel-related sustainability data.

Many European actors are working on the fundamental issues that are prerequisite for MaaS roaming. They became keenly aware of NOMAD as a peer project and soon saw it as a European signature MaaS projects. The visibility made it easy for NOMAD to access and consult the elite MaaS experts around Europe.

The first steps towards digital supported discovery, planning, booking, payment and navigation of seamless multimodal borderless journeys have been taken including:

- EU regulation and emission goals are making the case for more efficient mobility services. The coming regulation on Multimodal Digital Mobility Services (MDMS) will be particularly helpful.
- There are many standards for APIs and journey planning in place. The National Access Points (NAPs) in the Nordics already publishes public transport data in standardized formats. Private scheduled modes and on-demand services shall be available in the NAP’s shortly.
- The ODIN network of Nordic NAP stakeholders has created a single NeTEx Nordic profile for exchanging Public Transport schedules and related data.

- Entur, collects and distributes scheduled transportation services in Norway aligned with EU- regulation and standards and extensive use of open source components.
- It is technically possible to enable true cross-border planning, booking and payment in a single domesticated application.
- The NOMAD project has identified necessary steppingstones that need to be solved in order to succeed with MaaS roaming in the Nordic region. A large number of experts and stakeholders from the Nordics and Central Europe have been involved in the process.

While most of the regulations and standards are in place to simplify the use of sustainable multimodal travel, even cross regional and national borders, there are still a number of outstanding issues to be resolved. These are especially related to governance, agreements and compensation for the work of combining single modal offerings into multimodal travel plans:

- Clearing house for sharing/distribution of single payments for multimodal cross-border journeys to the contributing mobility service actors.
- Access to on-demand mode open mobility data and third party booking and payment across the Nordics.
- Single payment for cross border multimodal journeys still lacks standardization. There is an EU initiative called Multimodal Digital Mobility Services (MDMS) regulation in the making.
- There is still much transformation to be done before private and public actors will be willing to act in a way that supports cross-border MaaS.
- Fragmentation of public transport organizations and customer interface is a major barrier for land-based public transport use. The PTAs and their authorization areas are fragmented and add to the complexity for the traveler. There are few authorities with an overreaching responsibility for cross-border operations between municipalities and counties, and none between nations in the Nordics.

- The engagement level of the PTAs is low, and they are a key factor if MaaS roaming is to become a reality. Also the PTAs will benefit from more usage of their services as part of multimodal travel chains cross regional and national borders.
- MaaS roaming is not self-funding. The ecosystem of shared mobility services has to realize that by the sum of offerings is bigger than each individual single modal selling of mobility services.
- There is a dire need for more knowledge and collaboration on MaaS, despite emerging EU regulation, ODIN initiative and clear environmental goals.
- Well-defined FRAND (fair, reasonable, and non-discriminatory) principles for ticketing and third- party sales (MDMS (Multimodal Digital Mobility services)).

Recommendations based on NOMAD project - discussions and findings:

- Create a political process to rearrange and simplify multimodal cross PTA border planning and payment authorization zones.
- Create a political process to force a change in the funding mechanisms for MaaS (EU regulation).
- Systematic sharing of best practices for open mobility data in the Nordics
- Develop (in the Nordic Council) a shared ambition for seamless Nordic mobility at an ambitious level
- Implementation of a single Nordic interoperable profile for static and dynamic open mobility data accessed through the NAPs in all Nordic countries (ODIN)
- Establish a journey planner with full Nordic coverage
- Gap analyses for standards and local/national regulation

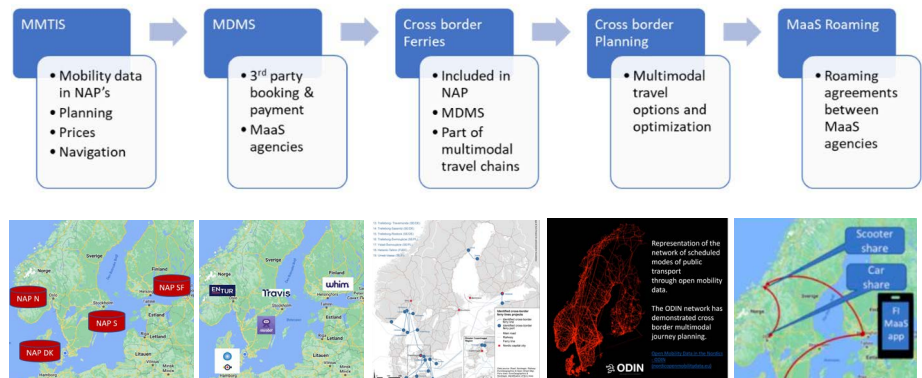


Figure 1: How to enable MaaS roaming in the Nordics

Suggested use of cross border projects, trials and pilots to fastforward the seamless digitized single planning, booking and payment for multimodal journeys at land and sea throughout the Nordics:

- Developing a viable business model for MaaS roaming. Potential pilots should include real money, and cross-border travel. See Figure 1: How to enable MaaS roaming in the Nordics.
- Demonstrate the effect of removing the PTAs geographical barriers Using digital tools.
- Demonstrate the use of Entur's concepts in two or more countries including private, public scheduled entities, and on-demand service providers.
- Determine "Who is the main driver for the transition – cross-border – vision – funding".

1.3 NOMAD Vision and background

NOMAD Vision

The vision of NOMAD has been disseminated in different versions over the years. Here is the most recent vision together with a couple of earlier visions and an example from Austria.

Vision:

To accelerate the transition to sustainable mobility and simplify life for all travelers.

Intention:

To pave the way for Inter Nordic MaaS agents, to make it easy for travelers to switch from air and private car to multimodal ground and sea modes for all journeys in the Nordics.

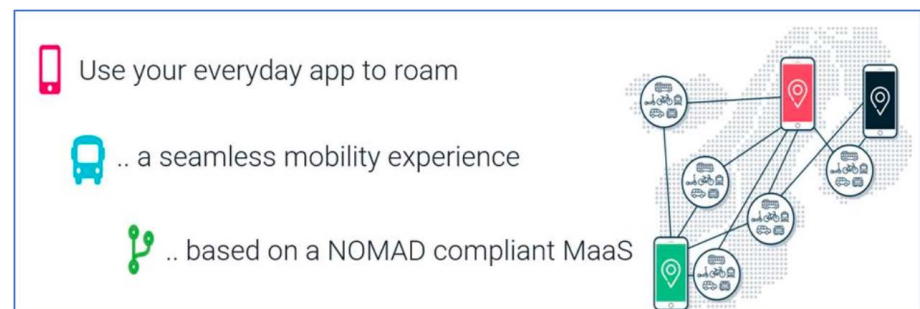


Figure 2: NOMAD's initial vision, that describe the complete idea behind the project.

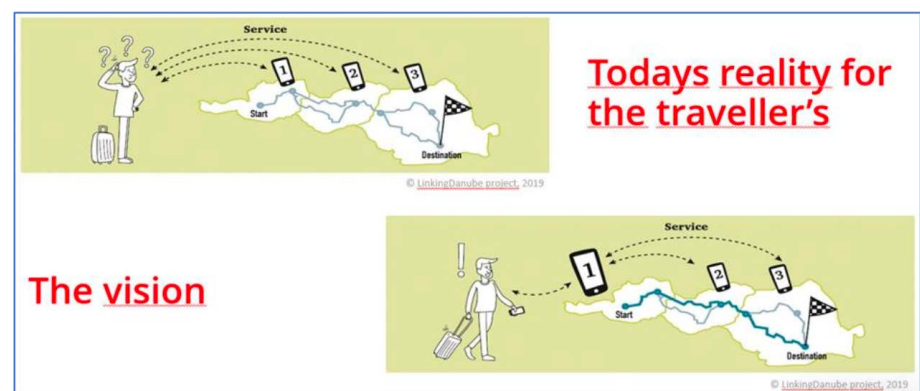


Figure 3: Austria's illustration of the MaaS concept. It is an easy-to-understand simplification of travel

As a result of the pre-projects ¹initiated in 2018, the NOMAD project started in October 2019. The projects aimed to enable cross-border data-sharing to support the roaming of new mobility services. At the time of initiation, there was hardly any successful sharing of mobility data in any Nordic country, and roaming was unheard of. Still, the two pre-projects demonstrated that there was a technical rationale for a roaming concept.

The Nordic project ODIN was established around the same time with an aim to standardise provision of mobility data for the National Access Points (NAP) in all the Nordic countries. ODIN was written into the NOMAD plan-of-action to resolve some of the data-sharing issues addressed in NOMAD.

The first attempt to solve the roaming issues revealed many fundamental questions about successful MaaS. It soon became apparent that there was a need for more standardisation, and the lack of trust hampered the development of viable business models for the private actors.

Even if roaming is NOMAD's prime target, understanding these fundamental issues is a prerequisite for a successful project. Many European actors are working on these issues. They became keenly aware of NOMAD as a peer project and soon saw it as a European signature MaaS projects. The visibility made it easy for NOMAD to access and consult the elite MaaS experts around Europe.

The NOMAD project was progressing as planned but faced delays and eventually stopped before the summer of 2020 due to Covid-19. During the covid period the project lost its two private MaaS actors Kyyti and UbiGO. This led to a change in project-structures and methods, but the main project goals were kept intact when the project resumed in late 2021.

¹ Two pre-projects the initiated the NOMAD project; NMIP (Nordic Mobility Innovation platform) and SHORT.

Pre Covid Project - Work on NOMAD before the lock down

The project assumed the upcoming EU regulation would pave the way toward a more sustainable user-centric mobility based on a MaaS solution. There will be new requirements for data management and sharing from the transport operators (public and private) for developing more resilient and sustainable travel services.

