International Transport Forum

Reaching Critical MaaS

Interregional Co-operation for Seamless Mobility in the Brussels-Capital Region

Case-Specific Policy Analysis

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Key messages

Back to basics. Developing the right foundation is key to a sound interregional collaboration

Stakeholders consulted as part of this study tend to focus on what MaaS should *do*, but many find it hard to define what MaaS *actually is*. This study recommends establishing foundational questions, the answers of which should provide stakeholders with actionable guidance.

Know the traveller. Delivering compelling MaaS travel experiences to people requires that stakeholders share information about travellers.

In order to create seamless intermodal, integrated trips for users, information about travellers must be shared among mobility operators and MaaS providers. This is the principle of data portability. Interregional MaaS requires near real-time portability of customer data, across stakeholders.

Build trust. Help establish inter-regional MaaS cooperation through a robust trust framework.

Data sharing efforts among stakeholders – some of which may be competitors – can only be enacted if they trust each other and trust that the outcomes that data sharing enables will benefit all. Trust models seek to formalise how to build such trust and address stakeholders' concerns about participating in the MaaS ecosystem.

Look around. Learn from other sectors to helps accelerate the development of MaaS

A variety of challenges discussed by MaaS stakeholders have been successfully tackled outside of the transport sector. Most data-sharing related challenges are not specific to the transport sector and cross-sectoral collaboration would be highly beneficial to the future of MaaS.

Main findings

The rise of commercially shared mobility services and new forms of travel has broadened people's choices when it comes to navigating cities and towns. Walking, cycling and other forms of micromobility, along with public transport, ridesourcing, taxis, and car travel may all fulfil different needs, at different times and for different purposes. However, it can prove challenging for people to use these modes in combination, or to select the best fit for a given trip, because these travel options are not sufficiently connected, coordinated or convenient. In the current environment, people lose out because good travel alternatives are not readily available to them, and cities and towns lose out because people's travel choices gravitate to the most compelling yet detrimental option in the current environment – the personal car.

Public authorities face the challenge of developing a regulatory framework for urban mobility that facilitates bringing together these different modes into an easy, unified and compelling offer geared

towards people's needs. Mobility as a Service (MaaS) promises a user-centric, compelling, accessible, and integrated travel experience that will help retain and grow the share of sustainable travel modes and reduce reliance on private cars. MaaS should provide people with better travel choices and enable public authorities to deliver on their mandates as orchestrators of mobility services and public space. This is the challenge the Brussels-Capital Region (BCR) addresses: steering the large-scale deployment of MaaS to ensure it fulfils the needs of citizens.

In the Brussels-Capital Region, nearly half of employees commute from the neighbouring provinces of Flanders and Wallonia, while 20% of employed residents work outside of the region. Successfully deploying MaaS in the Brussels-Capital region therefore requires co-ordination, alignment and enhanced interoperability with neighbouring regions. It also requires alignment with Federal and EU initiatives and policies in several domains linked directly (e.g. public transport and mobility policies and MaaS-specific rules) or indirectly (e.g. data and digital governance and competition policy) to MaaS.

This report's recommendations are based on a review of the academic and technical literature, a benchmark of MaaS-relevant initiatives in Belgium, in-depth case-studies of projects in Belgium and abroad, a review of relevant EU policies, as well as thorough dialogue with local stakeholders throughout the course of the project. In addition to interviews conducted with 18 stakeholders (policymakers, public transport operators, MaaS providers), three stakeholder consultation workshops were held.

These stakeholder consultations revealed that clarity exists regarding the necessary pre-conditions for MaaS to emerge (service and infrastructure connectivity), the expected benefits of MaaS (better connectivity, better accessibility, more sustainability), and the form it should take when it reaches end users (digital apps). However, there is less clarity about what actually comprises MaaS , the steps that need to be taken for a MaaS ecosystem to emerge, and the roles and responsibilities of different stakeholders in delivering MaaS. While there is a shared understanding on high-level definitions across the regions, these definitions are not detailed enough to support the harmonisation of regional MaaS governance frameworks.

A cooperative governance framework for MaaS – one that is actionable today and able to accommodate the innovations of tomorrow – can only be developed on a solid foundation of clear, agreed-upon definitions. This study suggests a conceptual framework that provides a starting point for such a discussion. It also identifies and prioritises several key questions to be addressed by local stakeholders. Answering these questions is an essential first step towards inter-regional coordination and should come before devoting resources to second-order technical discussions that will be informed by the consensus space that emerges around the definition of MaaS and what it should become.

A detailed review of MaaS-relevant projects in Belgium, presented in a companion report (ITF, 2024a), highlights the fragmentation of technical discussions across a variety of working groups. This fragmentation risks duplicating efforts and wasting resources when the same ground is being covered across different groups. This report's recommendations offer a framework to streamline the work done in and around the Brussels-Capital.

Input from stakeholders revealed a few particularly challenging points, many of which are not unique to the mobility sector (e.g. how to improve interoperability or ensure the safe and privacy-preserving portability of sensitive information) and have been tackled in other sectors. This report suggests learning from these pre-existing initiatives rather than revisiting these challenges completely anew in the context of MaaS. This challenges policymakers to break down silos. The ITF recommends building from the collaboration between transport administrations and digital agencies that already exists in Belgium.

Recommendations

This report recommends six tangible outcomes…

- MaaS Foundation Document
- MaaS Governance Authority (MGA)
- MaaS Network Coordinator (MNC)
- MaaS Trust Model
- Trust Model Building Blocks
- Repository of data sharing clauses

…and three ongoing processes …

- Develop interoperability through enhanced compatibility
- Widespread adoption of the "only-once" principle
- Enhance fairness and impartiality in the MaaS ecosystem

… that, together, establish a sound governance framework for interregional MaaS.

Establish an interregional MaaS foundation document to guide collaboration

Complexity complicates collaboration. Existing approaches to reduce this complexity – around the definition of MaaS, the roles of different stakeholders, the governance of the ecosystem, etc. – all favour consensus at a high-level but are not sufficiently operational to ensure concrete outcomes. The *MaaS Foundation document* aims to bridge this gap between high-level principles and operational frameworks that enable their delivery. The document should serve four key functions. First, it should serve as a vision document setting out desired outcomes. Second, it should identify common principles and define the concepts underlying these principles. Third, it should provide a description of the MaaS ecosystem and its governance framework. Fourth, it should map consensus and disagreement among stakeholders, enabling them to opt in or out of certain clauses.

Structure collaboration through the MaaS network coordinator (MNC) and MaaS Governance Authority (MGA)

A diagnosis of existing MaaS-related initiatives in Belgium reveals ongoing practices of collaboration and knowledge exchange around MaaS and related topics. For MaaS to become a compelling option for people travelling in the Brussels-Capital Region, these initiatives will have to be further structured, organised, managed, and steered. To that end, this report suggests the creation of two new roles. The *MaaS Governance Authority (MGA)* would be in charge of defining rules and policies, as well as providing the services that allow the ecosystem to function. All relevant transport ministries should be represented within the MGA. The MGA would procure the services of the *MaaS Network Coordinator (MNC),* which would be in charge of ensuring coherent collaboration, avoiding the risk of fragmentation and duplication and reducing the risk of information asymmetry among MaaS ecosystem stakeholders.

Develop a trust model for the MaaS ecosystem

MaaS relies on the collaborative sharing of data among stakeholders. However, this can only happen if participants in the ecosystem trust each other. Such trust can only be fostered if key questions are addressed, such as: can I trust actors to be who they say they are? Can they be trusted with personal or sensitive data? Can their data and affirmations regarding their use of data be trusted? The *trust model* provides agreed-upon rules and norms that allows data to be shared in a way that ensures the sovereignty of data holders and the security of data exchanges.

Identify, adapt or develop building blocks to support the implementation of the trust model

All the functions that comprise the trust model (e.g. verify that stakeholders are who they say they are) should be matched not only with norms and rules (e.g. a stakeholders' identity is verified by this entity, using the following protocol) but also with technical *building blocks* (e.g. a digital representation of identity and an authentication mechanism). The MaaS Governance Authority should steer the development of these building blocks or recommend existing solutions.

Develop a repository of standard and agreed data sharing clauses that set out clear requirements

Today, agreements regarding the integration of public transport and other mobility services into MaaS solutions tend to include a substantial ad hoc, non-standardised component. This need for substantial bilateral negotiations entails high transaction costs and may yield inconsistent requirements. This report recommends that the MaaS Governance Authority should develop a *repository of standard and agreed upon data sharing clauses*. These clauses should set out clear data sharing requirements, identify risks, and define strategies to mitigate these risks. They could be referred to in mobility service regulations applying to services such as ridesourcing, taxis, micromobility, on-demand services and public transport service contracts.

Work on enhanced compatibility rather than full interoperability

Interoperability is the ability of different services to work together; it is thus key to the development of MaaS. Many policy makers and public transport operators consulted as part of this project have primarily focused on full interoperability, otherwise referred to as "standardisation". While interoperability is necessary for MaaS to function, it should be seen as a process of incentivised convergence (i.e. ensuring that systems can communicate, to the benefit of all) rather than as one of strict standardisation (i.e. requiring that all systems follow the same exact standards). Focusing on harmonisation may be enough in the early stages of the MaaS ecosystem. The MaaS Network Coordinator ensure interoperability principles evolve overtime to reflect the increased maturity of the market, as well as technological evolutions.

Explore the application of the EU's Only Once principle to MaaS

To provide a customer with an intermodal, integrated trip, information about that customer must be shared among mobility operators and MaaS providers. Failing to share this data means that MaaS users would need to provide the same data to a variety of public transport operators, mobility service operators, and MaaS providers. Yet, sharing information about users is challenging, as their privacy needs to be strictly protected to the highest level. Defined by the IMI Regulation (1024/2012/EU), the Only Once Principle states that moral and physical persons within the EU should only be required to provide information about themselves to public authorities one single time. To implement this Only Once Principle, public authorities must set up the right infrastructure to support the secure sharing of this data. While this principle does not extend to the transport sector yet, learning from this existing infrastructure would help develop the

secured portability of relevant information about travellers necessary for an open MaaS ecosystem to function.

Address existing power imbalances to encourage participation within the ecosystem

Public transport constitutes the backbone of MaaS; many Public Transport Operators (PTOs) have also been tasked by local authorities to develop MaaS solutions. Public transport services are governed by public service contracts, which span over long time periods and are not dynamically revised to reflect more recent innovations. At the same time, Mobility Service Operators (MSOs) are increasingly required to share their data and ensure they can be integrated into MaaS platforms. Consequently, PTOs may benefit from the integration of private mobility services in their own MaaS offer, in addition to integrating their own public transport services. On the other hand, while private MaaS providers will also benefit from MSOs sharing their data, they may be unable to integrate public transport into their offer if PTOs are not held to the same data sharing requirements. The complex role of PTOs needs to be addressed, with a potential first step of establishing consistent data sharing requirements for PTOs and MSOs.

Reaching Critical MaaS: Introduction

MaaS challenges local authorities to develop new mobility and data governance structures

The ITF defines MaaS as a "a distribution model for mobility services that uses shared data and a digital interface to efficiently source and manage transport-related services into a seamless offer tailored to individual traveller preferences". MaaS is "typically delivered via an app or another digital interface combining different transport, information and payment services into a smooth and reliable digital customer experience" (ITF, 2023, pp. 7–8). MaaS combines three fundamental concepts. The first is the notion of providing transport *as a service* rather than through vehicle ownership – i.e. focusing on *access to* versus *ownership of* vehicles. The second relates to the ability to join multiple transport services seamlessly to carry out a trip, and the third is a customer or demand-side focus. MaaS promises a user-centric, compelling, accessible, and integrated travel experience that will help retain and grow the share of sustainable travel modes and reduce reliance on private cars. As a consequence, policymakers expect MaaS to contribute to a reduction of emissions and congestion. To date, the relative paucity of large-scale MaaS experiments has not allowed to robustly test these hypotheses (Hensher *et al.*, 2020; Storme *et al.*, 2020; ITF, 2021c).

The development of commercial shared mobility services has challenged local authorities' mandates as orchestrators of mobility services and public space; today, MaaS challenges public administrations to develop innovative mobility and data governance structures to ensure the potential benefits of MaaS can emerge. This is one of the challenges the Brussels-Capital Region (BCR) government is now addressing: steering the large-scale deployment of MaaS to ensure it is adapted to the needs of citizens. Through this TSI project, the European Commission is supporting Brussels Mobility in these efforts. In line with the recent Letta report on the future of the single market, and Draghi report on the future of European competitiveness, it is the Commission's priority to ensure that the MaaS market develops in a way that supports sustainable and fair competitiveness (Draghi, 2024; Letta, 2024).

Steering the development of a MaaS ecosystem: progress since 2021

A previous project under the Structural Reform Support Programme, conducted by the ITF in partnership with the European Commission's DG REFORM to the benefit of Brussels Mobility (ITF, 2021a), recommended 11 principles to underpin the regulatory framework and the market approach for the development of a MaaS ecosystem. These recommendations fell into 3 categories: enabling the creation of a MaaS ecosystem; facilitating an efficient and equitable market; managing mobility outcomes. Since the completion of this study in 2021, Brussels Mobility has worked on a variety of measures and projects to enable the development of a MaaS ecosystem, in line with the recommendations defined in 2021.

Brussels Mobility has developed different regulatory frameworks to organise micromobility, bikesharing, and carsharing services. It is also working on its MaaS ordinance, which will regulate the activities of MaaS providers in the future. These different ordinances enabled the development of a thorough data reporting framework for Brussels Mobility to monitor mobility services. Brussels Mobility is now communicating its policy intent and its regulations in a machine-readable format (e.g. provision of machine-readable drop-

off zones for shared micromobility vehicles, machine-readable geofencing) so as to feed into mobility service apps and MaaS apps.

STIB, the public transport operator for the BCR, has been given a key mandate: not only does STIB provide the backbone of the mobility system – public transport services -, but it also develops the regional MaaS app and has been tasked with developing a MaaS data sharing platform that could be used as a resource for the development of MaaS in the future.

This study discusses some of the topics that have not yet been fully addressed by Brussels Mobility: the qualification of the relationships between different stakeholders in the MaaS ecosystem; the risks of closure on the developing MaaS market; the complex implementation of mandatory data sharing requirements; the development of provisions for mandatory consumer data portability, subject to user consent.

A challenge: integrating transport offers beyond institutional boundaries

Most importantly, this study tackles a specific challenge: that of steering the development of a MaaS ecosystem that serve residents' mobility needs, even when their trips extend beyond the region's administrative boundaries. Integrating transport offers into a MaaS ecosystem is particularly challenging when a city's functional urban area extends across institutional boundaries. Not only do multiple types of transport modes need to be connected, but the multiplicity of public transport operators and the lack of continuous operation areas also need to be addressed.

According to the 2021 Census, in the BCR, nearly half (49.5%) of employees are commuters from the neighbouring provinces of Flanders and Wallonia, while 20% of employed residents of the Brussels-Capital Region work outside of it (De Standaard, 2023; Statbel, 2024). Successfully deploying MaaS in the Brussels-Capital region will therefore require co-ordination, alignment and enhanced interoperability with similar initiatives in Flanders and the Walloon regions. It will also require alignment with Federal and EU initiatives and policies in a number of domains directly (e.g. public transport and mobility policies and MaaS-specific rules) or indirectly (e.g. data and digital governance and competition policy) linked to MaaS.

This report presents key results from the project "Brussels-Capital Region - Adapting Co-operation Mechanisms for the Deployment of Mobility Services on an Interregional Scale", funded by the European Union via the Technical Support Instrument and implemented by the International Transport Forum (ITF), in cooperation with the European Commission's DG REFORM. Brussels Mobility is the beneficiary authority. This project addresses questions of interregional mobility governance in a way that is pertinent not only to MaaS, but to the inter-regional operation of other new mobility solutions. While the project focuses on the Brussels-Capital Region and only addresses neighbouring regions in relation to their links with the Belgian Capital, the principles and recommendations outlined in the report could be used by Flanders and Wallonia to inform their own efforts, as well as by European local authorities more widely.

This report summarises of the state of MaaS-related projects in the Brussels-Capital region at the time of the project, develops the conceptual framework that guided this research, and presents resulting recommendations. It is accompanied by two companion reports (ITF, 2024a, 2024b). The first one provides an overview of existing initiatives that could serve as components or building blocks for the development of a MaaS governance. Indeed, MaaS is an emerging concept in Belgium, as in the rest of the world. As a consequence, numerous actors are exploring and developing their own approaches to MaaS or MaaS-supportive initiatives and there is much to be gained in analysing and building on initiatives underway. This

companion report can be found here. The second companion report presents an overview of EU policies that are relevant to the development of a MaaS governance framework.