After the kick-off in October 2019, the project took form, and we agreed to make full-blown use cases that involved cross-mode and cross-border journeys. Kyyti and UbiGo, the project's private mobility providers, would use their mobility platforms as a mock-up "Market-enabler" platform - enabling roaming of each other's mobility services. Kyyti's Finnish customers could use the Kyyti app to book services using UbiGo's platform in Sweden - and the opposite. TØI and Rise were planning extensive use cases with different travel scenarios, like business trips from Copenhagen to Helsinki via Stockholm, leisure trips between countries, and climate-friendly trips between countries. It would involve a lot of actors and follow-up activities.

The project ran close to regular operation in the first two quarters: 2019-Q4 and 2020-Q1. At that time, the management did not foresee any significant Covid-impact on the project, and generally assumed that regular operation would commence by 2020-Q3.

The planned in-person multinational Stakeholder Workshop on 23 March 2020 in Copenhagen was changed to a digital Workshop due to covid restrictions.

But, towards the end of 2020-Q2, it became apparent that the Covid-situation would prevail well beyond the third quarter of 2020.

The slowdown of the project took effect after May 2020. The planned pilots and scenarios involved close interaction between actors and cross-border activities - which was impossible due to the Covid-regulation in the Nordic countries. More than half of the planned activities were affected. The imposed regulation stopped almost all activities. The lack of current and planned activities affected the financial side of the project as in-kind registration dropped significantly, and finally, invoicing from the partners also stopped.

After the summer of 2020, it was clear that business would not pick up until much later than anticipated. So, in September 2020, the management stopped and postponed the project for one year (until October 1st, 2021).

After almost a year without activities, Kyyti and UbiGo reported that they ceased their operation due to Covid and had to withdraw from the NOMAD project.

Post Covid Relaunch

The lack of private mobility providers led to a redefinition of the project's content - without the "Marked enabler" and the real-world pilots of roaming services. The real-world activities were replaced by "Scenario simulations" and "Verification measures" to yield much of the same answers and research results. The project terminated the affected work packages and established new ones to fulfil the tasks - followed by a new timeline that extended the project by about one year to make up for the pause and the replanning.

The objective of NOMAD MaaS roaming is still to explore how creation and fulfilment of multimodal travel plans within and across national borders in the Nordics can be achieved.

The EU has similar objectives as part of the green deal initiative. A regulation for how to enable multimodal travel information services (EU) 2017/1926 was passed in 2017 and was updated in 2023. Also, regulation is in progress to create an open marketplace for booking and payment of multimodal journeys. This initiative is known as the Multimodal Digital Mobility Services (MDMS) regulation.

The NOMAD project assumes that existing public and private owned MaaS actors in the Nordics will evolve as complete MaaS ecosystems serving national or regional territories.

The project assumes that Entur (N), Resrobot (S) and Rejseplanen (DK) likely will evolve into full function MaaS agents. Also that they will comply and take advantage of the EU regulations to enhance their own services and enable collaboration with each other to enable seamless cross border travel planning and execution.

Also, two private MaaS agencies Whim (Helsinki) and Travis (Stockholm) are included to explore the dynamics between public and private owned MaaS agencies.

More MaaS agents may appear on the market and the current setup may change, but the listed MaaS agencies provides a representative coverage of the Nordics.

MaaS roaming allows users to use their preferred/local MaaS agent to plan and pay for trips from anywhere to anywhere in the Nordics.

The MaaS agents interact in a roaming fashion to deliver relevant travel plans extending the geographical span of the preferred MaaS agent.

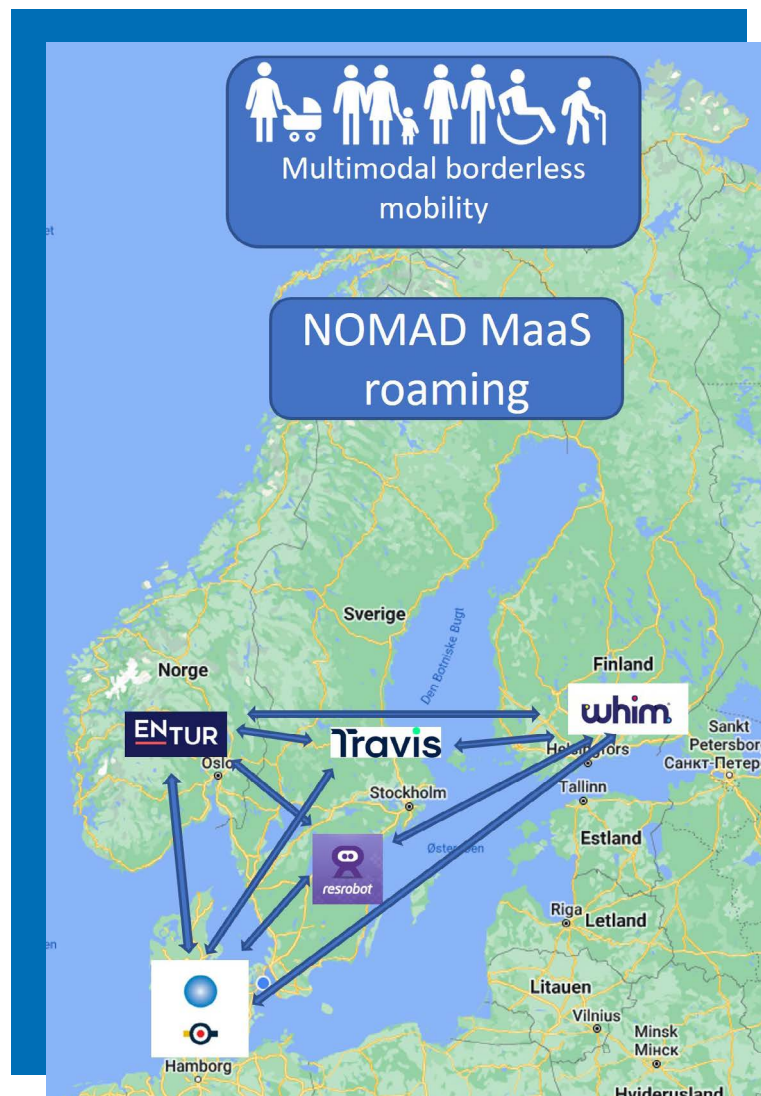


Figure 4: Some future MaaS agents in the Nordics

1.4 Standards and EU regulations

Accelerating the shift to sustainable and smart mobility is one of the major agendas for the European Green Deal. This has been folded out in objective 2: Smart Mobility in the EU Sustainable & smart Mobility Strategy. To achieve seamless, safe and efficient connectivity the commission is regulating to advance Seamless multimodal transport based on digital solutions and unleash the full potential of mobility data.

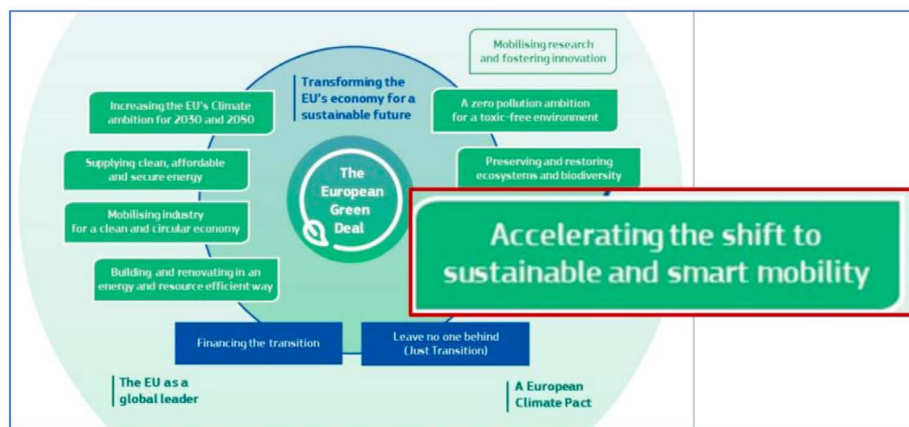


Figure 5: The European Green Deal
(The European Green Deal - European Commission (europa.eu))

Multimodal mobility services require standards related to data exchange and sharing within and between the modes. It is worth noticing that there is ongoing work addressing some of the critical concerns NOMAD has identified.

Standardization in the sector is developed and customized to operations and the operational practice in each mode and for each type of operation. In a zoomed-out view, the sector can be divided into four modes: air, sea, rail and road. Each of the modes can be divided into areas like person-oriented mobility services, cargo-centric operations, and navigation.

This fragmentation makes standards sub-optimal. To maintain a holistic view and support multimodal operations, overreaching standards that support shifts between modes are needed. (Ref. ORCHESTRA D2.5 and D3.3 part IV).

According to the EU ITS Directive §8, standards are necessary to maintain interoperability, compatibility and continuity for the deployment of operational ITS. These standards shall be developed in cooperation with the relevant standardization bodies as described in Directive 98/34/EC. (Ref. EU ITS Directive §8). Most of these standards cover multimodal aspects of travelling, especially planning, booking, and paying for cross-mode journeys. The most comprehensive concept is the provision for of further, EU-wide multimodal travel information services (MMTIS), alwhich all mobility services actors and MaaS agencies will have to comply with.

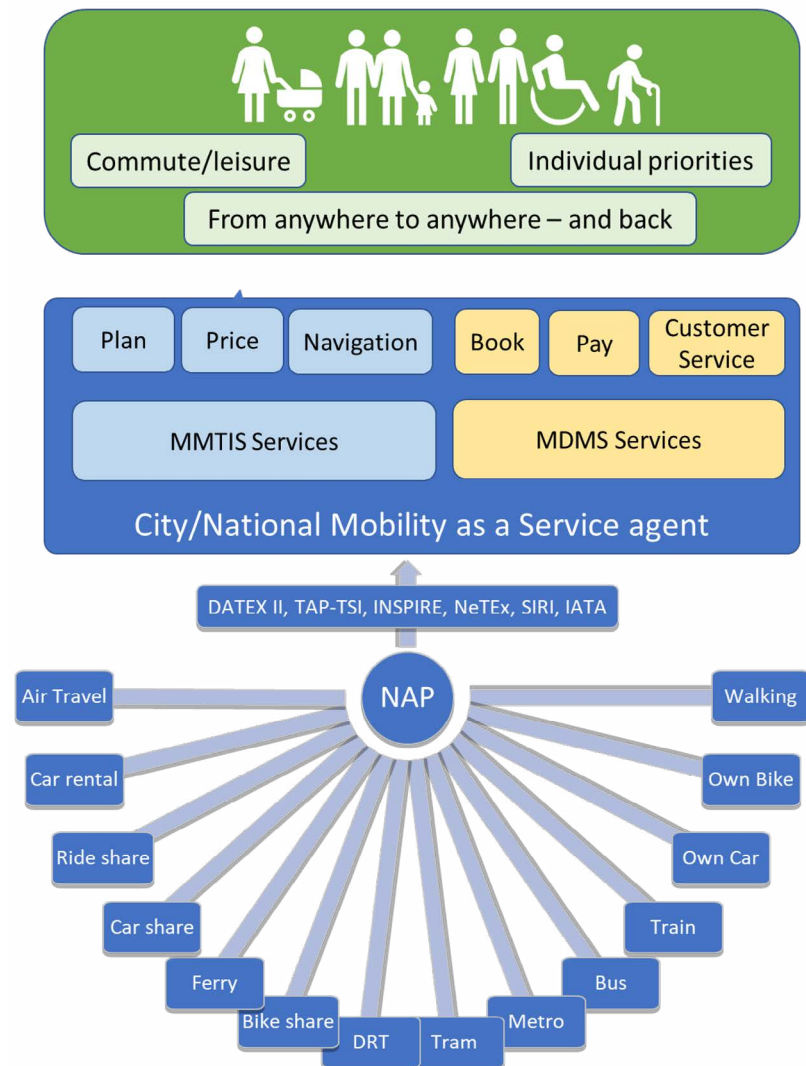


Figure 6: Multimodal travel planning using open mobility data from National Access Points

This includes that they are suppliers to and users of open mobility data through the National Access Points. Those data shall be reused in a neutral manner and without discrimination or bias. The first principal travel itinerary presentation shall not mislead the end user.

Relevant for the NOMAD project is especially article 7 of the MMTIS regulation:

Article 7: Linking travel information services:

1. Upon request, travel information service providers shall provide to another information service provider routing results based on static, and where possible, dynamic information.
2. Routing results shall be based on:
 - a. the enquirers start and end points of a journey along with the specific time and date of departure or arrival, or both;
 - b. possible travel options along with the specific time and date of departure or arrival, or both, including any possible connections;
 - c. the handover point between travel information services;
 - d. (d) in case of disturbances, alternative possible travel options along with the specific time and date of departure or arrival, or both, and any connections, where available.

Article 7 provides obligations to multimodal travel information service providers to be open for collaboration with peers to assist in delivering travel plans extending one travel information service provider's domain.

The MMTIS regulation has just been revised. The MMTIS regulation supports the shift towards more sustainable transport modes, including the use of active modes, such as walking and cycling. By mandating the accessibility of dynamic datasets and new static, historic and observed datasets, as proposed by the amendments to the MMTIS regulation, multimodal travel information services may enhance the information and service to the passenger, to boost multimodal mobility and reduce emissions, in line with the objectives set out in the European Green Deal.

The booking and payment for multimodal travel plans are not regulated yet. However, to present a level playing field for the NOMAD MaaS roaming project the EU regulation for Multimodal Digital Information Services (MDMS) is considered in effect and adopted by the MaaS agencies.

Problem definition	Objective
Overall problem Limited use of digital mobility services to improve the performance of the transport system through effective multimodality.	General objective Unleash the potential of MDMS to improve the performance of the transport system developing an effective multimodality offering
Driver A Lack of willingness to cooperate between MDMS and transport operators	Specific objective 1 Enhance cooperation and fair competition between MDMS platforms and transport operators
Driver B Commercial and technical challenges to establish viable, scalable and high quality MDMS	Specific objective 2 Facilitate the re-sell and integration of all mobility offers in MDMS by tackling commercial and technical challenges and establishing fair competition principles
Driver C Lack of commercial incentives to help improve the performance of the transport system through effective	Specific objective 3 Ensure that digital mobility services support the efficiency and sustainability of the transport system and societal goals

Figure 7: Multimodal Digital Mobility Services (MDMS) problems and objectives, an EU regulations in the making

Source: [1st public workshop impact assessment for the initiative on Multimodal Digital Mobility Services \(europa.eu\)](#)

The MDMS regulation seeks to enhance cooperation between MDMS (MaaS) platforms and transport operators. It will tackle commercial and technical challenges and establish fair competition principles (FRAND²) to facilitate re-sell and integration of all mobility offers.

For the NOMAD MaaS roaming exercise it is assumed that third party booking and payment has been established between MaaS and public and private shared mobility actors using standard API's (to be defined).

² FRAND: Acronym for fair, reasonable, and non-discriminatory - is often used in relation to technical standards that are developed through an open, consensus-based, and industry-led standardization process.

1.5 NOMAD contribution to the Green Nordic Region Vision 2030

The vision 2030 for the Nordic Council of Ministers is that the Nordic region will become the most sustainable and integrated region in the world.



Figure 8: *The vision 2030 for the Nordic Council of Ministers and NOMAD contribution*

To achieve this an ambitious strategy for 2021 - 2024 has been adopted to strengthen Nordic Cooperation in the priority areas. Ref: [Nordisk Ministerråd - PolitikNord2020-728 \(norden.org\)](https://norden.org/nordisk-ministerrad-politiknord2020-728)

The NOMAD project contributes to the Green Nordic Region strategy by stimulating and exhibiting the use of ITS and open mobility data cross border for a greener and more sustainable mobility consumption in the Nordics and beyond.

The greener Nordic region

Objective 1: Research and development and the promotion of solutions that support carbon neutrality and climate adaptation in relation to transport.

The NOMAD project combines knowledge and research from all Nordic countries to combat climate change and facilitate a rapid transition to a carbon neutral transport sector guided by digital planning, navigation and payment for more sustainable travel options.



Objective 4: Climate-friendly choices to Nordic consumers

A NOMAD key objective is to facilitate and accelerate the use of sustainable choices in the Nordic Region when it comes to transport.

Objective 5: Promoting Nordic green solutions in the rest of the world.

The Nordic countries are in front when it comes to digitalization and innovation. The findings from the projects are applicable to neighbouring countries and indeed all of Europe as the project makes use of open standards.

Dissemination is an important element in the project through webinars, workshops and presentations. This includes both audiences in the Nordics, the Baltics and the rest of Europe.

Objective 6: Supporting knowledge and innovation

The Nordic+ pursues projects and ventures that support the safe use of digital technologies to reduce congestion, increase road safety and reduce environmental impact of transport.

The Nordic+³ will drive progress at the Nordic level in data development and open data within the transport sector. This includes seamless access to mobility through digitalisation and work towards a complete digital twin of the Nordic borderless mobility ecosystem.

The Competitive Nordic Region Strategy - promoting green growth in the Nordic Region based on knowledge, innovation, mobility, and digital integration.

Objective 7: Freedom of movement in the Nordic Region to support a well-functioning labour market.

By stimulating the creation of seamless and borderless mobility planning navigation and payment the NOMAD project will pave the way towards freedom of movement for people and businesses in the Nordic Region.

³ The mobility network Nordic+ will follow up on results and proposed next steps from the NOMAD project.

Objective 8: Leverage digitalisation and education

The NOMAD project has a specific focus on how to remove obstacles for seamless journeys across regional and national borders through cross-border digital mobility services. The goal is to stimulate the use of mobility services across borders to make it easier to do business, study, and work in another Nordic country.

The socially sustainable Nordic Region Strategy – maintaining trust and cohesion.

Objective 10: Involving everyone in the green transition and digital developments work towards a socially sustainable green transition that does not increase inequalities in Nordic society.

NOMAD show cases how ITS and other digital solutions can allow everyone to enjoy seamless, and borderless mobility without increasing socio-economic, cultural, and geographical challenges linked to the green transition. The goal is to create sustainable, fair, and inclusive practice for the development of secure digital solutions to unleash the potential of freedom of mobility based on transparency and the secure use of data. In one sentence: Leave no one behind.

2. NAP, ODIN, Roaming and other concepts

2.1 The concept of National Access Points (NAP)

A National Access Point can take various forms, such as a database, data warehouse, data marketplace, repository, and register, web portal or similar depending on the type of data concerned and provide discovery services, making it easier to fuse, crunch or analyse the requested data sets. For these purposes, data is accessible on a non-discriminatory basis, in accordance with the necessary standards for exchange and reuse.

Access to standardized and structured mobility data in a common database is a prerequisite for realization of the NOMAD vision and MaaS roaming.

The National Access Point Coordination Organisation for Europe (NAPCORE) project was started in 2022, to work on a better alignment of the implementation of EU specifications in the Member States. NAPCORE has been launched as coordination mechanism to improve interoperability of the National Access Points as backbone of European mobility data exchange. NAPCORE improves the interoperability of mobility data in Europe with mobility data standard harmonisation and alignment. Also, NAPCORE aims at increasing access to and expanding availability of mobility related data by coordinated data access and better harmonisation of the European NAPs.

More information on <https://napcore.eu/>.

National Access Points are established in all Nordic countries, except for Iceland. The MMTIS regulation contains a plan for which mobility data should be available when (see appendix XX).

NAP represents the backbone for the NOMAD vision and MaaS roaming. The ODIN project is the driving force for the development and coordination of NAP in the Nordic region for mobility data.