Recommendations are based on a review of the academic and technical literature, a benchmark of MaaS-relevant initiatives in Belgium (ITF, 2024a), in-depth case studies of projects in Belgium and abroad, a review of relevant EU policies (ITF, 2024b), as well as on the consultation of local actors throughout the course of the project. In addition to interviews conducted with 18 stakeholders (policymakers, public transport operators, MaaS providers), three stakeholder consultation workshops were organised. Two of those gathered public sector stakeholders (policymakers and public transport operators) while one aimed to consult private sector stakeholders (mobility service operators, MaaS providers, data intermediaries). Recommendations have been guided by the insights and opinions gathered through this consultation process.

Developing co-operation mechanisms to support MaaS in the Brussels-Capital Region: the current situation

This research builds upon Brussels Mobility's past and ongoing efforts to steer the development of MaaS and to better monitor and regulate mobility services in the region. Some of these initiatives have been conducted in partnership with other regions, as well as with the federal government. After presenting the authorities who hold MaaS-relevant competencies in Belgium, this chapter presents the current approaches to MaaS in the Brussels-Capital Region.

Setting the scheme: competencies for MaaS in Belgium

Since 1980, certain transport competencies in Belgium have been transferred from the federal level to the regional level. Belgium follows a mode-based distribution of competences. At the federal level, the Federal Public Service for Mobility and Transport – hereafter referred to as FPS Mobility and Transport – is the executive agency acting on behalf of the Belgian Federal State. Following this mode-based approach, the Belgian State is the sole competent institution for national rail passenger transport in Belgium and the main shareholder of the national railway company (SNCB) – itself the main shareholder of the railway infrastructure manager, Infrabel. Regions, on the other hand, are responsible for regional public transport and other transport modes: school buses, trams, metros, highways, ports, regional airports, waterways, as well as for road safety.

Beyond this mode-specific competency, FPS Mobility and Transport is responsible for collecting transport and mobility data and providing it to the regions, as well as for setting nation-wide mobility regulations such as the road traffic law (Belgium Federal Government, 1980, 2014; SPF Mobilité, 2015). FPS Mobility and Transport also steers the implementation of transport-related EU legislation in Belgium, in partnership with the three regions which must ensure their actions are aligned with EU policies. It is thus a key convener of interfederal discussions on topics of EU interest, such as transport data sharing and interoperability standards. Interfederal dialogue is organised by the Executive Committee of Mobility Ministers (ECMM). The ECMM convenes meetings of the Federal and three regional mobility ministers about once every six weeks. Through ECMM meetings, ministers define joint priorities, launch common projects, give government agencies mandates to conduct these projects, and monitor their progress.

Most other transport policy topics are managed by regional authorities. Relevant regional transport agencies are Brussels Mobility in the Brussels-Capital Region, the Flemish Ministry of Mobility and Public Works in the Flemish Region (MOW) and the Walloon Public Service for Mobility and Infrastructure (SPW-MI) in the Walloon Region. These institutions are in charge of transport policy and infrastructure planning for their respective regions, on behalf of the regional government. Their scope of action encompasses mobility strategies, transport infrastructure planning and maintenance, public space management, road safety, as well as, in Flanders, the regulation of taxis and shared mobility services. Each region has its own public transport operator.

- STIB-MIVB is the internal operator of public transport services (buses, trams and the metro) in the Brussels-Capital Region through a public service contract issued by the Brussels-Capital Region. This contract is renewed every five years and is directly awarded as Belgium does not use

competitive tendering processes for public transport services (DG MOVE, 2019). STIB-MIVB works in close partnership with Brussels Mobility and contributes to setting strategic priorities regarding mobility policy (Goethals, 2010).

- The Walloon Transport Operator (Opérateur de transport de Wallonie, OTW) acts as the internal operator of the public transport network in Wallonia (European Commission, 2007). The OTW operates the transport network under the commercial name TEC, promotes and markets public transport services, and conducts studies on the public transport network. The Walloon Region established the OTW in 2018 by merging the five local transport networks with the former Société Régionale du transport de Wallonie (SRTW). Within the SPW MI, the Cellule Autorité Organisatrice du Transport (AOT) regulates and organises the public transport systems and directly interacts with TEC on behalf of the Walloon Region. The AOT has been created relatively recently, in 2019. Several functions that were previously managed by the transport operator (i.e. TEC) have been transferred to the AOT. It includes competencies regarding the measurement of the quality of service and the assessment of customer satisfaction (SPW, 2019).
- De Lijn is the internal public transport operator for Flanders. De Lijn manages the core network (i.e trams, buses) and the supplementary network (i.e. buses for specific flows). The public service contract 2023-2027 gave De Lijn a new role: transport system manager. The transport system manager is responsible for designing and managing the service offering on the core network and collaborates with local transport authorities on optimal solutions for the complementary network. De Lijn works with the MOW and infra-regional transport authorities (Vervoerreggio). MOW develops an overarching mobility management system to achieve policy goals set in the Basic Accessibility Decree. It acts as a mode-neutral authority responsible for supporting the Flemish Government and local authorities in deploying the regional mobility policy.

Beyond transport competences, information technology (IT) competences are key to the development of MaaS. Paradigm (formerly known as CIRB or Centre d'Informatique de la Région Bruxelloise) is tasked by BCR with supporting the IT development of all BCR institutions. Paradigm is also responsible for helping BCR institutions better manage, use and share data, sometimes via consultancy services (cirb.brussels, no date). The counterparts to Paradigm in Flanders and Wallonia are Digital Flanders and DigitalWallonia, respectively. The Federal Government has also taken a leading role in ensuring cooperation on ITS-related topics, even though these competencies are shared between it and the three regions. In response to the EU ITS Directive (2010/40/EU), the Executive Committee of Mobility Ministers (ECMM) created an interfederal cooperation entity: the ITS Steering Committee, created in November 2016 (SPF Mobilité, no date). The ITS Steering Committee is composed of representatives of the four mobility ministries in Belgium (Federal Public Service Mobility and Transport or FPS Mobility and Transport; Brussels Mobility; Flemish Department of Mobility and Public Works or MOW; Wallonia Public Service for Mobility and Infrastructures or SPW-MI) and consults external experts. One of its main tasks is to ensure coordination, communication, and cooperation on ITS-related topic as they apply to transport policy. Its secretariat has been assigned to the FPS Mobility and Transport, while its presidency rotates between the four members.

Current approaches to MaaS in the BCR

There are numerous MaaS-related projects in the capital region; key local stakeholders such as Brussels Mobility and STIB-MIVB are also involved in interfederal, cooperative projects that will impact the development of MaaS in the BCR. Through policy review and interviews with key stakeholders, the ITF has identified 6 main types of initiatives, currently at different stages of advancement:

1. Development of MaaS applications;
2. Efforts at regulating mobility service providers to make them "MaaS-ready";
3. Efforts at regulating MaaS providers themselves;
4. Efforts at organising data sharing and ensuring interoperability;
5. Acceleration of public service digitalisation;
6. Creation of interregional cooperation instances.

These projects, as well as similar projects in Flanders and Wallonia, are analysed in the companion report (ITF, 2024a). This section provides an overview of relevant projects in the Brussels-Capital Region and identifies the progress made since the publication of the report 'Developing innovative mobility solutions in the Brussels-Capital Region' (ITF, 2021a).

Development of MaaS applications

Two public sector-led MaaS apps have been developed in Brussels: Floya (initiated with the Move Brussels pilot project) and SmartMove. SmartMove was a pilot that has now ended, while Floya has been commercially launched in September 2023. Floya has been developed by STIB-MIVB on behalf of the Brussels-Capital Region, with active involvement from Brussels Mobility; its objective is to ease access to a variety of transport modes and encourage the use of sustainable modes of transport. SmartMove had been developed by Brussels Fiscality, with support from Brussels Environment, as part of the project to introduce a smart road taxing scheme. To support this fiscal reform, Brussels Fiscality decided to develop a free mobile app that would allow the implementation of the road pricing scheme while supporting and inducing car owners to switch to more sustainable modes of transport when appropriate (Cabinet du Secrétaire d'Etat à la Relance et aux Investissements Stratégiques, 2021, pp. 301–2).

Both apps have been developed through public service contracts with private MaaS providers: Trafi and Atos for Floya and Skipr for SmartMove. Both apps integrate public (STIB-MIVB, SNCB/NMBS, TEC, De Lijn) and private (shared e-scooters, taxi, carsharing and bikesharing) transport services (ITF, 2021a) and allow integrated trip planning. While the two apps offer similar functions, they have been developed with different objectives: Floya has been developed by the public transport operator, STIB-MIVB, and endeavours to ease multimodal mobility routines; SmartMove targeted car drivers and endeavoured to ensure the acceptability of a new tax as well as to optimise its impact on mobility behaviour. The Brussels Regional Government has decided to bring these two projects together. Floya will remain the official MaaS app of the Brussels-Capital Region; the integration of SmartMove within Floya may be explored.

Discussions around MaaS often conflate the *tools* used to deliver MaaS – i.e. Apps – with what MaaS actually *is*. A focus on the former often assumes the deployment of bespoke and siloed apps whereas approaching MaaS as an ecosystem gives rise to alternative and more open architectures. In the latter case, MaaS can be seen as building on a variety of "microservices" (ITF, 2023) that could be assembled by MaaS providers (may they be public or private) based on their target groups and goals. Rather than developing full apps, different microservice providers could concentrate their resource on developing a high-impact component for MaaS solutions. This would be the case, for instance, with a road-charging module or an environmental impact calculator.

The Floya and SmartMove apps were launched before a broad regulatory framework for a MaaS ecosystem in the BCR has been approved. While these earlier projects aimed to create a solution for citizens to use, ongoing discussions in the BCR and at the interfederal level focus on creating the right conditions for the

development of MaaS. This may reflect an evolution in how key stakeholders view MaaS, shifting from a final product perspective – the app – to an ecosystem perspective requiring coordination between multiple stakeholders.

Acceleration of public service digitalisation

The need to integrate information and services to effectively deliver MaaS aligns with the current acceleration of public service digitalisation in the Brussels-Capital Region. Paradigm has emerged as a key stakeholder to support the institutions of the BCR in this transition. Paradigm orchestrates and coordinates the regional government's digital transition, operating in two main ways. First, it acts as an internal consultant and supports BCR institutions in their own projects. This allows to address a key issue, identified in the ITF's previous work on MaaS in the BCR (ITF, 2021a) : the lack of sufficient internal resources and skills to tackle digitalisation.

Second, Paradigm offers three main services to BCR-based agencies in order to help them better manage and use their data: an integration hub, a data hub, and a data governance hub. The integration hub may be used by agencies to exchange data with other institutions or third parties. The data hub offers a number of data storage and processing services to help institutions better wield their data. Brussels Mobility already uses the data hub for data processing as well as to manage data reporting from mobility service providers or data integrators.

While Paradigm provides services through the data hub, it does not impose data standards or semantics; each institution using the data hub is able to structure its datasets according to its own methods. The data hub is a technical tool. Finally, the governance hub operates as a metadata catalogue. While the integration hub and data hub are currently functional and already used by institutions in the BCR, the governance hub is at a pilot stage. Brussels Mobility has identified use cases with Paradigm and is now working on cataloguing its data and identifying how it may be leveraged by other public institutions. These efforts, while not directly aimed at supporting the development of MaaS, are key to the development of the ecosystem in the future.

Work on digitalisation concerns not only institutions, but also public transport operators who must provide digital ticketing solutions in order to be compatible with MaaS solutions. STIB currently offers the use of contactless payment to access transport services, at the price of a single ticket. BruPass (and BruPass XL) tickets, which allow to travel on all four operators' network within the Brussels-Capital Region and its neighbouring municipalities, can also be purchased on the STIB app – if not on Floya or other MaaS apps (STIB-MIVB, no date). BMC, a joint subsidiary company created by all four public transport operators in Belgium (STIB-MIVB, TEC, De Lijn, SNCB), has launched this digital alternative for the BruPass. Interviews with public transport operators suggest that they expect BMC to play a key role in the development of new digital ticketing solutions and fare products.

Efforts at organising data sharing and ensuring interoperability.

The first ITF-DG REFORM study on MaaS in the Brussels-Capital Region (ITF, 2021a) identified the need to develop a thorough mobility data governance policy. Since then, Brussels Mobility has launched three workstreams to develop and structure its data governance: data reporting, machine-readable policies and data sharing in the sense of ensuring interoperability between stakeholders involved in the MaaS ecosystem. Brussels Mobility decided to prioritise the first two pillars – data reporting and machine-readable policies – and believes interoperability should be tackled in a concerted manner by public and

private stakeholders in the region. The agency is currently active in a number of working groups focusing on interoperability: the OSLO (Box 1) working group launched by Paradigm in April 2023 at STIB's and Brussels Mobility's request; two National Access Point (NAP) working groups; as well as the interregional working group on data harmonisation that has been launched in 2024 as part of the interfederal MaaS concertation process led by the Federal Public Service (FPS) Mobility and Transport. Brussels Mobility leads this interfederal working group and expects to create synergies with the work conducted by Paradigm. Finally, Brussels Mobility is also active in the EU-funded project CITCOM.ai, which focuses on mobility dataspaces and AI. Standardisation pathways will be explored.

Box 1: Open Standards for Linked Organisations (OSLO)

The Open Standards for Linked Organisations (OSLO) is a semantic model created in Flanders. It laid the basis for a shared vocabulary and standardised terms that enable digital data exchange for contact information management, localisation, and public services. The project was initiated in 2012 by the Flemish ICT agency (i.e. V-ICT-OR), initially for Local administrations. In 2016, the ICT agency broadened OSLO's scope to "Linked Organisations".

The OSLO semantic model aims to promote semantic and technical interoperability through an open process that involves market actors and authorities. It ensures that the vocabularies are maintained, and governance principles and rules are respected. OLSO aims to promote standards and provide support to facilitate the adoption of data standards. It covers over 18 domains, including mobility, with more than a thousand definitions.

OSLO-Mobility is the mobility component of the OSLO semantic model that was first introduced in April 2020. It provides a common vocabulary for sharing data related to people's trips and the mobility services they use. OSLO-Mobility includes lexicons for traveller information, trip information, booking actions, network description, operator service supply, and license-related information.

Source: (Flemish Government, 2019; European Commission, 2021)

Efforts at regulating mobility service providers to make them MaaS-ready

Brussels Mobility is using micromobility as a laboratory to develop an efficient governance of mobility data. To make service operations conditional on a certain number of requirements, a call for tender approach and a licensing system are currently being used. Shared micromobility services are regulated by ordinance, but the ordinance itself does not establish data interoperability requirements or specifications. These are set outside of the ordinance in a data reporting protocol referenced by the ordinance (Région de Bruxelles-Capitale, 2023). In this way, interoperability requirements and specifications can evolve without having to revisit or update the ordinance itself. The protocol includes annexes setting out KPIs and specific recommendations for each type of transport service, without imposing any specific standard or format. Brussels Mobility sought and incorporated input from service providers to ensure that the requirements set in the data sharing protocol are acceptable and feasible. This approach is adapted to the ever-changing nature of data-enabled mobility services as it couples *expectancy* on the need to report data with *flexibility* in what data and how it must be reported over time.

Efforts at regulating MaaS providers themselves

Brussels Mobility is currently working on the development of a MaaS ordinance for the regulation of MaaS providers within the Brussels-Capital Region. STIB has been consulted and shared its views. The MaaS ordinance should tackle the following themes: (i) defining the role of STIB as it relates to MaaS and establishing Floya as a public service; (iii) ensuring that certain policy objectives, as set out in Good Move, are reflected within MaaS solutions; (iv) specifying the scope of the MaaS data sharing platform that STIB should develop and specifying access conditions.

STIB is both a public transport operator and a MaaS provider with the MaaS app Floya (formerly known as MoveBrussels). The regulation of STIB's activities as a MaaS provider has been addressed through the new service contract, established for the 2024-2028 period (STIB-MIVB and Brussels-Capital Region, 2023).

STIB-MIVB's role in establishing a regional MaaS service – assorted with a public service obligation – is enshrined in this contract (Article 8). STIB is tasked with the development, management and exploitation of the regional MaaS app and of a regional MaaS platform. STIB has also been given the strategic orientation to develop and operate integrated mobility solutions in partnership with other stakeholders in the mobility ecosystem, be they public or private (Article 18), and to continue working with SNCB-NMBS, DeLijn, OTW-TEC and BMC in the development of integrated fares and tickets (Article 44). STIB-MIVB's MaaS related responsibilities are laid out in Article 45. STIB-MIVB is required, in collaboration with Brussels Mobility, to: (i) develop, offer and operate the mobile MaaS app; develop, manage and operate a platform and IT service to integrate third-party partners into the MaaS app; to prepare standard agreements for access to the platform and app, laying out the rights and obligations of partners.