National Access Point – Common standards

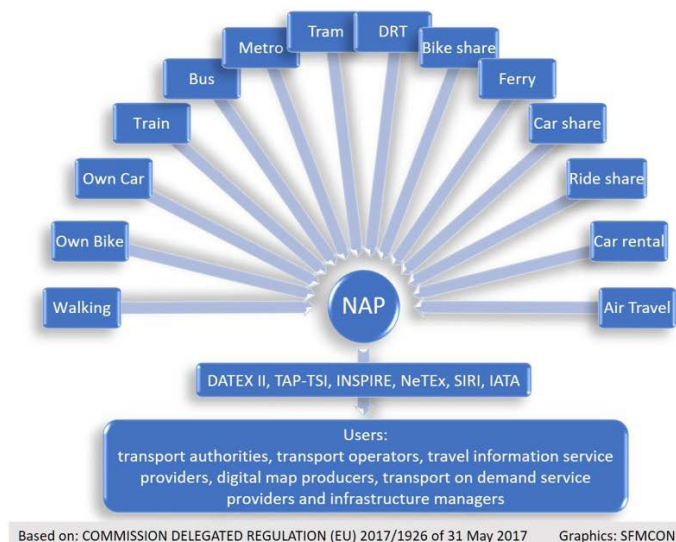


Figure 9: National Access Point – Open mobility data

2.2 ODIN Contribution to NOMAD MaaS roaming

The Open Mobility Data in the Nordics (ODIN) project aims to accelerate and coordinate the work necessary to create a unified market within the mobility sector in the Nordics.

The vision is to make it as easy to use mobility paid as a service as it is to use the GPS in the car.

ODIN is a collaborative initiative that aims to make mobility data and services for public transport in the Nordics interoperable and accessible in a free and open manner. The initiative brings together leading and national actors responsible for open public transport data from Sweden, Norway, Finland, and Denmark.

The ODIN network strictly adheres to Transport model data standards, MMTIS and uniform NAP data.

The key goals of Open mobility data in the Nordics are:

- Reduce barriers for developers of mobility services on a Nordic level
- Implement upcoming EU regulations in a way that increases the attractiveness of the Nordic mobility market
- Enable the Nordics as a living lab for new innovative mobility services

The initiative has already made significant progress. For instance, a common Nordic NeTEx profile has been developed, which is a standard for describing public transport data. This profile facilitates collaboration between mobility services across national borders and enables the use of data from various sources.

By making data accessible to everyone, we can create new and innovative solutions that make cities more sustainable and accessible. In 2024 the collaboration will focus on cross-border public transport in the Nordic region. Next step is inclusion of private scheduled and on demand services.

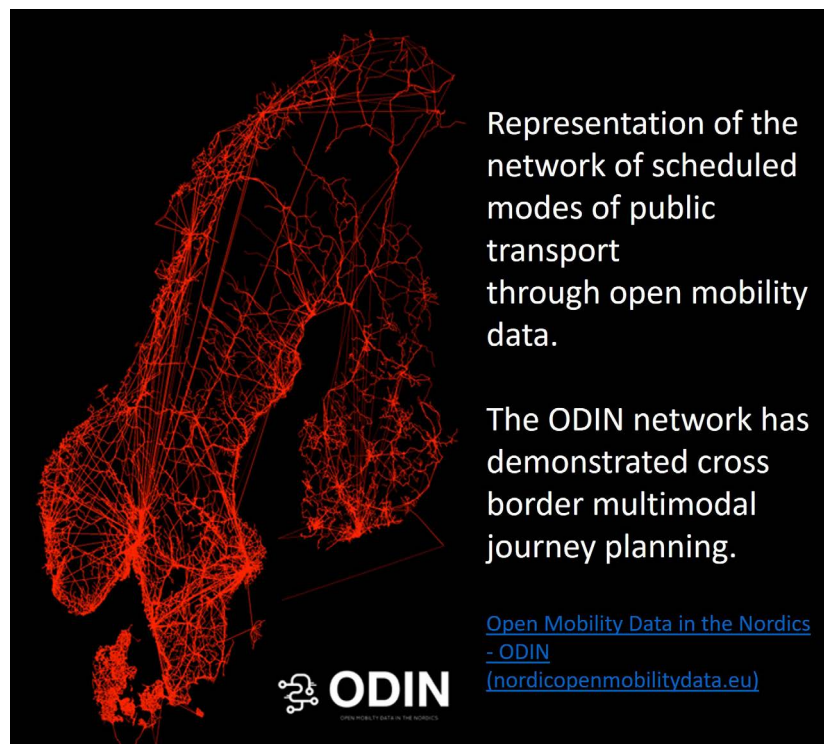


Figure 10: [Open Mobility Data in the Nordics - ODIN \(nordicopenmobilitydata.eu\)](https://nordicopenmobilitydata.eu)

2.3 Roaming

2.3.1 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.

See appendix 3 for more details.

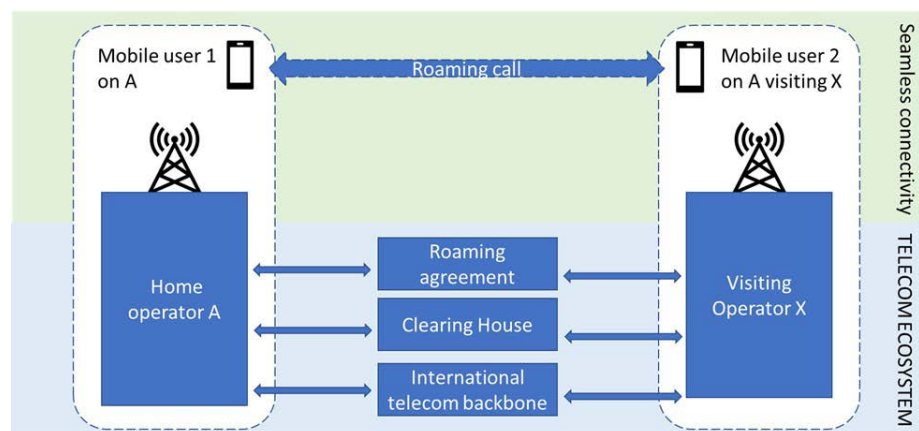


Figure 11: Roaming requires home and visiting mobile phone operators to establish a shared infrastructure.

To facilitate seamless communication through mobile phones when away from the home operators network reach, the participating operators needs 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.

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.

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

2.3.2 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.

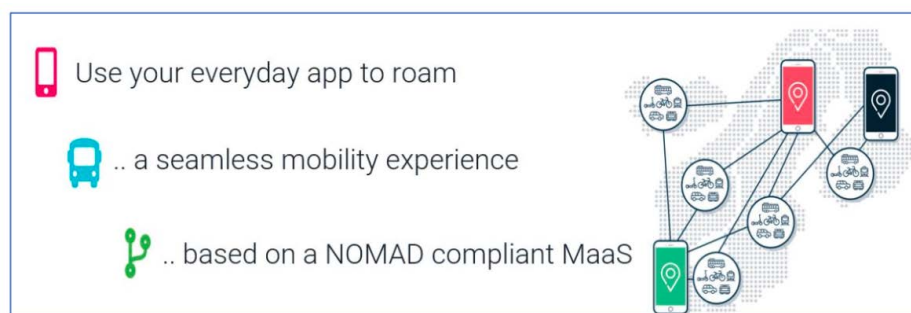


Figure 12: NOMAD vision

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&Rejseplan (DK) and Resrobot (S)). Some are privately funded and operate on commercial conditions (TRAVIS, Stockholm and Whim, Helsinki).

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.

2.4 Affiliated project exploring the MaaS business models

The NOMAD pre-project "Short" was conceived after ITS Norway ran and participated in several projects exploring the data foundation for MaaS in Norway. Through these projects, it became apparent that even if the data is available, it is hard to develop viability and business models for MaaS. As a result of Short, NOMAD was established to explore cross-border and cross-mode MaaS. To continue the research on viable business models, two projects "PengeMaaS" and "Maas-Peer" were established. These projects ran in parallel to NOMAD and had slightly overlapping goals. As a result of the projects and preliminary NOMAD findings, MaaS-eKOPP was established to create a simulator for testing different business models.

MaaS collaborations are currently mainly established to benefit MaaS Providers and the society. The Transport Service Providers offering transport means and services may struggle to see what they gain from the collaboration, or they may feel that the collaboration is not balanced and fair. Both MaaS Providers and Transport Service Providers may benefit from a more fact-based distribution of the revenue gained through a MaaS collaboration where there are well defined rules for the distribution that seem fair for all parties. For the MaaS Provider, such an approach may make it easier to get the relevant Transport Service Providers involved, and the contributions made to integrate all the services can be recognized and rewarded. For the Transport Service Providers, it will become clearer how their contributions are rewarded. It might also be easier to define how positive contributions to the totality shall be rewarded. For example, if the introduction of a new service leads to more use of other services, the provider of the new service should be rewarded.

Based on the above, the MaaSeKOPP project use **Shapley Value for a fair distribution of values**. Shapley Value is a concept in cooperative game theory that helps to fairly distribute values among multiple players involved in a cooperative game. The core idea is to assign payouts based on each player's contribution to the total value generated. Shapley Value creates a fair and stable distribution among all participants while considering their individual contributions.

The MaaSeKOPP project has develop an application for use of Shapley Value for fair distribution of values in MaaS collaborations. The application is now used with input data on costs and tangible and intangible values for both MaaS Providers and Transport Service Providers. The intention is to use the results in discussions with the stakeholders to investigate the value sharing strategies to be used in planned MaaS collaborations.

The MaaSeKOPP partners has participated in NOMAD workshops to share findings and to learn – thus NOMAD has influenced the development of MaaSeKOPP and opposite. The result and findings of MaaSeKOPP, so far, will be valued input to a follow-up project after NOMAD is finished.

3. Workshops and findings



The NOMAD project has arranged a number of workshops and dissemination events to ensure stakeholder involvement and to generate important stakeholder and expert input along the different stages of the project.