In a first report on the development of MaaS in the BCR, ITF recommended functionally separating transport service operation from MaaS provision (ITF, 2021a). The Service Contract requires STIB-MIVB to maintain an operational separation between its three missions as public transport operator; MaaS platform manager; and MaaS app provider, but no functional separation has been implemented. In this contract, it is also noted that a new legal framework (the MaaS ordinance) will further guide these activities. At the time of publication of this report, STIB's activities as a public transport operator and as a MaaS provider remain regulated through the same service contract, which raises questions that are discussed under "Recommendation 8 – ".

Creation of interfederal and interregional cooperation bodies

In its first EU-funded study on the development of MaaS in the BCR (ITF, 2021a), the ITF identified the need to create the conditions for MaaS to operate beyond regional boundaries. Since the publication of this first study, a number of interfederal initiatives have been launched to ensure coordination and define a roadmap for the development of MaaS in Belgium. The Federal Public Service Mobility and Transport has taken a leading role in organising the interfederal dialogue around MaaS.

On 7 September 2022, the Executive Committee of Mobility Ministers (ECMM) adopted the interfederal vision for MaaS which aims to promote three key projects:

- Reach an aligned position about MaaS among the federal government and the three regions. This position addresses the economic model, the technological and data governance model, the communication and awareness-raising strategy, and the necessary infrastructure to be developed;
- Ensure the inter-regional compatibility of the development of the Belgian MaaS ecosystem;
- Clarify the roles of different stakeholders: the public authorities, MaaS service operators, mobility service operators, and users.

To operationalise this vision, the FPS Mobility and Transport has proposed the creation of four working groups (WG) scheduled to start work in 2024, each group with its specific area of focus and leading institution:

(i) The communication and terminology working group will seek to create a shared glossary of MaaS-related terms to ease communication, both among institutions and with the broader public. This working group will be led by Flanders and prepare a shared communication campaign on MaaS, as planned in chapter 5 of the interfederal vision for MaaS.

(ii) The Data Harmonisation working group will contribute to ongoing work on interoperability, including data reporting. Brussels Mobility leads this WG and will seek to collaborate with other working groups on interoperability (see "Recommendation 6 - Work on enhanced compatibility rather than full interoperability" for a discussion of these working groups).

(iii) The regulations working group will work on defining common principles for the regulation of the MaaS ecosystem. The Federal government has tasked ITS Belgium with the organisation of this working group to define common minimum principles that could be integrated into an interfederal code of conduct. This code of conduct would include provisions both for the regulation of MaaS providers and for shared micromobility operators. The Walloon Public Service (*Service Public de Wallonie* or SPW) will lead this WG and the code of conduct will provide a basis and input.

(iv) The MaaS payment infrastructure and ticketing working group will provide guidelines to ensure the interoperability of ticketing solutions. The Federal level will lead this working group on payment infrastructure in concertation with BMC.

Enabling, Protecting and Cooperating: a conceptual framework for the governance of MaaS

In practical terms, what is MaaS made of? Stakeholders consulted as part of this study tend to focus on what MaaS *should do*, but many find it hard to define what MaaS *is actually made up of*. When asked to define MaaS, most discuss the expected benefits of MaaS as a tool that should support citizens in sustainable mode choices. These definitions tend to focus on the MaaS delivery interface – the app –, physical connectivity across modes, and their expected benefits, rather than on the processes and components necessary for MaaS to exist. All in all, there is clarity about the pre-conditions for MaaS to be attractive (service and infrastructure connectivity), about the expected benefits of MaaS (better connectivity, better accessibility, more sustainability), and about the form it should take when it reaches end users (the app). However, there is less clarity about how to create a MaaS ecosystem in terms of key actions and the responsibilities of different types of stakeholders in delivering these actions. These consultations suggest that *to jointly define compatible MaaS governance frameworks, Belgian stakeholders should move away from a focus on the apps towards a discussion of core governance principles for the MaaS ecosystem.*

Discussions with stakeholders have revealed a lack of clarity regarding what actually comprises a viable MaaS offer – e.g. what its building blocks are. However, understanding its components is a necessary precondition to the governance of MaaS. Interviews suggested that questions such as what MaaS is made of, what data sharing implies, and how data about individual users should be treated within MaaS systems, were not answered in the same way or with the same clarity by all stakeholders. These discrepancies can be explained by normal differences in specialisation and expertise across stakeholders who are expected to work together. Yet, these questions are foundational, and a common understanding of these topics is the cornerstone for productive discussions on the governance structure of MaaS.

This chapter endeavours to provide a clear conceptual foundation in order for this report to be as useful as possible for a variety of stakeholders. This conceptual framework builds on past research (ITF, 2021a, 2023) and adapts it to the challenges identified from stakeholder consultations. Five key principles have been developed from extensive stakeholder consultations. These principles stem from the different and sometimes contentious views emerging from the stakeholder interviews. The chapter then moves on to defining the areas of actions and, for each of these areas, the actions that should be part of a MaaS governance framework based on past research and the analysis of current MaaS-related projects in Belgium (ITF, 2024a). This conceptual framework should improve clarity on these foundational concepts. Additionally, more foundational questions need to be addressed to define compatible MaaS governance frameworks at the interregional level; these are tackled in chapter “Towards an interfederal MaaS governance: recommendations”.

Principle 1 – Treat mobility data as foundational infrastructure

Transport services such as ride-sourcing services, shared cars, bicycles and e-scooters are transforming the mobility systems of cities around the world. These newer services use the same roads, cycling lanes, parking areas and sidewalks as other modes. But what sets them apart is the extra digital layer that ensures the connection between users, platforms and other intermediaries and vehicles in real-time. Many services

that people experience in the physical urban world rely entirely on digital technologies that remain invisible to the user. *Data is therefore a foundational infrastructure for digitally enabled mobility.*

Infrastructure commonly conveys the image of roads, rails, roundabouts, and cycling lanes – physical objects that connect places and enable mobility. However, infrastructure is more than these objects, it is "the set of fundamental facilities and systems that support the sustainable functionality of households and firms, including the services and facilities necessary for its economy to function" (OECD, 2021b). Data increasingly shapes real-world outcomes: it underpins a variety of new shared mobility services, ensures the efficient delivery of all transport services and supports the integration of these services through MaaS (ITF, 2023). Moreover, mobility data is *foundational* infrastructure in that it is increasingly essential for citizens to live fulfilled lives (ITF, 2023).

Approaching data as foundational infrastructure for mobility has important implications: just like with the other components of the mobility system (the physical infrastructure, the vehicles that travel on it), public authorities have a role in establishing key principles for the development of the mobility data stack. Public authorities may also directly deliver critical components themselves. The private sector plays an essential role in the design and deployment of mobility data infrastructure and public authorities must find ways to ensure they continue to do so while contributing to improved societal welfare.

Specifically, public authorities should help establish and regulate this infrastructure layer in a way that supports policy objectives rather than seek to "own" the layer by building and deploying all components – including a single consumer-facing app. A regulatory framing from public authorities will ensure that the solutions designed and deployed by all parties will support public policy objectives by default. Such an approach is more proactive than reactive: rather than regulating to correct issues observed on the market, authorities can play a role in providing the infrastructure that will allow for the emergence of a market that serves their policy objectives. For example, in its recent LIDMo law, Switzerland has defined mobility data as a third form of transport infrastructure, in addition to roads and rails. This law creates a mandate for the Federal Office of Transport to regulate it and provide certain basic building blocks so that it could contribute to the public good (Assemblée fédérale, 2022; DETEC, 2022).

Mobility data infrastructure is comprised of three pillars representing the different outcomes that data flows enable (ITF, 2023). These pillars are data sharing, data reporting and machine-readable regulation. Data sharing refers to the practices, the obligations, methods, protocols and syntaxes that guide and facilitate how mobility ecosystem actors share data to jointly provide solutions or enable secondary markets to develop. Data reporting refers to data reported by actors within the mobility ecosystem to public authorities. This data can then be used to monitor how services are delivered, what their impacts are, and how public intervention (such as planning, operations, regulations, enforcement) could be improved (ITF, 2021b). Machine-readable regulation refers to public authorities conveying regulatory intent to mobility actors in a machine-readable format that can be integrated directly and natively into digital solutions (ITF, 2023). Speed limits or operational restrictions based on geofencing are forms of machine-readable rules that have been deployed by public authorities via application programming interface (API) endpoints and directly integrated into dockless micromobility and ridesourcing apps. Machine-readable regulations avoid a situation where authorities issue regulations in analogue formats, leading to a time-consuming and costly process of interpretation and re-transcription into digital systems by private sector entities.

These three pillars – sharing, reporting and machine-readable regulations – underpin MaaS and other digitally enabled mobility services. Data sharing creates the foundation for MaaS: without the sharing of data between stakeholders within the MaaS ecosystem, the MaaS market cannot function. On the other hand, data reporting and machine-readable regulation allow the MaaS ecosystem to function more

efficiently and in line with public policy goals. Approaching data as a foundational infrastructural organised around these three pillars helps identify the key governance actions that need to be delivered for MaaS to emerge. This is the focus of this report.

The fact that mobility data infrastructure is constituted of many data exchange is one of its key defining characteristics: it is a distributed infrastructure that emerges from interactions amongst a range of stakeholders; its development does not depend on a single entity, but rather on the collaboration of many.

Principle 2 – MaaS requires sharing informational, operational and transactional data.

Different types of data need to be shared for MaaS to function. These types of data serve three main functions (ITF, 2023, pp. 30–32):

- Informational data allows to plan trips by coordinating different modes. It encompasses information such as a vehicle type, a vehicle location, the availability of a shared vehicle, schedule information for public transport service, etc.
- Operational data allows to deliver a trip. It allows to join different transport and mobility services by ensuring that gates open, that vehicles unlock, etc.
- Transactional data allows users to book and pay for services. Its circulation also allows for revenues to be redistributed among stakeholders in the ecosystem. It is the most sensitive type of data to share from a commercial perspective, as it can be used to infer market activity, but also because its sharing allows third-party stakeholders to directly enter into a contract with one's customers.

In order for MaaS solutions to provide key services, all three types of data need to circulate. This report focuses on the governance aspect of this data sharing: for data to circulate, relations between stakeholders within the ecosystem need to be organised around clear, commonly agreed-upon rules.

In the context of MaaS, sharing data does not necessarily, or primarily, mean sharing all data with everyone. Three broad data access regimes characterise mobility data: closed data, restricted data and open data. Closed data is only available to the data controller. Restricted data can be made available to other parties than the data controller under specific conditions set by the data controller or other relevant entities. To access restricted data, third-party stakeholders need to be vetted by the data controller or other responsible entities. Restricted data encompasses operational and transactional data that must be shared to enable MaaS, as well as sensitive informational data. Finally, open data is available to all under minimal conditions (e.g. no commercial re-use) or no conditions at all. *Shared data is not necessarily open data*.

Ducuing (2020) notes that open data, which is accessible to all, has infrastructural quality insofar that it allows markets to develop. This is also the case for informational data, which allows for the creation of trip planners. She adds that other, non-open data sets may be necessary to the functioning of a derived market. This would be the case with operational and transactional data, which is necessary to the MaaS market. If a dominant player refuses access to this essential data, competition in the MaaS market will be degraded. Any regulation that limits the capacity to share this data risks preventing innovation and the emergence of new derived products or services. Ensuring fair competition implies "imposing (…) an obligation to supply under fair conditions" (Ducuing, 2020, p. 128), only to vetted stakeholders operating on this secondary market. All in all, not all data needs to be shared with everyone; specific rules need to be defined according to the data type and its sensitivity to build trust among stakeholders.

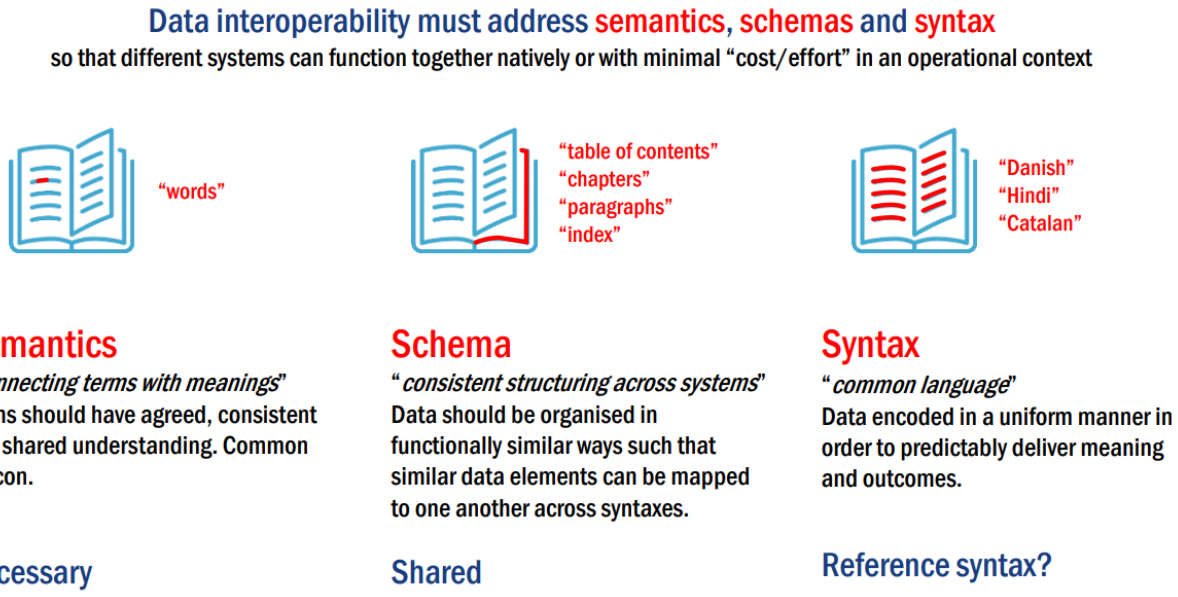
Principle 3 – Interoperability through harmonisation should be ensured at the interregional level

An important counterpart to data sharing is interoperability: data sharing can only occur if the data used by market stakeholders can connect and work together, in technical terms. Interoperability "refers to the ability of different digital services to work together and communicate with one another" (OECD, 2021a). In the context of MaaS, interoperability constitutes a form of data and system compatibility that enables different operators to deliver a combined service to the user (ITF, 2021). Interoperability should allow different stakeholders to connect their services, from governmental entities to businesses (Forum Standaardisatie, 2018, p. 3). Such interoperability should enable the delivery of joined-up trips involving different service providers – e.g. private shared mobility services, public transport operators, identity authentication services and payment processors.

When discussing interoperability, stakeholders interviewed in this project tend to talk about "standardisation". As a consequence, the process appears particularly daunting: it suggests that stakeholders within the ecosystem should adopt the exact same technical specifications. However, *interoperability does not necessarily imply standardisation.* The Data Sharing Coalition (2021) – an international cooperative initiative focused on cross-domain data sharing and supported by the Dutch Ministry of Economic Affairs and Climate Policy – talks about "harmonisation" rather than "standardisation". "Harmonisation" is about "establishing agreements, standards and requirements between actors to enable data sharing between them" (Data Sharing Coalition, 2021, p. 21).

Data interoperability concerns three domains. First, the compatibility of data semantics. Semantic interoperability "ensures that the precise format and meaning of exchanged data and information is preserved and understood throughout exchanges between parties, in other words 'what is sent is what is understood'" (European Commission, 2017, p. 28[1]). What are the tools that support semantic interoperability? According to the European Interoperability Framework, they take the form of "taxonomies, controlled vocabularies, thesauri, code lists and reusable data structures/models" (European Commission, 2017, p. 29[1]). The second domain, schema compatibility, refers to a compatibility in terms of structure: data may not be expressed in the same standard (i.e. in the same technical specifications) but it is organised under the same heading, enabling the two data sets to be mapped one against the other. The third domain concerns data syntax – the "language" in which the data is encoded to provide meaning. The highest level of interoperability is reached when data syntaxes are the same: not only are common semantics used and are systems organised in the same manner, but the language used to code the data is the same (ITF, 2023, p. 46).

Figure 1. Three levels of interoperability



Source: ITF (2023, p. 44)

Harmonisation may be full or partial. Full harmonisation implies following exactly the same standards, agreements and requirements; it may be difficult to achieve in practice, yet it is a pervasive "utopia for all newly formed data spaces" (Bastiaansen, 2022, p. 18). Standard and shared semantical lexicons underpin all forms of interoperability and should be strongly incentivised. In those cases where using the same term is not possible, standard translation logics should apply so that the transposition of one term into different syntaxes is always logically coherent.