Below is a list of the most important workshops, one prior to the shut-down during the Covid-19, and another five after relaunch in 2022:

1. Multinational Stakeholder Workshop. March 23, 2020
2. Multinational Digital Seminar. September 29, 2022
3. Simulation Rehearsal 1. Copenhagen, January 23, 2023
4. Simulation Rehearsal 2. Copenhagen, March 19, 2023
5. Simulation workshop. Copenhagen, April 17, 2023

Due to space constraints, we have summarized the workshop purpose, what we did, and lessons learned for each workshop in section 3.1. Workshop number 5 is presented in greater detail in section 3.2, while findings the workshop are included in Appendix 5.

3.1 Summary of NOMAD workshops

Multinational Stakeholder Workshop. March 23, 2020. Digital Meeting

This webinar—our first large public event of the NOMAD project—was originally planned as an in-person meeting in Copenhagen. Still early in the project, its purpose was to introduce the concept of MaaS roaming to a multinational stakeholder group, to solicit feedback on possible MaaS roaming pilot scenarios, to inspire participation from actors in the transportation sector, and identify challenges for future developments of MaaS roaming. At this point in the project, NOMAD still included MaaS operators Ubigo and Kyyti. We were hopeful that public and private transit operators might also be interested in participating in a technical pilot. In late February, after having reserved a physical space for the workshop, the planned in-person workshop was swiftly redesigned as a webinar in response to the emerging COVID-19 pandemic. The webinar was delivered on Google Chat and included two animated videos describing how the concept of MaaS roaming could improve the time efficiency of a daily commute and international business travel.

What we did

- 40 participants in the workshop included 17 from Denmark, 8 from Sweden, 7 from Norway, 5 from Finland, and 3 from other countries.
 - Showed two animated videos describing how MaaS roaming would streamline cross-border travel, and solicited feedback on a google form.
 - The video portrayed how a new MaaS app called "NOMAD" would bundle planning, payment, and ticketing (level 3 MaaS) into a single interface.
 - The two videos were 1) NOMAD for business travel and 2) NOMAD for commuter travel
 - After the videos were shown and data collected, there was a moderated discussion.
-

Lessons learned:

Participants reported that local public transport, airplane, regional- and intercity trains are the most common modes for their business trips, while taxi and personal vehicles are relatively less common. They expect increased use of micro mobility and train in the future, and decreased use of aircraft, personal vehicles and private cars. The respondents place the highest importance on arriving on time, managing and avoiding delays for their business trips. Also considered important are comfort, being able to work while travelling, and reducing the number of transfers and route planning in advance. A reoccurring issue was that managing payments and reimbursements for business travel is seen as complicated, which in part can be addressed by MaaS roaming service.

There was also a strong consensus that:

- Business and commuter multimodal travel would be easier if it could be planned and booked through a single interface.
- A single system for booking, paying, and reimbursing employee travel would help to reduce costs for the organization.
- Adopting International MaaS roaming would help the organisation's image as a 'sustainable' organization.
- Generating travel-related data for sustainability reporting is currently a difficult task within the organization.

In sum, we confirmed our hypothesis that multimodal international business or commuter trips are perceived as being complicated, particularly in terms of handling employee planning, booking, payment and reimbursements. A single MaaS- roaming interface service has the potential to make that easier, save cost and help with sustainability concerns in such travel.

Multinational Digital Seminar. September 29, 2022.

After a long pause due to the COVID-19 pandemic and several re-start meetings among NOMAD consortium members, we convened a multinational, multi-sectoral digital seminar to understand the diversity of challenges and opportunities related to cross-border MaaS roaming. Attendees included 45 representatives from Public Transport authorities, private mobility services, municipalities, researchers and technology firms from Denmark, Sweden, Norway, Finland, and Iceland.

What we did

The digital event began with several plenary presentations that described the NOMAD project generally, including its goals and the work we had undertaken up to this point. We then separated into two, hour-long breakout discussions:

- In the first discussion, participants were sent to digital breakout rooms to discuss MaaS roaming with other individuals from their professional sector (e.g. public transport, private mobility, consulting, etc).
- In the second discussion, participants were divided by country to discuss nation-related challenges and opportunities.

Both breakout sessions respond to two scenario prompts. "Scenario A" was focused on municipal support for MaaS in the form of infrastructure, land use policy, subsidies, etc. that could facilitate intermodal transport. "Scenario B" focused more on the role of public transit authorities and the extent to which they offered "mobility for all" by partnering with other mobility providers to deliver services beyond traditional trunk lines. NOMAD consortium members served as group facilitators and notetakers.

Lessons learned:

- The largest obstacles to international MaaS roaming are political and economic, not technical.
 - There is a lack of shared vision for MaaS at a regional or multinational scale. Actors will be more likely to invest in such a system if they share a basic understanding of a mutually-beneficial outcome.
 - Specifically, achieving MaaS at a local or international level will require that public and private mobility service providers have a clearer understanding of the benefits of offering their (traditionally isolated) services on shared platforms.
 - Large mobility actors, particularly public transit authorities, remain concerned that shared ticketing on MaaS platforms will expose them to competition from private mobility providers, and many have decided to develop MaaS services in-house rather than cooperate with independent MaaS operators.
 - Slow-changing institutional structures and public transit budgets that are designed for 10 years in the future make large-scale innovations like MaaS challenging
 - In the future, public funding might be leveraged to support/procure mobility outside traditional public transit (e.g. bus, train, tram). This could incentivize cooperation necessary for MaaS.
-

Simulation Rehearsal 1. Copenhagen, January 23, 2023

After analyzing the results of the digital workshop (above) it became clear that a shared vision for MaaS roaming was critical for stimulating the first steps toward creating a multinational MaaS system, otherwise no single actor would take the risk of initiating a cooperative mobility platform. To this end, we began to develop a scenario simulation workshop—a roleplaying game—wherein participants would be assigned roles, delegated resources, and asked to balance internal and external priorities as they built up an international MaaS roaming system. “The simulation” was envisioned as a live-action event facilitated on a digital sharing board like Mural. We met as a consortium in Copenhagen in January to rehearse the simulation.

What we did

Consortium members from Norway, Sweden, Denmark, Finland, and Iceland met to rehearse the simulation which imagined two regions with each their own PTA and municipal governments as well as private sector large-, medium-, and micro- mobility providers, and mobility app developers. Each role had an income source, an initial capital base, a customer base, and varying abilities to “invest” and “innovate”. The objective was to see whether actors in the two regions could agree upon a bi-regional MaaS solution, given the initial starting conditions.

Images of the proposed simulation can be seen in the presentations from the workshop.

Lessons learned:

It became quickly clear that the rules of the simulation were too complex to be reliably followed and that despite everyone's efforts and best intentions, we would have to re-imagine how to develop a shared vision for Nordic MaaS roaming. What was intended as a simulation rehearsal pivoted into a serious discussion about how to move forward as a consortium. We agreed that it would be important to meet in-person again before the intended April "simulation day." Notes at the end of the day included (paraphrased):

- Keep the game simple.
- Focus on the collective action problem of MaaS
- How can we make the Nordics to a global benchmark?
- Make sure the big picture is understandable.
- Make sure to allow for discussion about the outcomes after the game is played.

There were also some important discussions about the challenges and opportunities stimulated by upcoming European Union regulation that might shape how any mobility roaming scheme evolves. These regulations were not addressed in the original simulation.

Simulation Rehearsal 2. Copenhagen, March 19, 2023

After the first simulation rehearsal it became clear that we needed to re-think the simulation entirely. Shortly after the first rehearsal event, NOMAD consortium members from RISE, TØI, and ITS Denmark met to discuss next steps and developed a three-stage workshop that adopted some elements of the simulation, but opted not to focus much more on the consequences of regulations emerging from the European union, namely;

- 1) Multimodal Travel Information Service (MMTIS), which sets standards for the delivery of trip planning, pricing, and navigation services across European borders; and
- 2) Multimodal Digital Mobility Services (MDMS), which standardizes booking, payment, and customer service functions to integrated mobility operators.

What we did

The day-long workshop, which was attended by only NOMAD consortium members, consisted of three stages:

1. The "feel the pain" exercise. This exercise was completed in small teams. It asked participants to plan a trip from Jönköping, Sweden to Skagen, Denmark. This is a rather short trip from a "birds eye view", but it is logistically quite complicated if completed without a personal vehicle due to multiple necessary changes in transportation providers. "The pain" is the unexpected number of mobility apps, tickets, and unique payments that must be made. Participants experienced the stress of booking a cross- border trip.
 2. Live polling about MaaS roaming priorities. We then gave a lecture describing the technical steps necessary to achieve seamless cross-border mobility ecosystem and conducted live polling to determine whether these steps were a priority to participating organizations and whether they were actively addressing them.
 3. Group discussion and reflection. The exercises were followed up with a group reflection about smaller-scale trials of mobility roaming in the Nordics.
-



Lessons learned:

This simulation rehearsal was critical for preparing the simulation workshop (see below).

We realize that the exercises we had developed stimulated a lot of creative and collaborative thinking about MaaS roaming and helped everyone understand that high costs of the status quo.

Simulation workshop. Copenhagen, April 17, 2023

This workshop applied the three-stage workshop rehearsed at the prior event (see above) and included representatives from five Nordic countries plus the Netherlands and Austria. Participants represented public transportation authorities, municipal government, private mobility companies, app developers, and researchers.

What we did

The in-person event attracted participants from PTAs (11), mobility apps (3), municipalities (1), regional government (3), private mobility services (5), researchers (2), ITS organizations (6), and "other" organizations (5). They represented Norway (11), Denmark (10), Sweden (9), Finland (4), Iceland (2), and other countries (2).

Lessons learned:

The "feel the pain" exercise succeeded in revealing the inefficiencies of the status quo: e.g. planning, booking, and paying for cross-border travel using only collective transport options. Six teams of participants—challenged to plan a car-free trip from Jönköping to Skagen—developed unique itineraries using whichever apps or websites they preferred. It required that teams use 4-7 unique apps, make at least 4 different payments, and use 45 minutes to plan and book. Alternatively, planning a car trip is comparatively simple. It can be done using one app, very quickly. It was clear for participants that the entire process could be streamlined with better data sharing and standards that included private mobility operators and especially ferry operators.