Legacy systems may be key obstacles to interoperability: information systems have generally been developed in a piecemeal manner, to answer specific problems, resulting in "fragmented ICT islands which are difficult to interoperate" (European Commission, 2017, p. 30[1]). In the interregional perspective adopted in this report, the fragmentation risk is even higher: regional-level efforts to ensure interoperability may nonetheless result in the creation of regional silos. For these siloed regional systems to connect, further bilateral discussions and adjustments would be necessary. This would be both costly and time consuming (Groen, Baguet and van Mol, 2023) and might limit the development of the interregional market and smaller players' capacities to enter it.

The European Interoperability Framework recommends that interoperability strategies should be defined at the highest possible level to limit fragmentation risks (European Commission, 2017). Yet, it is at the local level that trust is built, pointing to a key role of local and regional authorities. These multi-level interoperability challenges will need to be addressed collectively by key stakeholders in Belgium.

Principle 4 – Personal status information and access rights must be portable

To provide an intermodal, integrated trip to a customer, information about that customer must be shared among mobility operators and MaaS providers. Customer information may relate to the identity or other

personal information pertaining to the traveller that then allows each actor involved in delivering joined-up trips to ascertain what access rights the traveller holds. Alternatively, that information may simply pertain to whether the traveller has an access right to each mobility operator's services in the trip chain. In this case, data portability does not imply the transfer of personal data, as zero-knowledge protocols may also be used to share information about a person's access rights and status (e.g. eligibility to social pricing, age, driver's licence) in the form of a yes/no request.

Data portability enables MaaS but what data is ported and under what conditions may differ. Without this portability, users would need to register individually for each and every service that would be part of their integrated trip. While interoperability is about the *ability* of different systems to work together, portability is about *rights and responsibilities* that different MaaS stakeholders hold towards the end-users who agreed to share personal data with them (ITF, 2023, p. 44).

In practical terms, portability can take three different forms (ITF, 2023, p. 52). The end user may download their data from one data controller and then share it with another data controller. This implies some level of functional interoperability between the two stakeholders; it comes with a great amount of control from the end-user, but also imposes a great burden on them. It does not allow for the real-time data portability, needed to deliver a joint trip. Alternatively, the end-user asks a data controller to transfer data to another data controller on their behalf on an ad-hoc basis, and according to conditions defined specifically for such infrequent data transactions. However, such ad-hoc delegated data transfers are not amenable to delivering the kind of data portability MaaS requires. Finally, the end-user may direct a data controller to transfer their personal data to another data controller as needed, in real-time and on a transactional basis. The end-user defines the overall conditions under which such continuous data transfers may be authorised. This transfer is generally handled via real-time data exposure mechanisms such Application Programming Interfaces (APIs). All three data portability models require some level of interoperability between different stakeholders' systems. Only the final form is compatible with the delivery of intermodal MaaS trip offers.

The OPEN DEI project (2021, p. 10) uses a credit card analogy that can also be compelling when discussing continuous data portability: when using a credit card to pay in a shop, we allow the bank to share a piece of information – does the customer have enough balance to pay for this transaction, yes or no? – to the shop. The type of information that is shared is well defined: for example, the bank is not allowed to share the customers' account balance with the shop. When subscribing to a credit card service, the customer enters a type of framework agreement with the bank: this limited piece of data will be shared every time the card is used. Customers do not need to renew their consent every time they use their credit card in a new shop. Using a MaaS service would imply the same sort of relationship: customers would delegate their right to manage access to their data to a MaaS provider, under set and clear rules. When using the app to plan a trip, a limited amount of data (e.g. a unique identifier, some yes/no answers to requests about social pricing) about the customer will be shared with the mobility service provider.

If data portability is necessary for MaaS, it is because each actor involved in delivering trip-related services must be confident that the person receiving those services indeed has a right to them. The ability to authenticate identification or rights is at the heart of MaaS-related data portability. For instance, authentication is a necessary prerequisite to grant access to a vehicle or service as it allows to link vehicle access rights to a natural person. Identity data may also include information about a traveller's preferences (e.g. preference of active modes), specific needs (e.g. mobility impairment), or characteristics (e.g. eligibility to social pricing). This information is valuable to MaaS providers as it allows them to tailor the service to the end-user, optimising MaaS's potential to induce mode shift.

The ability to decide how one's data will be used and shared is referred to as data sovereignty. The EU Open DEI project (2021) identifies data sovereignty – for individuals, companies and organisations – as a key design principle for data spaces. These data spaces should include specific tools for individuals to monitor who has access to their data, to edit those access rights, but also to delegate their data rights management to third parties – such as MaaS providers – who would manage these access rights for them, under conditions set in a broader agreement.

Box 2: Common European Data spaces

In February 2020, the European data strategy laid the foundations of a single market for data to make data available for access and reuse. Within the scope of this strategy, data availability and sharing rely on the establishment of common data spaces defined as "relevant data infrastructures and governance frameworks in order to facilitate data pooling and sharing" (European Commission, 2022b). The Common European data space aims to support the emergence of cross-sector collaborations through data sharing and re-use.

The Commission announced the gradual deployment of sector-specific European data spaces in strategic sectors such as agriculture, mobility, finance, manufacturing, and health, among others. While acknowledging that each sector-specific data space will have unique characteristics, the European Commission noted that their data infrastructure and governance frameworks will share strong similarities across all data spaces.

European data spaces are not about centralising all data in a single place, but rather about achieving a common governance and technical norms and principles to ease the secured sharing of data among authorised stakeholders. As such, they may take the form of a variety of local projects, federated under common principles.

Two projects are currently advancing the development of the European Mobility Data Space (EMDS). The project PrepDSpace4Mobility works on mapping existing data ecosystems in Europe and finding their commonalities to recommend common principles for the EMDS. deployEMDS builds upon the work done by PrepDSpace4Mobility and will support operational pilot projects in nine cities or regions, including Flanders in Belgium.

Source: (European Commission, 2022b, 2024a; PrepDSpace4Mobility, 2022; deployEMDS, 2024)

Several stakeholders interviewed in this study feared that data portability practices may contravene personal data rights as established by the EU General Data Protection Regulation (GDPR). GDPR however, does not prevent the transfer of personal data amongst data controllers and with third parties, but only establishes the strict conditions under which this transfer may take place. At the core of GDPR personal data rules is the notion of the operational control that data subjects are entitled to exercise over their personal data and that is substantiated via their explicit consent. Consent is also at the heart of the OECD's definition of data portability: "[data portability is] the ability (sometimes described as a right) of a natural or legal person to request that a data holder transfer to the person, or to a specific third party, data concerning that person in a structured, commonly used and machine-readable format on an ad-hoc or continuous basis" (OECD, 2021a). Privacy protection and consent management frameworks should thus be at the core of any MaaS governance system.

Principle 5 – Sharing data does not require pooling data

Data sharing requires establishing a common data resource available to vetted MaaS ecosystem actors. Many stakeholders interviewed in this study assume that this data resource would take the form of a common and centralised data pool – most likely housed by centralised platforms such as the MaaS platform that STIB has been tasked with developing. Such platforms would form one-stop-shops for all stakeholders willing (or required) to integrate the MaaS ecosystem either as mobility operators or MaaS providers.

Yet, centralised data platforms pose risks. Centralised data pooling potentially confers data access rights to the platform owner which are not shared by other MaaS stakeholders. This opens the door to the abuse of a dominant position by the platform operator and raises important issues of trust among MaaS ecosystem actors. This risk can be mitigated by designating third-party data resource managers who have no stake in providing mobility services or the MaaS offers on which these services are based. Third-party management is not without cost: this approach adds another layer to the MaaS ecosystem and may increase the cost of providing MaaS services.

An alternative risk-mitigating strategy is to pivot away from the data pool model towards a decentralised and on-demand framework that enables limited transactional data exposure to vetted MaaS ecosystem participants. In such federated architectures for data sharing, "data remains stored where it is produced and only the result of a request is made available" (EU OPEN DEI Project, 2021, p. 76). Under such a system, all data holders remain responsible for their own data, which they share only in response to specific transactional requests made by authorised stakeholders via APIs. Common interoperability principles still need to be adopted for this system to function: under a decentralised, API-based system, actors retain access and control to their core data and only specific data elements necessary to fulfil MaaS-based trips are released via a standardised API gateway. The EU Data Strategy promotes a decentralised approach to data sharing.

Data sharing platforms relate to decentralised data sharing architectures as a library relates to the internet: both allow to access knowledge. The library can only be used by users coming into a single building; these users access the books available within the library catalogue, which is not necessarily updated in real-time: some recently released books might not be available yet. Access to the data in a library is also controlled by the building owner who may only open the building at certain times or (in the case of private libraries) only to certain users. The internet, on the other hand, allows to access information shared by a wide variety of data sources, without needing to go through one building. It is constantly updated, and knowledge producers can share information with whoever they want, based on their own terms. Some pieces of information are available to everyone, others are only accessible to registered users, or paying clients. The internet is a decentralised, constantly up-to-date, collectively managed resource for information.

A guiding framework: three essential areas of actions of an interregional MaaS governance

MaaS requires multiple functionalities to be delivered to create seamlessly connected trips for people. These functionalities are delivered by various microservices. All of these microservices can be delivered by one single actor, via one single interface, but this approach is associated with competition- and welfare-related risks. The key regulatory challenge for authorities is creating the right conditions for a wide variety of stakeholders to work together in delivering high-quality, user-centric and socially beneficial MaaS trips. The relevant regulatory framework for MaaS must ensure that key actions are taken in three main areas,

defined below. This guiding framework may help guide discussions about the governance of MaaS amongst a variety of stakeholders with different responsibilities and forms of expertise. This guiding framework fosters discussion at a non-technical level and provide objectives that stakeholders should strive to attain. Based on these, policymakers would then need to define regulatory, operational and technical action plans to ensure these actions are taken.

1. Enabling – Allowing data flows within the ecosystem

For MaaS to seamlessly deliver a variety of mobility services, informational, operational and transactional data need to be shared. As established in principles 2 and 4, data sharing implies interoperability and trust. Data sharing can be delivered via data pooling or, preferably, via common but distributed data exposure mechanisms (principle 5). This area of action therefore encompasses governance functions that support data sharing.

Supporting data sharing implies, first, making sure that data is available and that it can be found and accessed by stakeholders. To support these functions, meta-data catalogues that highlight the data available and who holds it are key. Discovery protocols also need to be established; they should include procedures to vet stakeholders before granting them access. Data exposure mechanisms need to be chosen to enable the flow of data. These data flows should be monitored; data usage accounting and registries of data users support this function.

Second, interoperability is key to ensure that the data resources shared by different stakeholders can be connected to deliver joint service. As established by principle 3, this does not necessarily imply full standardisation. It does, however, imply a certain degree of harmonisation.

2. Protecting – Ensuring secure portability of access rights, user-centricity and compatibility with public policy objectives

Offering people a seamless intermodal experience implies the portability of access rights and some information about end-users (principle 4). This raises important questions regarding privacy protection. Governance actions to protect users and ensure user-centricity thus constitute a second area of action.

This area encompasses four main actions: first, ensuring that sources of personal data are identifiable and accessible through secured protocols. These protocols should be based on a commonly agreed-upon consent language; they should be precise and be regularly revised to ensure respect of both GDPR and the highest ethical standards. Second, users should be empowered to decide on the use of their data. They should be able to monitor who has access to what data and for which purposes. They should be able to revoke their consent and withdraw their data from any stakeholder at any moment (GDPR-established exceptions notwithstanding, as in the case of personal data held by public authorities to carry out their mandates).

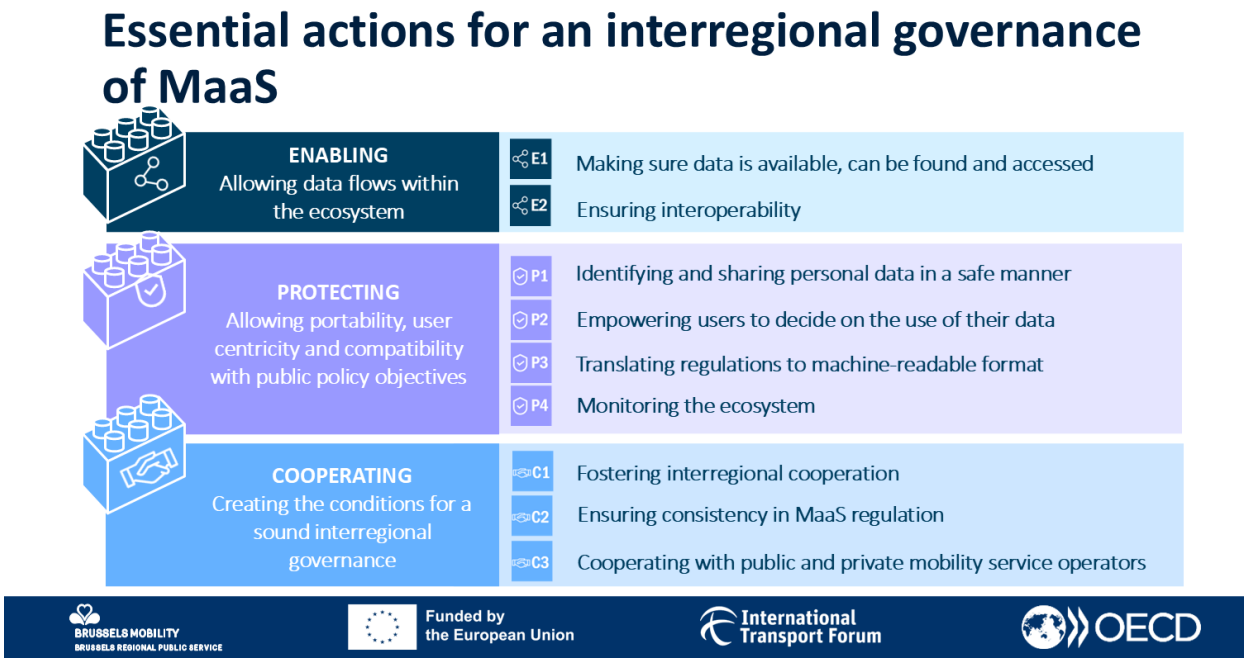
Protecting citizens also implies ensuring that mobility services contribute to the policy goals set by their elected representatives. Translating regulations to machine-readable format allows public authorities to directly communicate their regulatory intent to service providers (e.g. geo-fencing, speed limits, methodologies to compute carbon footprint, restrictions on sharing information to non-vetted actors under certain conditions, authentication of eligibility to social fares across operators, etc.). Monitoring the

ecosystem also ensures that it serves public objectives, offers inclusive benefits and does not create negative externalities.

3. Cooperating - Creating the conditions for a sound interregional governance

The final area of action encompasses all the functions that are necessary to enable a sound cooperation between stakeholders in the ecosystem, both public and private, and cooperation at an interregional scale. Interregional governance is most efficient when it relies on formalised cooperation mechanisms. Such mechanisms are most efficient when participants proactively ensure that a shared lexicon and shared principles are defined in the early stages. The interregional operation of MaaS can only be ensured if a certain consistency in MaaS regulations is achieved – duly acknowledging that in Belgium, the authority for transport planning and regulation rests with regional governments. Machine-readable regulation can be used as a tool to correct for the remaining discrepancies in a seamless manner. Finally, cooperation and thorough consultation of public and private mobility service operators is key to ensuring the acceptability of consistent regulatory principles.

Figure 2. A guiding framework for the governance of MaaS: areas of actions and key actions



Towards an interfederal MaaS governance: recommendations

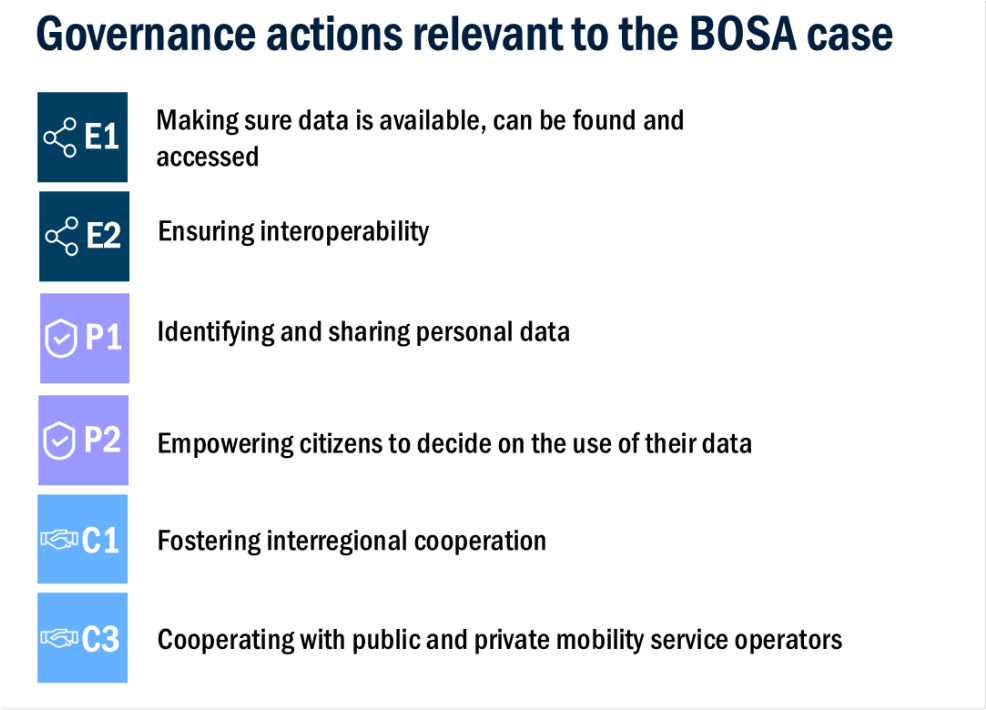
Mobility as a Service (MaaS) is a core component of the Brussels-Capital Region's plan to sustainably improve everyday mobility for its inhabitants and businesses as outlined in the "Good Move" Regional Mobility Plan. Good Move's initiatives are designed to provide each inhabitant with "adapted, facilitated and integrated mobility solutions, enabling them to choose the most appropriate mode of travel for each of their trips, depending on their destination and needs at a given time" (Good Move). This aim requires the physical interconnection of different transport options as well as the digital integration of services – both within the region and with neighbouring regions. The governance of the physical interconnectivity is well-established, whereas the governance of the digital interconnectivity necessary for MaaS is not. ***These recommendations address what a structured governance framework for MaaS in the Brussels-Capital Region and beyond, may look like and what actions would support its adoption***. The first 5 recommendation tackle tangible outcomes and identify clear milestones that can be phased in time. The last 3 refer to ongoing processes that should enable these tangible outcomes.

The recommendations build on a detailed investigation of ongoing MaaS-related initiatives in Belgium (ITF, 2024a). This diagnosis has revealed that there is a lot of ongoing work on the technical dimensions of MaaS, while the governance issues continue to raise concerns. Consequently, guiding questions regarding the definition of MaaS, the roles and responsibilities of stakeholders and the organisation of data exchange still remain unanswered. Moreover, technical discussions have been fragmented into a variety of different working groups and projects, leading to a scattering of resources, knowledge and skills. These discussions also have involved experts who mainly come from the transport and mobility sectors, overlooking insights and experiences from other sectors that face similar issues for which innovative solutions have been implemented. The following recommendations address these three imperatives: 1) focusing on MaaS governance; 2) avoiding fragmentation and building a coherent inter-regional approach to MaaS and; 3) ensuring that cross-sector experience and innovation benefits the development of MaaS in the Brussels-Capital Region and beyond.

Several recommendations presented here are inspired by established practices found outside of the mobility and transport sector that address analogous challenges. To illustrate these recommendations and ease their implementation, two case studies are used as common threads throughout this chapter: BOSA and the EU Health Data Space.

BOSA – SPF Stratégie et Appui – develops, hosts and manages a number of information technology (IT) solutions for federal public institutions in Belgium. Among other services, BOSA manages the federal service integrator that organises the secure sharing of personal data among public institutions in Belgium. BOSA has developed a number of protocols, including administrative processes and technical building blocks, to manage data flows. BOSA is also involved in promoting interoperability through the BELGIF initiative; it is active in several interfederal working groups, working on enhancing interoperability in different sectors. Finally, BOSA is also working on two projects aimed at improving personal data portability while protecting citizens: the Single Digital Gateway and Digital Wallet (see recommendations 4 and 8). As such, the activities undertaken by BOSA address a number of governance actions included in this study's conceptual framework (Figure 3).

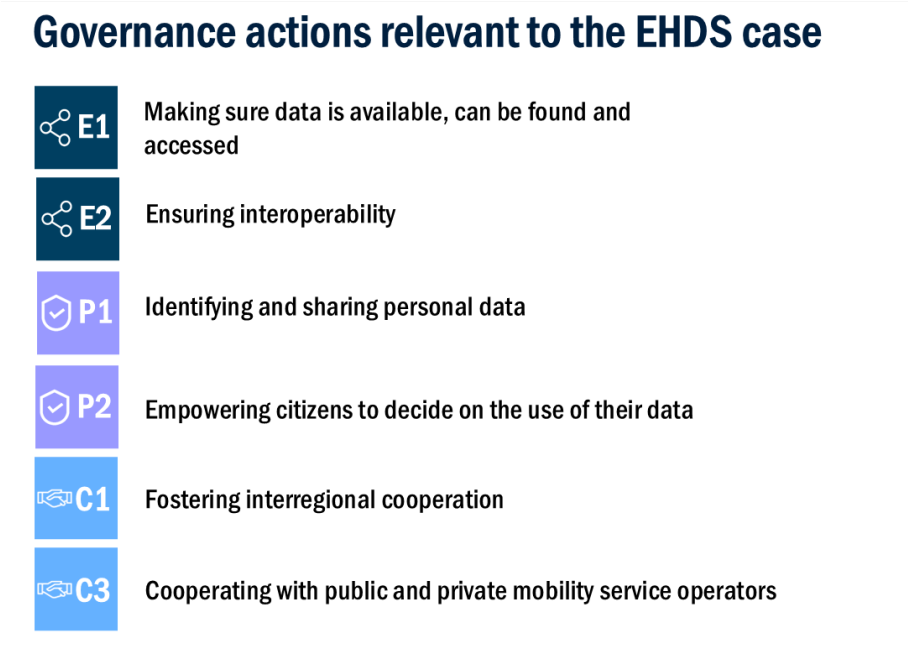
Figure 3. Governance actions relevant to the BOSA case



The second key case study is the EU Health Data Space (EHDS) (see Box 2) Health is the first strategic sector to receive a detailed and comprehensive proposal for a domain-specific European data space. The proposed governance framework of the EHDS can help inform how to address analogous data sharing challenges within the mobility ecosystem – especially those concerning MaaS. The health and mobility sectors share strong similarities in terms of data characteristics and data sharing requirements. Firstly, as with MaaS, natural persons are at the centre of the EHDS ecosystem: the proposal aims to increase European citizens' control over their health data. Secondly, data sharing in the EHDS aims to enable - often sensitive - data sharing between different service providers in the health sector (i.e. general practitioners, hospitals, pharmacies) to facilitate healthcare service provision – just as is the case with cross-operator service delivery for MaaS. Finally, the proposal integrates a cross-border dimension to enable the continuity of healthcare for European citizens, which is also crucial for seamless MaaS operations.

The case of the EHDS also speaks to a number of governance actions included in this study's conceptual framework (Figure 4).

Figure 4. Governance actions relevant to the EHDS case



Beyond these two central cases, additional examples are cited. These additional examples always come from projects that are currently implemented in Belgium and that could play a key role in the MaaS ecosystem. These examples highlight that pre-existing technologies, frameworks and practices may already be drawn upon to overcome the challenges posed by inter-regional MaaS governance and deployment. Details on all MaaS-relevant projects identified through this project are available here (ITF, 2024a). Some of the recommendations that follow go beyond what exists today in both the mobility and other sectors – in those instances, the report highlights examples that could serve as inspiration or guiding principles for addressing the challenge at hand.

All eight recommendations are prefaced with an overview that highlights:

- The governance actions and how a given recommendation addresses those actions, in line with the framework defined in this study.
- The stakeholders responsible for delivering this recommendation and, if relevant, those that should be consulted by the responsible stakeholders.
- The level of difficulty: recommendations classified as “Existing” can build upon ongoing and past projects. These require structuration rather than the launching of new projects or inventing new solutions. Recommendations classified as “Existing +” imply some reform or adaption of existing projects or solutions. Finally, recommendations classified as “New” imply the development of new solutions or the launch of new projects.
- The level of priority, from high priority in red (actions that should be implemented immediately) to medium priority in orange (actions that should be implemented in the next 2 years) and lower priority in yellow (actions that should be implemented in the next 4 years).
- Dependence on other actions, that is, the degree to which a recommendation can only be implemented after other recommendations have been implemented.

- Evaluation indicators that can be used to monitor whether the recommendation has been implemented.
- When relevant, suggesting of a review mechanism for each action.

Recommendation 1 - Structure collaboration to limit fragmentation: the key role of the MaaS network coordinator (MNC) and MaaS Governance Authority (MGA)

RECOMMENDATION OVERVIEW

Recommendation 1 - Structure collaboration to limit fragmentation

Governance actions	Difficulty
C1 C2	Existing+ Build upon: ITS Steering Committee; interfederal MaaS WG

Responsible stakeholders

Priority level

- Creation of MaaS Network Coordinator and MaaS Governance Authority
- Integration with fortcoming EU Mobility Data Space

Dependence on other actions

None

Evaluation indicator

Presence / absence of the MaaS Network Coordinator and MaaS Governance Authority

Collaboration is the key to making MaaS a reality, which implies clarity on organisational arrangements, roles and rules of engagement. The diagnosis of existing MaaS-related initiatives in Belgium in the accompanying deliverable (ITF, 2024a) reveals ongoing practices of collaboration and knowledge exchange around MaaS or related topics. These constitute a valuable resource to tap into. To go to the next stage in MaaS development, interregional collaboration for MaaS needs to be further structured, organised, managed, and steered. This implies a key identification of roles, structures for communication and knowledge sharing, processes for delivering joint projects and for addressing conflicts.

Several actions will need to be taken to structure inter-regional MaaS collaboration, each implying a number of stakeholders. This report suggests that a new coordinating role – that of MaaS network coordinator (MNC) – can help to ensure coherent collaboration, avoid fragmentation and duplication risks as well reduce the risk of information asymmetry among MaaS ecosystem stakeholders. The MNC would support effective and continuous collaboration and ensure linkages and synergies between the strategies and actions of all MaaS stakeholders. This can include collaborating with an existing working group from another region rather than launching a new one, or using the policy developed by another stakeholder as input for similar work in another region.

The MNC would actively prevent fragmentation and improve the efficacy of collaboration outcomes by limiting the risk of narrow "groupthink" with respect to both the complex problems at hand and their solutions. Groupthink refers to a situation where cooperation is limited to a group of stakeholders with a similar expertise and similar experiences, resulting in a false sense of consensus and a lack of dissenting voices. Interviews and other stakeholder engagement carried out in this project revealed the existence of such groupthink – for instance, based on their experience, many stakeholders seem more at ease with centralised data-sharing platforms than with the more decentralised approaches present in certain other sectors. The MNC would widen the knowledge pool available to address these challenges by bringing together different types of expertise in the mobility sector as well as from outside of it.

The MNC would be in charge of making sure that information flows and that all relevant stakeholders work together. However, it would not be responsible for drafting documents or policies, nor have decision-making authority. In the context of Belgium, where competence for transport is shared among three regional and one federal transport ministry, these decisions must remain the prerogative of each administration. The MNC should be independent, that is, it should not represent the state of knowledge, expectations, and concerns in a subjective manner. Nor should it be an entity that represents the interests of stakeholders who have a vested interest in steering the market in a certain direction (e.g. mobility operators, MaaS providers). All in all, the MNC is a new interregional function, which can be taken on by an individual or by a team; it exists to ensure effective collaboration and communication. It is not a new institution and does not have a legal identity. The MNC does not have authority to take decisions; it exists to support bodies that do have this authority.

Such independent but coordinated decision-making also needs to be structured. Here, discussions about the governance of data spaces offer inspiration. The International Data Spaces Association (2023) identifies the role of a "data space governance authority" (DSGA) responsible for establishing rules and policies, as well as ensuring the provision of key services that enable the system to function (International Data Spaces Association, 2023). This authority does not need to be a single actor; a variety of entities may be represented within the DSGA. The European Health Data Space also offers an example of cooperative governance: national health data spaces are managed by digital health authorities (primary use of health data) and health data access bodies (secondary use of health data for research purposes); these two types of national bodies are represented within the European Health Data Space board, chaired by the European Commission. This board is in charge of ensuring the consistent application of regulations, ensuring coordination between authorities, and enabling the sharing of good practices. The Board may draw on external experts.

This study recommends the creation of a MaaS Governance Authority (MGA). Similar to a dataspace governance authority, the MGA would be in charge of defining rules and policies, as well as of providing the services that allow the ecosystem to function. Similar to the European Health Data Space Board, it would be composed of representatives of the relevant authorities, that is, the four transport ministries. It can be compared to the ITS Steering Committee (Box 3): it should be interfederal and answer to all four public transport ministries, while having a technical mandate (defined in a cooperation agreement) that stems from the technical services of these four ministries. Similar to the European Health Data Space Board, it could also call on external experts, such as the regional and federal IT agencies (e.g. Paradigm, Digital Flanders, Digital Wallonia, BOSA) but also public transport operators and private mobility service operators. The MGA will be supported in its actions by the MaaS Network Coordinator – the individual(s) who will work as MNC should answer to the MGA. The MNC would ensure good communication among the institutions represented within the MGA, but also with public transport operators, mobility service operators, MaaS providers, and partners in other sectors.

Box 3. ITS Steering Committee

The Federal Government has also played a leading role in ensuring cooperation on ITS-related topics, even though these competencies are shared with the three regions. In response to the EU ITS Directive (2010/40/EU), the Executive Committee of Mobility Ministers (ECMM) created an interfederal cooperation entity: the ITS Steering Committee, founded in November 2016. The ITS Steering Committee comprises representatives of the four mobility ministries in Belgium and consults external experts. One of its main tasks is to ensure coordination, communication, and cooperation on ITS-related topics, since they apply to transport policy. Its secretariat has been assigned to the FPS Mobility and Transport, while its presidency rotates between the four members.

The ECMM tasked the ITS Steering Committee to seek "… maximum harmonisation when developing ITS initiatives and projects so as to ensure service interoperability" (SPF Mobilité, no date). As part of this mandate, the ITS Steering Committee initiated work on the National Access Point (NAP) for multimodal transport information (i.e. transportdata.be), in conformity with the EU ITS Directive and relevant delegated regulations. It has been operational since February 2020. The ITS Steering Committee has developed the interfederal vision for MaaS, adopted on the 7 September 2022 and has outlined a set of interfederal working groups tasked with its operationalisation. These working groups are expected to all be launched through 2024.

The ITS Steering Committee received a mandate from the ECMM to develop a template for a code of conduct, in consultation with MaaS providers and mobility service operators. As of May 2024, work on this code of conduct is ongoing. It should suggest measures to ensure a continuity of services at the national level and define obligations in terms of data sharing, customer service and service availability. It should also include recommendations on how results should be presented to users in terms of environmental impact, latency and schedule, accessibility, cost and comfort. Finally, the code of conduct should offer recommendations and principles regarding data portability. In discussions with the ITF, the ITS Steering Committee highlighted that the interfederal code of conduct should provide guidance to local authorities but should not displace regional initiatives. The interfederal code of conduct and any regional code of conduct should complement each other.

Source: (SPF Mobilité, no date).

How can the MNC and MGA be created? Both the MNC and MGA will be interfederal in nature and will thus need to be created based on an agreement concluded between the Belgian State and the three Regions. Only the MGA will have legal personality, as it will be a new interfederal body capable of taking decisions; the MNC is a support role without authority. This has an impact on the types of agreements needed to create these two entities. The MGA will exercise power on behalf of the four entities mentioned and be tasked with the development of joint initiatives. As such, its creation needs to be approved by the respective parliaments through the adoption of a cooperation agreement. Cooperation agreements are needed to create new bodies with legal personality; yet they are time consuming, and it may take several years for the MGA to operate.

Governments can also use protocols to structure their collaboration; protocols cannot produce normative effects, and they cannot be used to create a body with legal personality. They are a lighter form of cooperation and can be developed in a swift manner. The MNC could be created through a protocol and precede the creation of the MGA. The MNC would have no legal personality and no resources of its own;

it could thus, until the creation of the MGA, be composed of staff-on-loan from the four transport ministries. Once the MGA is created and benefits from its own resources, the MNC could be transferred to operate within its remit.

To start the process of creating these two entities, the Belgian State and the three Regions could sign a protocol which would plan for the creation of the MNC, as well as for joint work on the first two tasks outlined under recommendations 2 and 3 (foundation document and trust model). Existing interfederal processes, such as relying on working groups, could continue until the creation of the MGA. Documents published before the creation of the MGA could be signed by representatives from all four governments and published and a shared position. Once the MGA would be created, it would be able to enforce shared regulations and create new rights and obligations.