The results of the live polling exercise can be found in APPENDIX 6. In summary, participants find that the steps necessary to achieve Nordic mobility roaming are relevant to their organization, but relatively few organizations are working toward achieving these steps.

The panel discussion at the end of the workshop revealed some practical lessons about how regional-scale MaaS schemes have been working to-date.

Some main points:

It is technically possible to enable true cross- border planning, booking and payment in a single application, own language and payment in local currency.

The planning part is now well regulated, and the National Access Points in the Nordics already publishes public transport data in mandated transmodel formats. Private scheduled and demand responsive modes will likely be available in the NAP's shortly. Price information, booking, ticketing and payment is still up for regulation. MDMS regulation is coming to create an open and level playing field for combination of all mobility modes in one- stop planning payment experience.

See more details in Appendix: 5 and 6

First European Conclave on MaaS, 27 September 2023

The First European Conclave on MaaS was created to bring together as many existing European perspectives on international MaaS roaming as possible. The term "Conclave" was used to indicate that there is a need for consensus among the actors in the MaaS community on how the user of the MaaS services shall be greeted, transferred, and serviced throughout at interregional trip using MaaS services.

What we did

Sören Sörensen (DK), continued presenting the concept of roaming, and why this is needed, not only between Nordic counties, but also within region. The Danish example shows that it is possible to create such a "roaming experience" within the boundaries of a single country.

Mr Edvin van den Belt from Netherlands presented different approaches for standardisation of mobility data sharing and trip planning in Europe. NAPCORE project, National access points (NAP's) Open Trip-planner, and the need for further standardization and harmonization.

Mr Ferdinand Burgersdijk, FRCD (NL) described experiences from BeNeLux pilots and how these services can be affected and aligned with privacy issues such as GDPR and DGA (Data Governance Act) and how an architecture for ticket transactions can provide for meeting those requirements.

Katharina Helfert from Austriatech (AUS) shared experiences from integrated mobility services in the Alpine region and how they have made it possible to find information on cross -border and multi modal mobility services. The challenge with payment and booking remains, however. The approached taken by using the linking of services between trip planning services (OJP), as opposed to central databases that can provide the "mega optimized" journey, was described with pros and cons.

The second half of the Conclave consisted of panel discussions covering MDMS/MMTIS regulations in the European Union; standardisation and data frameworks and how this could support information sharing.

Lessons learned:

There is still much work to be done and a dire need for collaboration on these topics even though there are legislative initiatives on the way. There is still much translation to be done before private and public actors will be willing to act in a way that supports cross-border MaaS.

Fragmentation of public transit organisations, and customer interface is a major barrier for the use of land-based public transit. There are many developed standards for APIs for routing, but on ticketing this is still lacking. Further there is a need for experimentation and developing a usable business model. As it stands the PTAs are not involved, but they are a key actor if MaaS roaming is to become a reality.

Presently, MaaS roaming is not self-funding. There is a need to create a political process to force a change, as this will not happen. Pilots should include real money, and cross-border travel.

3.2 Simulation Workshop in Copenhagen

3.2.1 Organisation and implementation

In the NOMAD project we consider the 2023 Simulation Workshop late in the project as one of the most important stakeholder and expert involving activities, and this workshop is therefore presented in greater detail than the other workshops and dissemination events in the project summarized in section 3.1.

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.

3.2.2 Pre- and post-workshop activity

The pre-workshop survey was carried out to probe potential workshop participants about their familiarity with and interest in MaaS roaming and their organizations' interest, assessed importance of, and engagement with establishing MaaS type operations. It also served to prime participants of (and have them think about) issues to be discussed at the workshop in advance. In summary the pre-workshop survey results can be considered as 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 appear to be in effect. Moreover, the opportunities and benefits appear to outweigh the obstacles and drawbacks, at least to some degree.

The later post-workshop survey was designed to get feedback from participants on the content, relevance, and experiences from workshop, and served as a base-point measurement for similar possible follow-up surveys. Details about the two surveys and results are included in Appendix 5.

Prior to the physical workshop in Copenhagen, the NOMAD team created a Nordic MaaS Fact Sheet with information about relevant National access point (NAP) status, existing MaaS operations, public transport organization, and main "ecosystem" actors in each of the five Nordic countries. The fact sheet was distributed to participants prior to the workshop to inform them about the current MaaS relevant situation in their own and other Nordic countries. A copy of the fact sheet is included in Appendix 7.

3.2.3 Workshop event in Copenhagen

The physical workshop was attended by 44 people, including 11 members of the NOMAD-team, and two representatives from project funder Nordic Innovation, as well as representatives of different MaaS-relevant actors in all five Nordic countries (public and private), and two participants from other European countries.

The workshop was carried out as a full day event from 9:00 to 16:00 in Copenhagen, including a lunch and two coffee breaks in between sessions. It had three main parts, carried out as separate sessions, plus a concluding panel debate:

- Session 1 - Plan & book cross-border travel simulation; group exercise
- Session 2 - How to reach roaming in the Nordics; individual exercise.
- Session 3 - MaaS Roaming a reality – how? group exercise.
- Concluding panel debate: In-plenum debate with four experts among the participants

The purposes of the workshop were mainly:

- to inform participants about relevant issues regarding MaaS roaming in the Nordics,
- to have participants simulate and experience cross-border travel planning and booking as of today without MaaS roaming in place,
- to get participants' feedback and reflections on anticipated necessary steps towards achieving MaaS roaming,
- to elicit participants' views and considerations about how to get to a future state of MaaS roaming
- to engage participants in debate about the opportunities and obstacles involved with MaaS roaming,
- to inform about possible solutions, and motivate participants to work and cooperate towards MaaS roaming establishment, and provide a relevant networking arena,
- and get project relevant information, views, and opinions from participants with insight in MaaS roaming issues, and to provide input for the current report.

The workshop was concluded with the panel debate, and then a brief in-plenum summary, and overview of the next upcoming steps in the project. The post-workshop online survey was conducted the week following the workshop.

3.2.3.1 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 in the Nordics and introduce important concepts and issues at hand for the workshop sessions.

3.2.3.2 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, booking, and payment tools, without having the benefit of cross-border MaaS roaming tools available.

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 at a specified time.

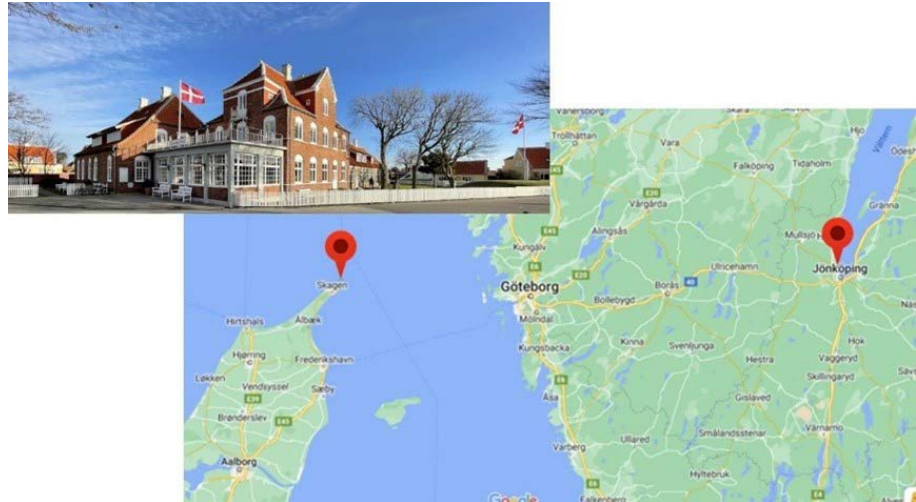


Figure 14: Challenge – how to get from A to B without using a private car

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 get the lowest total cost.

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 as they were discussing options and solutions vividly during the exercise. Many group members were displaying at least some degree of frustration with the difficulty of the task.

Other observations: Several of the groups reported challenges with trip planning using GPS/Google Maps etc. for the border crossing segment where a (non-visible) direct ferry sea crossing would be the best option. 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, and no other available ferry options, which makes optimal planning and booking suboptimal.

On average the groups had to consult many apps or sites to plan and simulate bookings and payments for tickets for the proposed journey, on average close to 6 each, with a great variety of sites/apps used. The groups consulted between 4 and 7 apps to find the travel plan. This included Google Maps and national/regional travel planners, rail operators, private bus operator and taxi. Groups reported between 3 and 4 necessary purchases or transactions for the trip one-way, in most cases with a requirement to register and leave payment information with several operators and/or download apps etc. On average the cost of the simulated journey was between 700 and 800 NOK per person one-way.

The observations suggest that there is no one single obvious travel and booking option that could be effectively used for planning, booking and paying for the entire journey. In sum, this exercise illustrates the difficulties and extended efforts involved with planning and booking cross-border Nordic travel using existing solutions without travelling by a car or plane. Additional details about the exercise and results are shown in Appendix 5.

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

After group session 1 the participants were presented some important concepts and assumedly required steps or visions towards achieving functioning MaaS roaming in the Nordics. The material presented is described in Appendix 5.

The purpose of session 2 was to get participants' feedback on assumed critical steps towards achieving Nordic MaaS roaming.

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 in the future. They were shown five steps or visions described below, sequentially one at a time, starting from no. 1 and ending with no. 5:

1. National access points (NAP) are populated with all scheduled and demand-responsive travel modes
2. National and regional MaaS agents comply with MMTIS and upcoming MDMS regulations
3. Cross-border ferries are included on an equal basis with land based private/public travel in travel plan suggestions.
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
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

Participants were then asked to assess the visions in terms of 1) the relevance to their organisations' works, and 2) if their organisation is working hard on the step/vision in question.