Looking ahead, and in line with EU policy, the creation of the future common European mobility data space (EMDS) will have implications for Belgium and MaaS ecosystem stakeholders. The EMDS governance framework will be built upon existing governing bodies (PrepDSpace4Mobility, 2024). The Mobility Data Space Governance Authority (MDSGA) will play a leading role in finding common ground between the different data space participants (See Box 4). The integration between the MDSGA and the MGA would need to be organised in the medium term. The governance of data sharing for MaaS will be integrated within the Mobility Data Space; good practices experimented in the MaaS ecosystem will also inform the development of the MaaS Governance Authority. As noted in PrepDSpace4Mobility (2024), the MDSGA will govern trust frameworks and ensure interoperability to reinforce the confidence of data space participants and reduce the uncertainty related to unverified data exchanges. Establishing the MGA could pave the way to creating a future MDSGA within the overarching framework of European Mobility Data Space.

Box 4. Mobility Data Space governance authority

In February 2020, the European data strategy laid the foundations of a single market for data. This single market would make data available for access and reuse. Within the scope of this strategy, data availability and sharing rely on the establishment of common data spaces defined as "relevant data infrastructures and governance frameworks in order to facilitate data pooling and sharing" (European Commission, 2022c). The Common European data space aims to support the emergence of cross-sector collaborations through data sharing and re-use.

The Commission announced the gradual deployment of sector-specific European data spaces in strategic sectors, among which the common European Mobility Data Space which aims to facilitate the access, pooling, and sharing of data from existing and future transport and mobility data sources (Source: Communication from the Commission to the European Parliament Creation of a Common European Mobility Data Space). Several initiatives have started to propose a framework for a future European Mobility Data Space (i.e. PrepDSpace4Mobility, Mobility Data Space, deployEMDS project in Flanders)

These initiatives emphasised that data spaces require a more agile and cooperative approach. Traditional governance frameworks—characterised by a centralised and rigid decision-making structure—are usually misaligned with a distributed ecosystem like a data space. Requirements for distributed governance should rely on multi-level governance and leverage already existing governance frameworks and agreements within the ecosystem (PrepDSpace4Mobility, 2024).

PrepDSpace4Mobility (2024) proposes an organisational structure relying on both ecosystem-wide bodies and member states. These stakeholders compose the governance authority which would have specific roles to foster collaboration between the ecosystem stakeholders, act as a point of contact between the

Mobility Data Space and regulatory bodies, and work to resolve disagreements or disputes among stakeholders. The report further explores different governance trajectories from a scenario where the role of the EMDS Governance authority lies in the hands of an expert working group and thus does not imply establishing a new legal entity to a scenario where the EMDS governance authority is driven by the European Commission. This latter scenario was retained for the EHDS, where the European Commission chairs the EHDS Board (European Commission, 2022a).

Following the example of the EHDS, the participants of the EMDS governance bodies could be existing entities involved in mobility data governance (e.g. National Access Points, etc.). In this context, a proposal for a future EMDS would rather extend the roles and responsibilities of existing data governance bodies responsible, rather than create new ones. This is the approach adopted within the EHDS proposal: while it provides new responsibilities related to ensuring consistency in the application of data interoperability rules, these bodies were established by Directive 2011/24/EU on the application of patient's rights in cross-border healthcare with the aim of facilitating cross-border exchange of data (European Commission, 2011).

Source: (European Commission, 2022c, 2022a, 2024b; PrepDSpace4Mobility, 2024)

Recommendation 2 - Establish an interregional MaaS foundation document to guide collaboration

RECOMMENDATION OVERVIEW

Recommendation 2 – Focus cooperation efforts on a MaaS Foundation Document

Governance actions	Difficulty
P4 C1 C2	Existing+ Build upon: Interfederal MaaS vision, interfederal WG on MaaS-related communication, ITS.be's code of conduct

Responsible stakeholders

Priority level

Preparation of the MaaS Foundation Document

Dependence on other actions

None

Evaluation indicator	Review mechanism
Presence / absence of the Document	Review every 2 years (stakeholder survey) + Ad hoc edits at the discretion of the MGA

Complexity complicates collaboration. The complexity characterising the interregional collaboration for MaaS in Brussels reflects the different ways stakeholders characterise the challenges, their different goals and objectives, differences in the types of solutions stakeholders find desirable or relevant and different working methods or institutional contexts and imperatives. Crucially, existing approaches to reduce this

complexity by enhancing alignment among stakeholders views, working methods and outcomes – notably the interfederal vision for MaaS, the Flemish MaaS Framework Agreement, or the code of conduct coordinated by ITS Belgium (Box 5 and 6) -- all favour consensus at a fairly high-level but are not sufficiently operational to ensure concrete outcomes.

The MaaS foundation document would serve to bridge this gap between high-level principles and operational frameworks that enable their delivery. It would serve four key functions.

First, it would be a *vision document regarding desired outcomes*. That is to say, it would set a clear vision of what MaaS is, what it is composed of, which outcomes it should serve, and, in turn, which functions it should provide. For instance, agreeing that the purpose of MaaS is to improve residents' mobility experience and support sustainable mobility behaviour would imply identifying the functions that allow for the provision of solutions tailored to users' needs (e.g. ensuring personal status portability). It would also clarify what MaaS is not or should not be according to participating stakeholders (e.g. need to define whether contactless payment solutions are considered as MaaS; whether multimodal trip planners such as Google Maps or CityMapper are considered as MaaS). This would be a valuable resource for MaaS providers and mobility operators looking to develop new value propositions and solutions within the ecosystem.

Second, the MaaS Foundation Document would *identify common principles and clearly define the concepts underlying these principles*. The five principles defined in this research can be used as a basis (see Enabling, Protecting and Cooperating: a conceptual framework for the governance of MaaS). This should foster a common understanding of key definitions and principles among stakeholders and mitigate the risk of misunderstandings or different understandings of the same concepts and terms.

Third, the MaaS Foundation Document would outline a *description of the MaaS ecosystem* (including those stakeholders that compose it) *and its governance framework* (what are the relations among stakeholders, how are they regulated). It would clearly identify roles and responsibilities and would also define the role of the MaaS Governance Authority and MaaS Network Coordinator. The MaaS Network Coordinator role is a necessary and potentially resource-intensive one; the mechanism created to fund this activity should be defined at this stage. As part of the description of the governance framework, the document should establish the linkages between the document itself and the legal framework in which it be inserted within the Brussels-Capital Region (and other Regions and at the Federal level).

Fourth, the MaaS Foundation Document should provide a *mapping of consensus and disagreement*. A number of past initiatives (e.g. interfederal MaaS vision; Flemish MaaS agreement framework) have allowed to reach high-level definitions and clauses (see, for instance, Box 7). While these high-level definitions and clauses have been a valuable starting point for collaboration, this project has found that they leave open several important questions. This is not due to a lack of desire but rather due to differences in approaches and lack of a priority given to the alignment of inter-regional approaches. Stakeholders consulted as part of this study note that divergent viewpoints among ecosystem participants made it difficult to agree a common vision for MaaS and operationalise it in a meaningful way across the different Belgian regions.

The MaaS Foundation Document would tackle these shortcomings, but the challenge of reaching full agreement will likely endure in the short term. This does not prevent the development of this foundational document: to the contrary, the MaaS Foundation Document offers an opportunity to clearly identify consensus and differences of views that help focus future discussions. It should be a living document, updated regularly (e.g. once every two years) to reflect the current state of positions. As such, it could be structured around a set of foundational statements for each of which each of the four jurisdictions indicate whether they opt-in, opt-out or withhold until the next update.

The ongoing interfederal MaaS working group on communication and terminology (see: "Current approaches to MaaS in the BCR"), led by Flanders, may kick start the discussions around this MaaS Foundation Document. The working group could tackle key themes listed here to reach a first actionable definition of MaaS that would cover: desired outcomes, associated functions, components, stakeholders within the ecosystem, and governance frameworks. This definition could be developed and elaborated in the MaaS Foundation document. This document could be created under a cooperation protocol, before the official creation of the MGA (see Recommendation 1)

Box 5. "6 minimum principles to be MaaS-ready" and the future code of conduct

The ITS Steering Committee received a mandate from the ECMM to develop a template for a code of conduct, in consultation with MaaS providers and mobility service operators. In discussions with the ITF, the ITS Steering Committee highlighted that the interfederal code of conduct should provide guidance to local authorities but should not displace regional initiatives. The interfederal code of conduct and any regional code of conduct should complement each other.

As of May 2024, work on this code of conduct is ongoing. Six minimum principles have already been shared following discussions with public transport operators and private mobility services operators (its.be, 2023):

Governments (municipal, regional and federal) should:

(i) "Follow-up and help apply the principles that MaaS providers and mobility providers have signed up to"

Mobility providers, both public and private, should:

(ii) "Provide access to data" about their offer, as well as trip data.

(iii) "Provide access to services (e.g. to tariff products)".

(iv) "Commit to non-discrimination in co-operation with MaaS providers".

MaaS providers should:

(v) "Provide access to (…) multimodal trip data (to authorities for planning purposes only)"

(vi) "Commit to non-discrimination in co-operation with mobility providers".

In the future, the code of conduct should suggest measures to ensure a continuity of services at the national level and define obligations in terms of data sharing, customer service and service availability. It should also include recommendations on how results should be presented to users in terms of environmental impact, latency and schedule, accessibility, cost and comfort. Finally, the code of conduct should offer recommendations and principles regarding data portability.

Source: (SPF Mobilité, no date).

The MaaS Foundation Document would constitute a novel approach to the collaborative development of a MaaS ecosystem. There is no example of an existing, entirely similar document. Yet, the European Health Data Space proposal, developed by the European Commission, offers a helpful indication of the level of precision necessary to ensure that definitions and principles may be used by a wide variety of stakeholders to develop innovative solutions together. The EHDS proposal document provides a detailed and thorough description of what the EHDS should look like, who will be the key stakeholders involved in its governance,

who will be the data users and what member states should do to develop their health data spaces. This sound and precise grounding has allowed this complex and challenging project to develop swiftly.

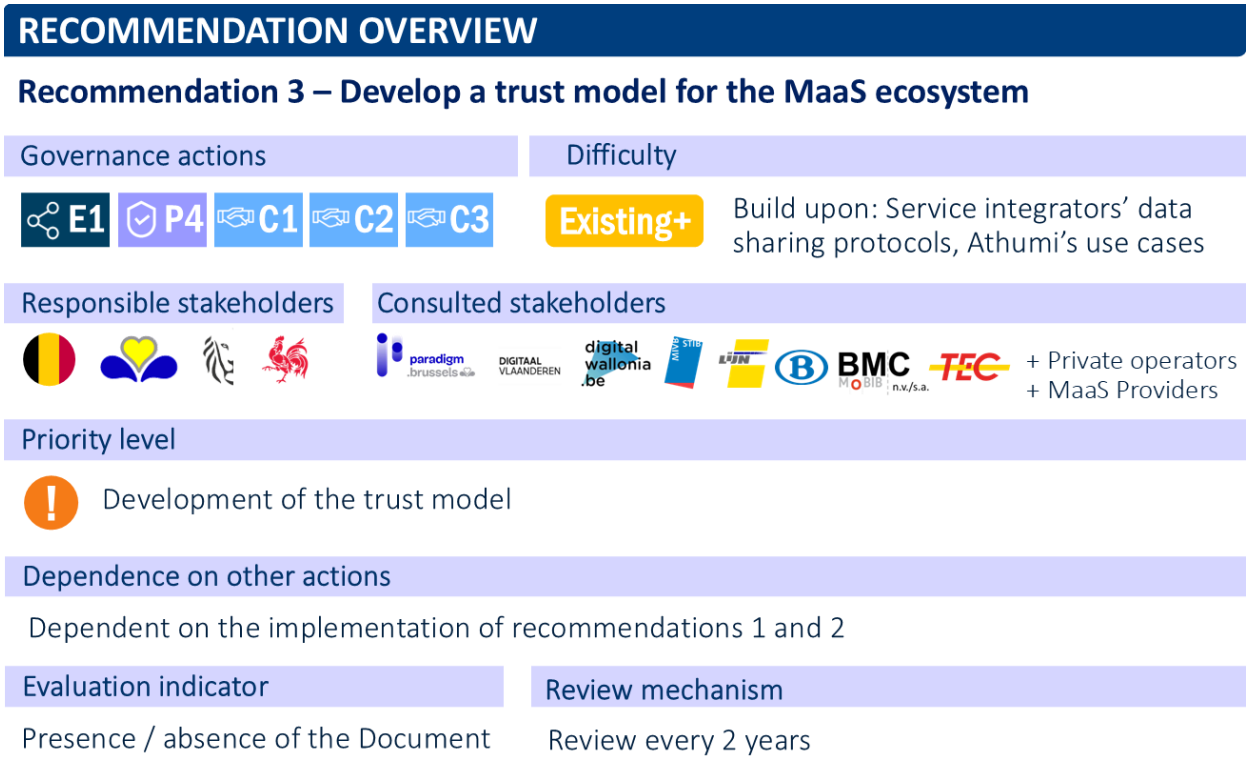
In practice, how should this MaaS Framework Document be developed, maintained, revised and evaluated? All four mobility authorities would own the MaaS Foundation Document; it would be signed by representatives from the three regions and the Belgian state. The four governments would oversee its development, sign it, and ensure it is regularly revised and evaluated. Before the creation of the MGA (see Recommendation 1), this could be organised by an interfederal working group. Alternatively, the ITS Steering Committee could be tasked with the development of the MaaS Foundation Document. The MaaS Network Coordinator, which could be created promptly via a protocol, could offer a support role and ensure that all relevant parties are consulted; the MaaS Foundation Document could further detail the role of the MNC.

Once the MGA is created, it would be in charge of organising the MaaS Foundation Document's evaluation and recurrent revision. Evaluation should be conducted by an independent third party, contracted by the MGA. The MNC would actively work with this neutral third-party. The evaluation should assess: (1) whether the relevant regulations, policies and public service contracts at the federal and regional level are aligned with the MaaS Foundation document; (2) whether the vision and principles set out in the document are still up to date; (3) whether its representation of stakeholder consensus and disagreement is still accurate; (4) whether new functions or clauses may be needed to reflect evolutions in the market or in EU policy.

This evaluation could, in the future, be conducted together with that of the trust framework (see recommendation 3). Based on the evaluation of the results, the MGA would organise the revision of the document; the revised version would need to be approved by all four mobility ministers. The revision process could be coordinated by the MNC, who will ensure that stakeholders not represented through the MGA (PTOs, MSOs, MPs) are duly consulted.

The development of MaaS in Belgium rests on a network of stakeholders of different nature (public, private, public-private), with different forms of expertise and priorities, working in a constantly evolving field. Significant flexibility is required by all stakeholders to ensure that their collaboration process delivers the innovations MaaS requires. This report recommends that the MaaS Foundation Document should enshrine the model of a flexible and dynamic governance. Beyond the thorough evaluation which may be conducted every two years, mechanisms should be created to allow ad hoc revisions, as long as they are agreed upon by all four mobility ministries represented in the MGA. This implies continuous communication, sharing of information, sharing of skills, and revisions of all guidelines and resources issued by the MGA, which are all tasks the MNC would be ideally suited to carry out. This will require a commitment to stable resourcing and staffing necessary to sustain the collaboration process.

Recommendation 3 - Develop a trust model for the MaaS ecosystem



Data sharing creates the foundation for MaaS: without the sharing of data between stakeholders within the MaaS ecosystem, the MaaS market cannot function (ITF, 2023). This collaborative data sharing effort among stakeholders – some of which may be competitors – can only be enacted if they trust each other and the outcomes data sharing enables. Interviews with key stakeholders within the Belgian MaaS ecosystem revealed concerns regarding expansive data-sharing in support of MaaS. Indeed, a number of mobility operators noted a trade-off when deciding on whether or not to share data with a MaaS provider. On the one hand, this could expose them to greater competition for the same rides as customers are presented with a variety of options from competitors. On the other hand, MaaS may generate new rides by facilitating access to services and creating new intermodal use cases (Carballa Smichowski, 2018).

Once the MaaS Foundation Document is established, the MaaS ecosystem trust model should be developed. A trust model is a set of agreed-upon rules and norms, supported by technical building blocks (see recommendation 4), that allows data to be shared in a way that ensures the sovereignty of data holders and the security of data exchanges. Trust models seek to answer the following questions: is an actor who they say they are? Can they be trusted with personal or sensitive data? Can their data and affirmations regarding their use of data be trusted?

Enabling stakeholders to retain their data sovereignty is a key way to create and maintain trust among different actors. When data owners retain sovereignty over their data, sharing personal or sensitive data becomes an option.

An effective way to ensure that stakeholders retain their data sovereignty is to build a distributed data ecosystem, that is, one in which all data remains with the data owner[1], but all data owners are federated and agree to similar rules regarding data access, data use, service integration, customer service, redress mechanisms. This contrasts with a centralised ecosystem, where all data is pooled on a single platform with a single manager, and a fully decentralised system, in which data also remains with data holders, but no common rules and protocols are agreed upon (International Data Spaces Association, 2023). This is the guiding principle of the forthcoming EU Mobility Data Space, which will "offer a framework for interlinking and federating many different transport-data ecosystems". In the EU Mobility Data Space, "data will continue to be maintained with data space participants or in the domains and databases that are already governed by public or private stakeholders at EU, national, regional and local level" (COM(2023)751).

BOSA provides an example of how secured data sharing can be organised among a range of vetted stakeholders (public authority, in the case of BOSA). Should a Belgian municipality need information held by a federal service (e.g. the national register) to deliver one of its policies, it can request the data from BOSA who will, in turn, query the national register and pass on the results of the query to the municipality. Depending on the request and context, this may take the form of a data transfer, partial database access or the establishment of webservices or API access. BOSA's role is to evaluate the legitimacy of the request and, once access rights to that data are established, seek and return the data from data holders to the vetted data consumer. In doing so, BOSA does not store the data; the data remains with the institution responsible for it (as such, it prefigures the role of the data intermediary established in the EU Data Governance Act). Institutions that apply for data access through BOSA agree to the rules BOSA follows to evaluate the legitimacy of the request, as well as to the way data will be transferred should this request be granted.

BOSA stresses that data exchanges between public institutions imply three key stakeholders. First, the data owner - that is, the authentic source - who collects the data, keeps it, ensures that it is available and that it is of quality. Second, the stakeholders who ensure secured and uniform data exchanges; in Belgium, there are six of these so called "service integrators". Three of these are regional service integrators: the Crossroads Data Exchange Bank (*Banque Carrefour d'Echange de Données* or BCED) for Wallonia, *Informatie Vlaanderen* for Flanders, and FIDUS for Brussels. The remaining three have a nation-wide mandate: *e-gezondheid*: the national eHealth service portal; the KSZ / Crossroads Bank for Social Security (*Banque Carrefour de la Sécurité Sociale* or BCSS), federal service integrator for social policy; BOSA, the integrator of federal services (except for social security matters). Service integrators are the sole contact point between data owners and data receivers and ensure consistency both in terms of technical standards and governance (agreement, data quality). Finally, the third type of stakeholder is the data consumer, which uses the data they receive for their own applications.

The example of BOSA shows that distributed ecosystems - in which data owners retain sovereignty over their data - already exist in Belgium. Data flows through the distributed infrastructure of service integrators everyday.

This report recommends establishing a trust model encompassing two key functionalities to facilitate the emergence of a distributed MaaS data ecosystem. First, the trust model should grant stakeholders the ability to specify to what end, and by whom, their data may be used, along with the ability to verify these uses and users. This may take the form of contractual measures as discussed in this recommendation or involve technical measures as outlined in recommendation 4. Second, the trust model should define key

1 The European Health Data Space proposal refers to data owners as data subjects who own data about themselves and have rights associated with this data ownership. The GDPR, on the other hand, refers to data subjects who may not necessarily own their data but would still have rights with respect to the ways in which this data is used.

principles that will guide how these rights, responsibilities and roles are established and audited. These principles will need to be developed by the MGA to ensure that the distributed MaaS ecosystem is operational (see recommendation 4).

The governance component of the trust framework should provide clear and detailed information on the following:

- Which type of data may be shared within this ecosystem? For what purpose?
- Who can access this data? Who verifies eligibility to access?
- Under which conditions can data be accessed? Who vets stakeholders and grants access?
- How can interoperability be ensured? Which actions will the MGA take in the future?
- How can data be used once it is shared? Who monitors its use and compliance with rules?
- How are customer relations managed?
- Who is in charge of resolving conflicts?
- How will revenue from the activity be shared among mobility services operators (may they be public transport operators or private service operators) and MaaS providers?

In the proposed framework, the MaaS Governance Authority only represents the four transport ministries and not the public transport operators and other public and private mobility service providers. This setup ensures that those who shape the MaaS ecosystem's guiding principles do not have a vested interest or market advantage to protect. Neutral third parties play a key role in ensuring the trust necessary for effective data sharing. This has been recognised by the Flemish government, who decided to create a public data utility company, Athumi (Box 6). The MGA could play a similar role of public sector led, interfederal, neutral third party in charge of creating the right conditions for data sharing. Once a cooperation agreement is signed and the MGA is constituted, it could ensure that the rules set out in the trust model are enforced.

Box 6. Athumi, a neutral third-party to foster data sharing

In 2020, the Flemish Government announced its ambitions to establish a neutral third party to foster data sharing between actors across sectors of the Flemish economy (Flanders Region, 2020). The Flemish Data Utility Company (FDUC) was established by decree in December 2022 as a lever to stimulate data sharing between stakeholders such as companies, governments, and citizens (Flemish Government, 2022b). It was commercially launched under the name Athumi in May 2023.

Athumi is a public company that supports data collaboration by fostering trust among partners. Indeed, Athumi has singled out lack of trust as the key barrier preventing data sharing-based projects from scaling: while the technology is mature, data holders are still wary of entering data-sharing agreements with partners – or in some cases, competitors. Athumi presents itself as "bound by a statutory mandate to process personal and sensitive corporate data in a smart and secure way, ensuring that all who share their data through our services and partners retain full control and transparency" (Athumi, no date). By working with Athumi, institutions and companies can ensure that the data sharing project will comply with all relevant regulations, and that it respects the interests of all project partners. In practice, Athumi provides support to develop the business case, define project governance (e.g. data sharing agreements), design data sharing architectures and define interoperability principles.

Depending on the business case, Athumi may support either centralised data-pooling platforms or API-based approaches that expose data to vetted actors while also enabling the data to remain with the entity that produced it. API-based approaches are well-adapted for applications requiring the sharing of personal data and/or commercially sensitive data as in the case of MaaS.

Source:(Athumi, no date; Digitaal Vlaanderen, 2022)

Private and public stakeholders bring complementary knowledge, skills and resources to the table. Therefore, for the MaaS ecosystem to develop, private stakeholders also need to be involved in this collaboration process.

To maximise trust, additional consultation mechanisms should be envisioned to make sure private mobility service operators, MaaS providers, and public transport operators feel represented in the trust framework. Past structured consultation efforts, such as the Flemish MaaS Agreement framework (Box 7) represent a valuable resource to structure further work with mobility service operators and MaaS providers. Future consultation efforts should be adapted to ensure that they advance dialogue and trust within the MaaS ecosystem. Such a structured consultation could take several forms: first, formal consultation mechanisms (surveys, workshops) should be organised. Second, the trust framework itself may establish a role for these stakeholders via through an advisory group. For instance, according to the "Multiple Eye Principle" (Huber Monika *et al.*, 2022), different partners may conduct different evaluations following the same protocol; a central body, such as the MGA, is then in charge of "ensuring the comparability and quality of all conducted evaluations" (ibid). Such a collective vetting mechanism could be implemented, for instance, to verify participants' identity and eligibility to access the ecosystem.

Box 7. Structured consultation of mobility service operators: the example of the Flemish MaaS agreement framework

The best way to ensure trust within the MaaS ecosystem is to involve its stakeholders and allow mobility operators and MaaS providers to shape the regulations that will govern their operations. This is what the MOW endeavoured to achieve with the MaaS agreement framework in Flanders. This document resulted from a multi-year co-creation process between the MOW and MaaS market stakeholders. MOW consulted five groups of actors: users, local authorities, mobility operators, MaaS providers, and data platforms. As part of the initial phase of the process, consultations identified "minimum quality requirements" that stakeholders considered necessary to foster collaboration within an open MaaS market (MOW, 2021). Within the framework's scope, all stakeholders committed to drawing up a data governance framework which defines data access, sharing principles and handling rules (e.g. what data is shared, with whom, for what purpose, when, for how long, with which users). The need for clear guidance on this point also emerged from this MaaS agreement framework process, as it did from stakeholder consultations conducted as part of this study. A similar consultation process could be implemented during the trust framework's development; the MGA would have a final say on what is included within the document.

Source: (MOW, 2020).

Data about users' behaviour is a resource for public and private mobility service operators. Certain public transport operators have expressed concern about losing the capacity to infer knowledge about their users if tickets are sold by a third-party operator. For instance, one Public Transport Operator (PTO) notes that when selling a combined ticket, the company gains extra insights about that customer's mobility needs; if the combined travel product is bundled and sold by a third-party, the knowledge on the other leg(s) of the trip is lost for that particular PTO. This can have an impact on how decisions are made regarding improvements made on the network to accommodate customer needs. MaaS operators may voluntarily decide – or be required – to share some data with mobility operators, as this would create reciprocity and build trust.

The trust model should be evaluated and, if needed, revised regularly to ensure it remains efficient (e.g. every 2 years).

This recommendation may guide the work of the interfederal MaaS working group on regulation (see "Current approaches to MaaS in the BCR"), led by Wallonia: any regulatory effort will need to rest on clear and transparent organisation principles for the ecosystem.

Recommendation 4- Providing building blocks to support the implementation of the trust model

RECOMMENDATION OVERVIEW

Recommendation 4 – Building blocks to operationalise the trust model

Governance actions	Difficulty Dependent on the building block
E1 E2 P3 P4 C1 C2 C3	Existing Existing+

Responsible stakeholders	Consulted stakeholders
	paradigm .brussels, DIGITAAL VLAANDEREN, digital wallonia .be, BOSA FOD Beleid & Ondersteuning SPF Stratégie & Appui

Priority level
Dependent on the building block

Dependence on other actions
Dependent on the implementation of recommendation 3

Evaluation indicator	Review mechanism
Presence / absence of each block	Building blocks should be continuously updated

Establishing trust requires policies outlining the respective roles of stakeholders as well as the technical mechanisms to ensure their enforcement. For instance, verifying that a data user is who they say they are implies a digital identity and an authentication process to ascertain their identity. All the elements that comprise the trust model (see recommendation 3) should be matched with technical building blocks and processes. In line with the role set out for Data Space Governance Authorities (DS4Skills, 2022), the MaaS Governance Authority would be responsible for enabling trust via its actions and roles. This implies providing the technical building blocks that operationalise the trust framework.

Table 1 illustrates the pairing of trust model functions with associated building blocks. They are illustrated with examples from case studies and ranked according to their priority level – in other words, how early in the stage of ecosystem development they should be delivered. Functions that need to be delivered as early as possible – basic components of the trust model – have a priority level of 1. Functions that foster trust but are not pre-requisite to collaborative work have a priority level of 2. Functions that would imply reforms or innovations and may thus not be delivered right away have a priority level of 3.

Table 1. Trust model functions and technical building blocks

Function within the trust model	Technical building block	Example
Verify that actors are who they say they are	Digital identity: data that represents a stakeholder's identity online. Difficulty level 1 Existing	In 2014, the eIDAS regulation established an EU-wide framework for official electronic identification enabling electronic transactions and underpinning public services. In Belgium, two systems are commonly used. First, eID, the Belgian digital ID card, managed by BOSA. It allows to prove one's identity, nationality and age, as well as to electronically sign documents. Second, itsme, a solution provided by the private sector. The revision of the eIDAS regulation (eIDAS2), originally adopted in 2024, introduced the EU Digital Identity Wallet. This EU Digital Wallet aims to enable people and businesses throughout Europe to store, present and otherwise manage electronic identification, authentication and trust services irrespective of where and by whom they are issued, as long as they meet the eIDAS requirements. This should ease the portability of digital identity. BOSA is developing the digital wallet for Belgium.
	Authentication mechanism: a process through which a stakeholder's identity can be verified. Difficulty level 1 Existing	Authentication mechanisms can take several forms, from basic username and password mechanisms to token-based solutions (a legitimate stakeholder issues a token to a vetted stakeholder that allows them to access the ecosystem). BOSA has developed the "Federal Authentication Service", or FAS, which allows individuals to prove their identity to access secured public service platforms. FAS offers three levels of security, depending on the sensitivity of the information accessed: (i) the username and password system; (ii) the username, password and token system; (iii) the eID and pin code system. The FAS service can be adopted by any public institution in Belgium, with BOSA's support.
Making sure data can be found	Index of metadata: a list of all data accessible through the ecosystem. Difficulty level 1 Existing	The European Health Data Space project plans for a rich, clear and indexed metadata catalogue with persistent identifiers so that authorised actors can find health-related data. This data space will contain all the information regarding data stored by health data bodies in the EU. It will also provide information regarding data quality through labels, which will be developed as part of a "Data quality and utility framework". The EU-level data catalogue will be populated by national-level health data bodies, which are responsible for making data findable through sharing information regarding the available datasets. To facilitate the discoverability of data, they should establish a metadata catalogue which will contain information concerning the scope of the dataset, its source, characteristics and access conditions. BOSA keeps a registry of all data held by authentic sources and other government sources on its website (BOSA, no date c). This catalogue lists all data holders, the data they hold, and the relevant service integrator to contact in order to access this data. It is possible for users to find data either by institution or by data type.

Function within the trust model	Technical building block	Example
		Delegated Regulation (EU) 2017/1926 multimodal travel information services (MMTIS) set out an obligation for transport authorities, mobility operators, infrastructure managers and transport on-demand mobility service providers to make data accessible via a national access point (NAP). The Belgian NAP offers a metadata catalogue. In Brussels, Paradigm is piloting its "governance hub", a metadata catalogue developed in partnership with other institutions of the Brussels-Capital region around pre-identified use cases. This catalogue will ease data exchanges between public administrations, and extend the OnlyOnce Principle by ensuring that different public administrations do not collect, produce or purchase the same data.
Making sure data is accessible to authorised stakeholders	Standardised protocols to retrieve data, including allocating or granting rights and giving access to stakeholders with rights Difficulty level 1 Existing	In the context of the European Heal Data Space project, HealthData@EU will act as the European-level data access infrastructure by connecting the different national-level health data spaces. Article 52 of the EHDS proposal defines the authorised participants of the platform, namely health-related entities that use health data for research, policymaking, patient safety, statistical work, or regulatory purposes. Other entities are required to submit an access application to a national contact point indicating the intended use of health data with the requested data. BOSA also implements standardised protocols to retrieve data. Eligible data consumers - that is, public institutions or organisations with a general interest mission (BOSA, no date b) – may fill in an online form to request access to existing web services. BOSA processes these requests following both administrative and technical steps. On the administrative side, BOSA checks whether the applicant is eligible, issues authorisation prepares a data use convention and checks whether the applicant has the capacity (e.g. skilled staff time) to follow this convention. On the technical side, BOSA checks whether the applicant is able to connect to the relevant servers and services, has appropriate security certificates, and then sets up the connection and tests it (BOSA, no date a).
Enabling data flows	APIs Webservices Difficulty level 1 Existing	One of BOSA's key task is to facilitate data sharing among federal institutions. Its "Federal Service Platform", or FSP, consists of a uniform set of web services, following the same norms (SOAP, REST ftp), that allow data to flow between data holders and institutions that may use this data. BOSA is currently working on standardising addresses in Belgium through the BeST project (BELGIF, 2022), a pilot that aims to open data access to the private sector in the form of APIs. No personal or sensitive data will be transferred via these APIs, as the addresses will not be linked to occupants' or owners' identities. However, a similar infrastructure of APIs, combined with the right identification and authentication mechanisms, could be developed to support the development of MaaS.
Ensuring interoperability	Semantical interoperability: common definitions of terms used in datasets Difficulty level 1 Existing	The Open Standards for Linked Organisations (OSLO) is a semantic model created in Flanders. It laid out the basis for a shared vocabulary and standardised terms that enable digital data exchange for contact information management, localisation, and public services. The project was initiated in 2012 by the Flemish ICT agency, Digital Flanders. OSLO-Mobility is the mobility component of the OSLO semantic model that was first introduced in April 2020. It provides a common vocabulary for sharing data related to people's trips and the mobility services they use. OSLO-Mobility includes lexicons for traveller information, trip information, booking actions, network description, operator service supply, and license-related information.