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 work effort on the matters was 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

On average the participants considered that all the proposed steps/visions (no. 1.-5.) are quite relevant for their organisation (scores 9 - 8 of max. 10 on relevance, see Appendix 5). The participants agreed to a lesser extent that their organisations are working hard on the proposed matter, possibly with an exception regarding the first step, NAP establishment (vision 1).

Participants were also asked to assess the likelihood that two different scenarios were likely to occur in the future: A. Multilateral financial agreement established, and B. Single MaaS agent market-takeover. On average, both scenarios were considered being slightly more likely than unlikely (55 % and 56 % found it likely, on scenario A and B respectively, see also Appendix 5).

3.2.3.4 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 backcasting-exercise. They were then presented a future scenario background framework shown in Appendix 5.

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

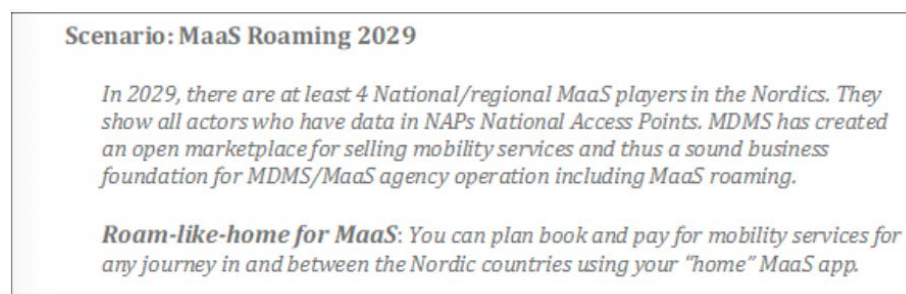


Figure 15: MaaS roaming a reality in 2029. How to get there?

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 shares from short distance air travel and use of private cars?

Participants were then instructed to start with a 5-minute individual brainstorm task on how MaaS can become a reality and 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-minute 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 with 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 able to present an (confirming) answer to question 3 about managing to take market share, which seemed to be either difficult to answer or not discussed sufficiently due to time constraints.

Session 3 findings

Figure 16 shows the findings from the group task in workshop session 3, and the results are summarised in the timeline.

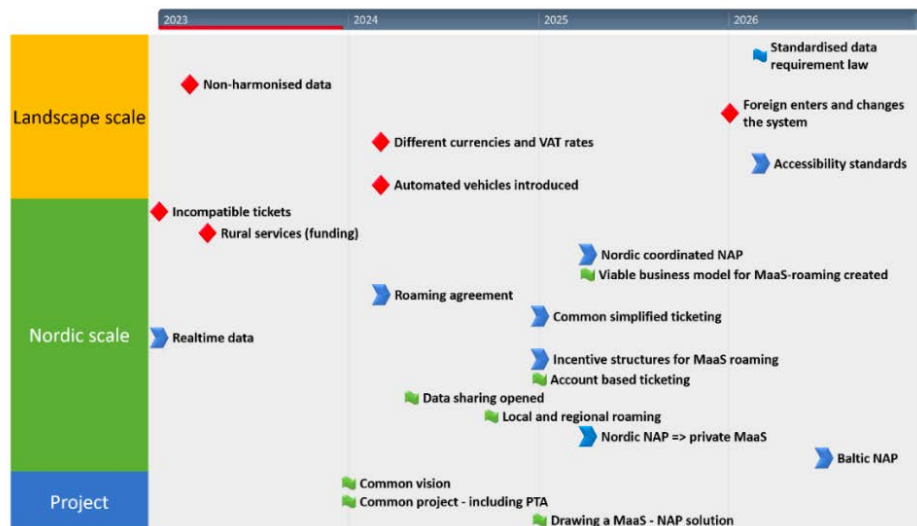


Figure 16: Summarized findings from workshop session 3

Figure 16 places key events identified by the workshop participants on a timeline and at a geographical scale. The figure is created by combining and condensing answers given by the different groups to the back-casting exercise. Reading figure 16 from top left, it starts with the landscape level, which represents developments on a global or EU-scale. This includes the challenges represented by the present situation with non-harmonised data, different currencies and VAT-rates, and possibility of foreign (non-EU) disruptive market entry. In the middle is the Nordic scale. This includes the presence of incompatible ticket products, the economic challenges presented by the political requirement for rural services which prevails throughout the Nordics. But also possibilities created by ongoing processes such as ever-increasing generation of real time data, standardisation processes, roaming agreements and coordination of data formats used by NAPs. At the bottom there are potential outcomes of a "NOMAD 2" project. In general, the symbols used in the figure are red diamonds that represent challenges, Blue arrows and flags represent processes and green flags achievements.

The main takeaway from the figure is that there are 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. Still there are important 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. For a possible NOMAD2 project there are key and concrete events that such a project can be used to facilitate. This includes the establishment of a common vision and a common Nordic drive/project which includes key PTAs, in extension this can help sketch out a MaaS or Nordic NAP solution.

3.2.4 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 summary address by the panel session moderator.

Panel debate observations

The following main issues were discussed:

Going multimodal with 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 more 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 (e.g., 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.

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.

3.2.5 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. It also probed intentions to work towards establishing Nordic MaaS roaming, or increased the likelihood that participants and their organizations would be more involved in establishing MaaS roaming operations in the Nordics in the future.

Survey results

The results show that, on average, the participants mostly agree 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. Survey details are shown in Appendix 6.

4. Conclusions and next steps



4.1 Criteria for viable MaaS roaming for cross border mobility in the Nordics

A while into the future, cross-border MaaS roaming will feel as natural as using your phone or bank card anywhere. Getting there is challenging and requires a clear political vision, suitable regulation, standards and substantial cooperation between all stakeholders.

The NOMAD project set out to find out under which circumstances, i.e. city/area size, demography, local regulation, types of scheduled/ on-demand transport providers, culture, and policies will MaaS roaming work. The project findings have verified many assumptions about MaaS, and provides new insights to how MaaS roaming can be develop and what still needs to be tested and piloted.

There is a minimum number of criteria that need to be in place:

- Common understanding of the MaaS concept and societal goals
- Sharing of data in a free, standardized, and unbiased way
- Clearinghouse functions for both private and public transport providers
- Fair models for cost and revenue sharing for all transport providers, might include sharing of public subsidies
- Borders, concession areas and other boundaries should not limit transport operations
- A responsible unit/authority/policy for crossing borders and boundaries
- Standards for the exchange of data, organizational aspects and mobility operations (including the ODIN projects work on NAP and mobility operations
- Adoption to local currencies and language



There are few technical and few regulatory barriers to allow MaaS roaming. The ITS Directive has already established the NAP and will implement MMTIS and MDMS which in combination will provide a framework for MaaS and MaaS roaming. In an ideal world, the framework only needs to be adapted to local currencies, language, and culture to make MaaS work. However, there are gaps, and the above criteria need observed, verified and resolved.

Further developed and testing need to be carried out before any mobility app can be used to roam a seamless cross-border and cross-mode journey. In line with the above criteria, the main obstacle is the business models for the private transport provider (taxi, rental, bike, e-scooter).

Carefully planned pilots, aligned with the above criteria, need to be carried out. are necessary to develop the business models in an environment where the financial risk is removed and where it is possible to bail out or reconfigure the set-up if it doesn't work. The pilots need to include cross- border operations and a mixture of private and public transport providers.

The project recommends initiating pilots using real money and real transport providers in a setting where the financial risk is removed and where it is possible to bail out or reconfigure the set-up if it doesn't work. Carefully planning of the pilots will adopt current and emerging EU regulations and ensure that all the above criteria are meet, tested, verified, or simulated.

This way, the NOMAD results and findings provides a platform to thoroughly test all aspects of the real business models and at the same time help meet or fulfil the criteria while demonstrating real MaaS roaming. Further, NOMAD has established a substantial network of experts, practitioners, and public and private entities around Europe. This network will substantiate the set of requirements for the pilots to makes sure is well aligned with other pilots, initiatives and coming regulation in Europe.

In the next chapters, the steps and actions to develop MaaS Roaming are outlined based on the gaps identified in NOMAD.

4.2 The steps to reach MaaS roaming

Developing a robust roaming service requires a profound understanding of the gaps between today's situation and future goals for the transportation sector. The NOMAD project has identified a number of these gaps and challenges and suggested solutions for some and suggested future actions for some.

As part of the NOMAD project, experts were asked (project participants) to identify key events in the road towards MaaS roaming.

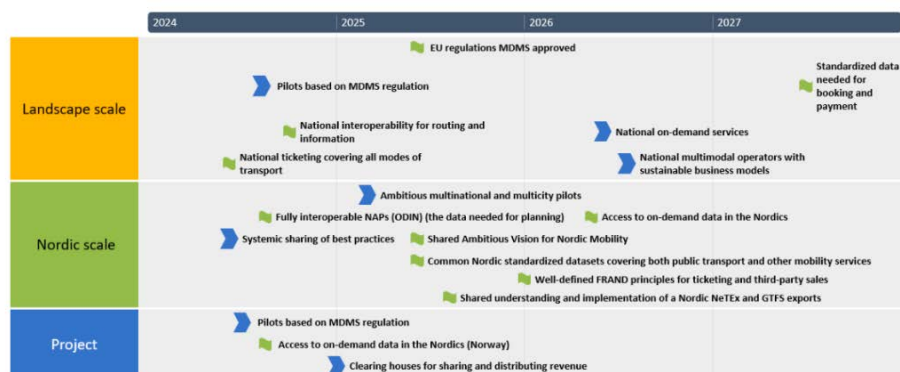


Figure 17: Identified points on the road towards the establishment of MaaS roaming

Figure 17, (as figure 16) places key identified events on a timeline and a geographical scale. Green flags represent achievements. Blue arrows represent started process.

Reading from the top left, the figure points at the need to establish pilots on MDMS regulation, national interoperability and national ticketing covering all modes. This has to be implemented by each EU member state. Further down at the Nordic level, there is a need to establish a system for sharing best practices, and an expectation that a fully interoperable national access point will be established, based on the work in the ODIN project. At project level there is the possibility of establishing own MDMS pilots. Further there is a process leading towards the establishment of clearinghouses for sharing and distributing revenue.

The main takeaway from this work is that there are many issues both related to the sharing of best practises, conducting pilots and the establishment of clearinghouses for revenue, that can be gainfully included in a future Nordic level project. Further the process towards MaaS roaming is also dependent on actions taken outside the scope of the Nordics (i.e. decisions at EU level and by each national government). There is an element of exogenous risk in this process.

4.3 Proposed next actions for MaaS roaming

How to move forward towards seamless and sustainable cross-border traveling using multimodal mobility as a service:

The NOMAD project has found that there is a possible path to a more seamless travelling experience in and between the Nordic countries using the mandated EU regulation for Multimodal Travel Information Services and the principles for the upcoming Multimodal Digital Mobility Services MDMS regulation.

Yet there are still issues to be addressed by pilots and activities:

- Will MaaS roaming create more use of shared mobility services?
- Will travellers recognize the benefit of single planning, booking, and payment for multimodal journeys?
- How can the MDMS regulation facilitate MaaS roaming?
- What is a fair business model for MaaS roaming?
- What effects will MaaS roaming have on cross-border commuting?
- What needs to be included in a MaaS roaming agreement?
- How to find multimodal travel planning for more than one MaaS domain for scheduled modes of transport.
- How to simplify cross border multimodal ticketing and validation
- How to provide 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.

With the backdrop of EU-regulation and the criteria, this list of issues forms the basis for follow-up actions after NOMAD. To be explicit, the project team has developed the scope for a follow up project: Nordic Mobility Unlimited. This way, the project use real NOMAD findings and network resources to demonstrate a viable path forward. (this project proposal does not exclude other actions or projects.



Figure 18: Map living labs

4.4 Nordic Mobility Unlimited: From simulation to live demonstration of multimodal cross-border planning, booking, payment, and navigation

4.4.1 Scope:

Establish a digital ecosystem for Mobility as a Service in the Nordics A Living Lab utilizing open mobility data from several National Access Points to create borderless multimodal travel information services on land and sea. While MaaS in principle shall display and market both scheduled and demand responsive modes services, the first priority is to support scheduled modes of transport also known as the Backbone of a MaaS ecosystem. This includes both public and private modes of transport on land and sea.

4.4.2 Challenge and mission

Today we can navigate the world by air travel from one travel agency app including booking, ticketing and payment in the currency we prefer. We can also navigate from anywhere to anywhere even across borders using the GPS in a car or on an app.

If we want to use more sustainable and shared mobility as a service on land or sea there is no end-to-end digital planning, purchase and navigation services available that can compete with the borderless navigation in the cars GPS.

We must rely on own skills, abilities and plenty of time to figure out how to get a ticket, book a ride or even more difficult make and navigate a multimodal travel plan.

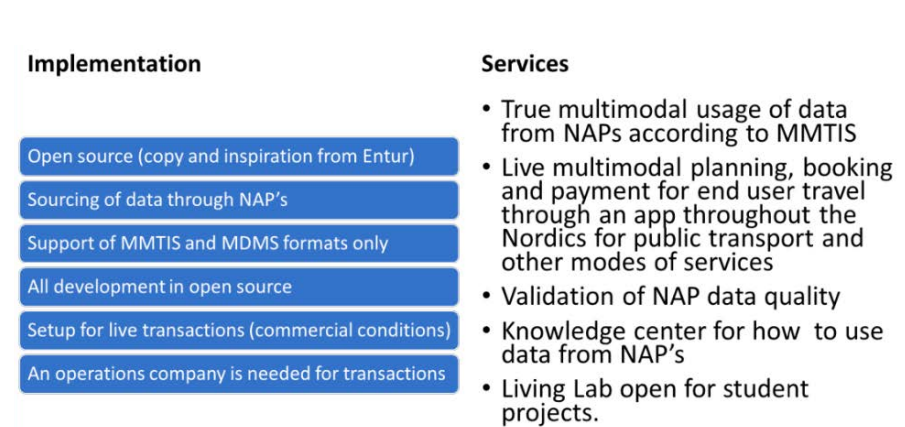
No wonder that the use of the car and air travel is increasingly popular.

4.4.3 EU's regulations

The EU is addressing the lack of Europe wide multimodal planning and navigation through the MMTIS regulation which calls for access to open mobility data from all modalities in National Access Points. Shortly the booking and payment of mobility services through MaaS agents will be governed by the EU regulation known as Multimodal Digital Mobility Services.

The NAP's are beginning to get populated with open mobility data, but the true value of the MMTIS and MDMS regulation will first be recognized when MaaS agents materialize utilizing the open mobility data. While regional and national MaaS implementations may be facilitated both by public and private actors, it is unclear how cross-border MaaS schemes will evolve.

Project content The Nordics Unlimited project is poised to address the challenges for more sustainable, shared seamless cross border mobility in the Nordics through a Living Lab:



Figur 19: Services Living Lab for sustainable, shared seamless cross border mobility in the Nordics

- **Cross border travel:** Pilot test multimodal planning, booking, payment and navigation across land and sea borders between the nations in the Baltic Sea
- **Full use of NAP open Mobility data:** Multimodal Travel chains combining Baltic Sea Ferries, public transport and private modalities
- **MMTIS and MDMS Living Lab:** Demonstrating the value of using common standards to enable cross border multimodal travel procurement and associated services.
- **The cross border specifics** Seamless mobility across borders in the Nordics and beyond is an important part of the EU single market both for commuting and for leisure/tourism.

While it is easy to use a private car or air travel to cross borders in the Nordic region, the use of digital planning and navigation of other land or sea-based mobility modes is very fragmented and within national borders.

The Nordic Mobility Unlimited project will focus on how to seamlessly bridge national borders through a single digital service using shared and more sustainable mobility choices.

The project is by nature transnational. It aims at validating the use of open mobility data from several National Access Points in nations in the Nordic region to deliver multimodal multinational travel information services of real value to citizens in the region who cross national borders regularly.

4.4.4 Partnership and stakeholders

The ideal primary partner is the entity/entities who is going to deliver the end-to-end planning, booking, payment and navigation. Public and private mobility actors interested in getting more business from cross regional/cross national services.

ITS non-profit organizations promoting smart use of digital means to improve use of sustainable mobility choices.

Public and private mobility actors providing services in connection with or across major cross border corridors. NAP's in Baltic Sea countries (to attract usage of the collected open mobility data). People with travel needs crossing regional and national borders (commuting and leisure)

4.4.5 Main activities and work program

Figure 20 shows a draft for a Masterplan for a follow-up project to NOMAD with live piloting based on real transactions between the actors. There is a need to demonstrate the effect MaaS roaming can have for the participants.

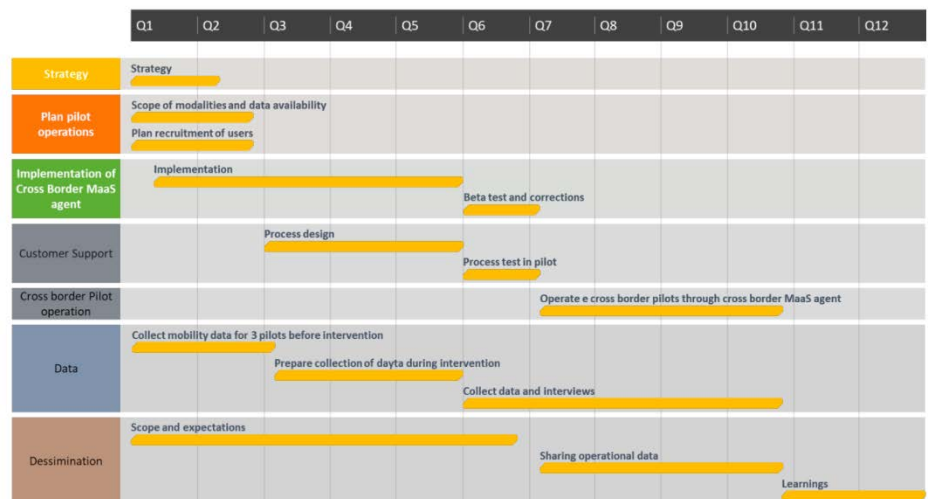


Figure 20: Masterplan for activities in a Nordic Mobility unlimited project.

4.4.6 Timeline/actions

- Strategy: Identify 2-3 cross border mobility corridors with substantial traffic. The corridors shall be served by mobility actors who has delivered open mobility data according to the MMTIS and MDMS regulations.
- Establish a multinational multimodal travel planner/MaaS agent service covering in principle the Nordics– but at least relevant rel modalities for the 3 cross border pilots.
- Recruitment of pilot users for the cross border pilots
- Prepare MaaS agent processes and customer support
- Collect mobility data for the 3 cross border corridors before intervention

- Prepare collection of mobility data during intervention
- Communicate scope and expectations
- Run pilots for 12 months with recruited travellers for the cross border pilots
- Collect mobility data as planned.
- Conduct surveys of end user experience of cross border MaaS service
- Conduct surveys of connected mobility actors on relationship with the Multinational MaaS agent
- Evaluate impact of end-to-end journey planning booking and payment
- Disseminate findings from the pilot

The actual project scope and activities will have to be adjusted according to requirements from funding sources.

The NOMAD core team will actively seek partners and funding to continue paving the way for seamless multimodal and sustainable mobility especially in and between the Nordic countries and beyond.

4.5 Other actions and additions

The initiative "Nordic Mobility Unlimited" will address most of the findings in NOMAD including testing of the business models – and the project will be an important part of the NOMAD platform to create more projects and activities.