Function within the trust model	Technical building block	Example
	Schematical interoperability: similar structure and organisation of datasets so that they can be mapped onto each other Difficulty level 1 Existing	The MMTIS Delegated Regulation specifies that existing European data formats should be used (NeTEx, DATEX, etc.) wherever possible to establish strong interoperability. The Delegated regulation also requires Member states to adhere to a common minimum EU profile for each standard in order to allow cross-border basic functionality.
	Full interoperability: all stakeholders use the same data syntaxes Difficulty level 3 Existing	Under the EHDS framework, member countries and healthcare providers are required to make certain data categories available under the European Electronic Health Record Exchange format (EEHRxF). European Commission (2018) defines the basic health information that should be contained in the structure of the record. It should contain information regarding patient summaries, prescriptions and dispensations, laboratory results, medical imaging and reports, and hospital discharge reports. It sets interoperability requirements in terms of clinical information and content representation, recommending specific standards. Requirements follow existing guidelines to establish cross-border health infrastructure
Ensuring services can be operated across boundaries while respecting the relevant local regulations	Machine-readable regulations: policies, legislation and rules written and issued directly in computer code in order for them to be used natively by algorithms or other forms of code-based computational systems Difficulty level 2 Existing	The Mobility Data Specification (MDS) is an example of a machine-readable regulation approach relevant to MaaS ecosystem stakeholders. The "Policy" API establishes a mechanism for public authorities to directly convey to mobility operators, and others, the rules relating to where and how their services may operate. The Policy API also enables real-time enforcement of those rules, should providers schedule a call to Brussels Mobility's API (PULL request). Such rules may pertain to the extent of the service allowed at any time (how many vehicles may be operating), where operations are allowed and under what conditions (e.g. pick-up and drop-off zones, speed restrictions, access fees, etc…). The rules could also serve to determine trip- or zone-specific payments and subsidies. The Policy API principally targets mobility operators but MaaS providers would also need to use it to ensure that the blended trip options they offer comply with rules and regulations. In Brussels, all providers have access to the policy API to implement drop zones and speed limit zones.
Ensuring data is used in a way that is aligned with rules set by the MGA	Machine-readable regulation (Box 8)	The MDS Policy API could be used as an inspiration to create a data-regulation API, that would ensure that data user respect rules set by the MGA.

Function within the trust model	Technical building block	Example
	Difficulty level 2 Existing+	
Monitoring the ecosystem	Interoperability requirements for reported data Difficulty level 2 Existing	MDS establishes a common syntax for reporting data about transport services (in version 2.0, these include shared micromobility, car-sharing, taxis/ride-sourcing and delivery bots) to public authorities. MDS's data reporting syntax also allows operators to share data regarding their services with other stakeholders (e.g. MaaS providers) and the public (via Apps and other user interfaces). In particular, the MDS Provider API can be implemented by mobility service operators to share historical data (vehicle status, trips start and end) with the authorities. The MDS Metrics API can then be used by the authorities to compute metrics/KPIs from the data shared by providers in a standardised manner. Brussels Mobility is implementing a thorough data reporting framework. Specific standards are recommended but not imposed, except for the requirement for dockless micromobility service operators to report data through the MDS Provider API. Brussels Mobility is currently working on developing a list of standardised indicators and semantics which could be referenced in its mobility regulations.
	APIs monitoring Difficulty level 2 Existing	Brussels Mobility receives some reported data from mobility service operators via APIs. In some cases, data is reported almost in real time. For instance, Villo shares information about the status of stations (open/closed; number of bicycles available; number of free docking spots) via an API that is updated every 10 minutes.
Revenue sharing model	Sharing of transactional data Difficulty level 2 Existing+	BMC ensures the technical implementation of combined fare products and coordinates the data sharing that sustains them. It is also tasked with ensuring that the clearing of revenues between PTOs can be enacted. While details of these activities are not publicly available, working with BMC could help develop this building block.

While the MGA may need to develop certain building blocks – or entrust another stakeholder or third party to do it – a wide variety of existing solutions are already available in Belgium. This report recommends turning to these existing solutions, especially to those already implemented by authorities represented within the MGA either within or outside of the transport and mobility sector where appropriate (see also recommendation 8 about the Only Once Principle).

In line with the principle of flexible and dynamic governance, these building blocks should be continuously re-evaluated, updated, and changed if needed. This would imply regular monitoring of progress in the MaaS and other sectors. The MNC would play a key role in this regular monitoring.

Box 8. Machine-readable regulation and the MDS Policy API

As mentioned in "Principle 1 – Treat mobility data as foundational infrastructure", machine-readable regulations are comprised of policies, legislation and rules written and issued directly in computer code such that they can be used natively by algorithms or other forms of code-based computational systems. Machine-readable regulations ensure that whenever a computer system or software needs to comply with rules issued by public authorities, they can access these directly in a way they can immediately read and use. This avoids increasingly common situations where public authority rules and regulatory intent are written in human language in analogue form and then interpreted and transcribed by third parties into computer code.

Directly issuing machine-readable regulations avoids situations where rules, policies and legislation interpreter by third-parties may be incorrectly encoded or out-of-date. Establishing a single, authenticated digital source of regulations (e.g. such as a public authority application programming interface – API) allows any stakeholder needing to reference government regulations or policies in their computer systems to point to a single API which is maintained and updated by public authorities in real-time. This avoids situations where updates to rules or policy changes involve re-interpretation and updating by multiple parties across multiple systems. For these reasons, public authorities have already begun to issue rules in both human-readable and machine-readable language in health care, banking, building regulations and the transport sector.

The Mobility Data Specification (MDS) is an example of a machine-readable regulation approach relevant to MaaS ecosystem stakeholders. MDS is an open-source and public authority-led data specification that standardises communication between mobility service providers and other stakeholders with public authorities. It is maintained by the Open Mobility Foundation and is used by hundreds of operators and authorities around the world.

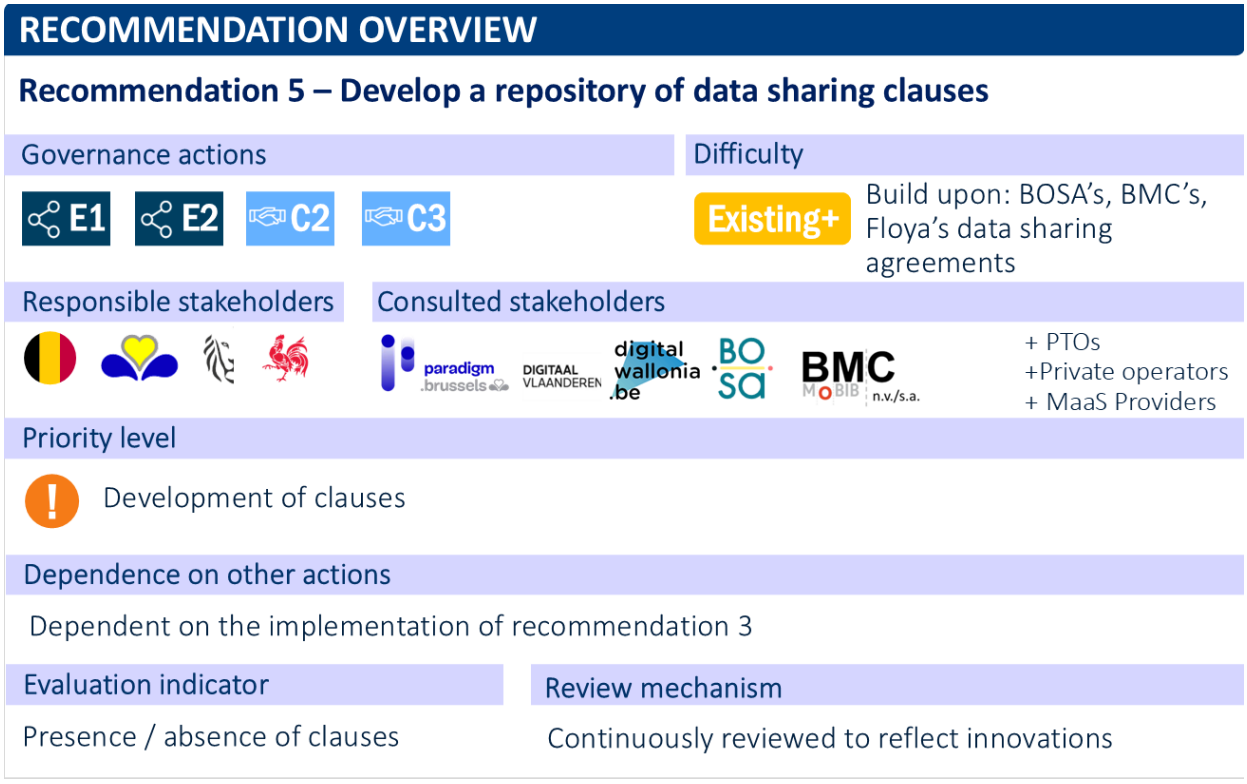
Among a variety of other functions, MDS includes three API endpoints that enable public authorities to communicate their regulatory intent via machine-readable rules and supporting information. The principal one of these is the "Policy" API that establishes a mechanism for public authorities to directly convey to mobility operators and other rules relating to where and how their services may operate. The Policy API also enables real-time enforcement of those rules. Such rules may pertain to the extent of the service allowed at any time (how many vehicles may be operating), where operations are allowed and under what conditions (e.g. pick-up and drop-off zones, speed restrictions, access fees, etc…) and could serve to determine trip- or zone-specific payments and subsidies. The Policy API principally targets mobility operators but MaaS providers would also benefit from access to the API to ensure that the blended trip options they offer comply with public authority rules and regulations.

The "Geography" and "Jurisdiction" APIs provide additional information which help inform the applicability of rules coded into the Policy API. Geography establishes common and official geo-spatial referencing for regulations (e.g. a parking spot, a fare zone, a street network, etc). The Jurisdiction API establishes an analogous common and official referencing relating to which authority has regulatory responsibility for different mobility services across multiple jurisdictions.

MDS's machine-readable regulatory APIs facilitate a common and real-time approach to regulating mobility services, enable MaaS providers to ensure they are presenting offers to travellers in compliance with public authority rules, help facilitate public authority monitoring of the MaaS ecosystem and ensure consistency in mobility service and MaaS regulation across multiple jurisdictions.

Source:(ITF, 2023; Open Mobility Foundation, 2023)

Recommendation 5 - Develop a repository of standard and agreed data sharing clauses setting out clear requirements and strategies to mitigate risks



Today, agreements regarding the integration of public transport or other mobility services into MaaS solutions occur on an ad hoc and non-standardised basis. Stakeholders consulted as part of this study mentioned that this entails high transaction costs linked to the time and effort required for bilateral negotiations, mapping systems to each other and accomodating inconsistent requirements. Creating consistency in data sharing requirements would address these transaction costs and, in turn, would make participation within the MaaS ecosystem more attractive to all parties. It would also create more certainty and predictability for public transport operators and mobility service operators who would know how and where to focus their investments.

Such standardised data sharing agreements are already used by service integrators in Belgium. In order to rely on BOSA as a service integrator, data users must agree to the "federal service integrator user agreement" which forms the basis of their contract with BOSA. This agreement requires them to respect a number of data usage requirements, but also to conduct confidentiality audits of their data and data use. This existing process can serve to inspire the development of MaaS-relevant standardised data sharing clauses.

This report recommends that the MGA, in consultation with all stakeholders and with the support of the MNC, should develop a repository of standard and agreed upon data sharing clauses. These clauses should set out clear data sharing requirements, identify risks, and define strategies to mitigate these risks. They could be referred to in legislative acts regulating mobility services such as ridesourcing, taxis, micromobility, on-demand services and public transport service contracts. Establishing these clauses supports the principle of flexible and dynamic regulation outlined in the MaaS foundation document. These clauses should regularly be revisited and updated, as necessary. Where they cover technical or other

parameters that are likely to change over time, they should be referenced by, but not included in, implementing ordinances and regulations.

These standard data sharing clauses should set out the respective roles and responsibilities of data owners and data users addressing the following topics:

- Which types of data – such as informational, operational and transactional data – need to be shared to deliver which functionalities (ITF, 2023)? What is the minimum scope of data that should be shared to deliver these functionalities, for each type of data?
- What are the risks associated with sharing these different types of data? Who bears this risk?
- What mitigation strategies should be adopted to address those risks and ensure that data holders retain sovereignty over their data? Who oversees the implementation of these mitigation strategies?
- Who can data owners turn to if a conflict emerges with the entity that received their data?
- How should this data be shared to ensure interoperability?

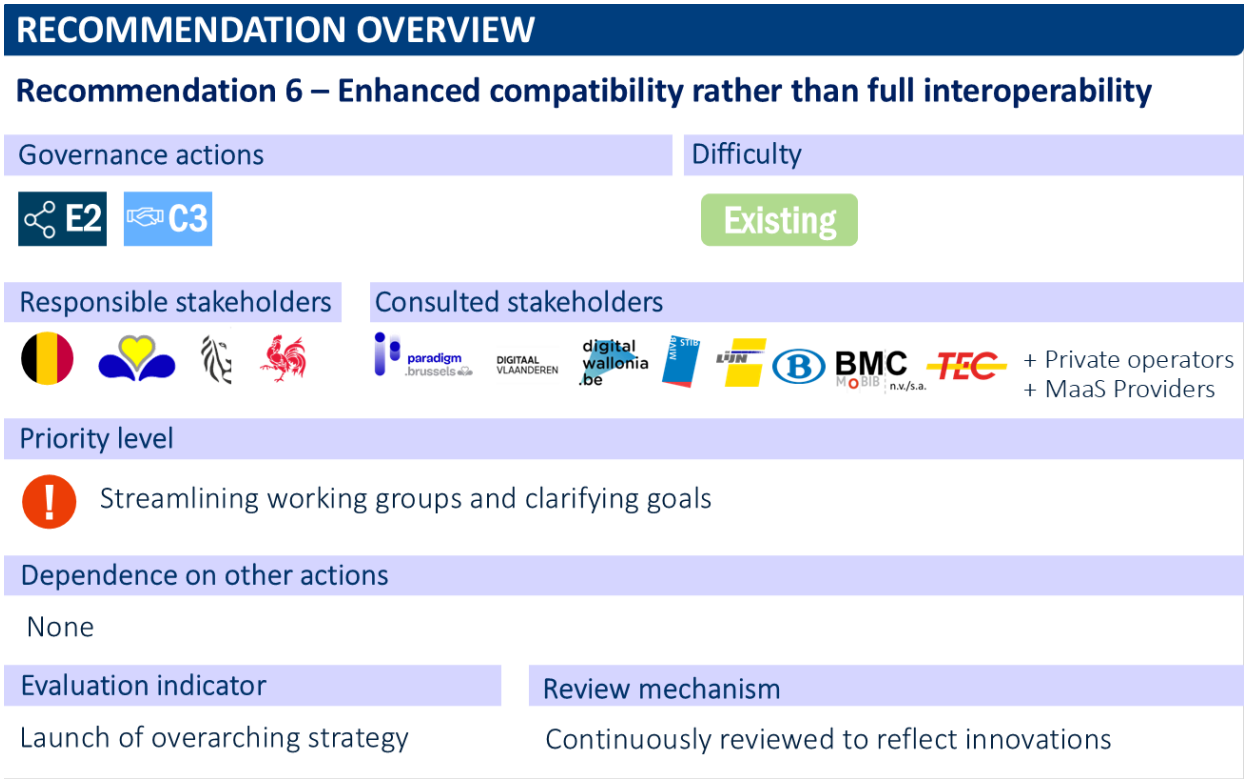
Table 2. Different types of data and example of associated functionalities

Type of data	Example of functionalities	Perception of commercial sensitivity by data owners
Informational General information on transport services (e.g. availability, location of stops, schedule, cost, etc.)	Trip planning Design of combined mobility offers Communication about these combined mobility offers	Low sensitivity
Operational Data enabling or supporting the operational delivery of the mobility service	Locking / unlocking shared vehicles Enabling gate or turnstile access Confirming status at validators Terminating a shared vehicle trip	Medium to high sensitivity
Transactional Data about and allowing purchases	Purchasing tickets through a third-party app Redistributing revenues among service providers	High sensitivity

Source: Mix and MaaS (ITF, 2023)

A detailed data sharing clause may reassure data owners that they will maintain their sovereignty. This data sharing clause, in turn, will be necessary to ensure there is enough trust for even competitors to share data.

Recommendation 6 - Work on enhanced compatibility rather than full interoperability



Interoperability – the ability of different services to work together – is thus key to the development of MaaS. As revealed in the diagnosis (ITF, 2024a), it is one of the most actively invested topics by regional and federal stakeholders in Belgium. Nonetheless these important efforts appear to be fragmented, as shown by this non-exhaustive overview:

- An interfederal working group on data harmonisation, led by Brussels Mobility, has been created as part of the strategy to deliver the interfederal vision for MaaS;
- The NAP is also working on interoperability principles for transport;
- BMC has several ongoing projects related to data interoperability. Their work endeavours to improve the interoperability between public transport operators, as well as openness to third parties;
- Brussels Mobility has defined interoperability principles as part of the reporting requirements, imposed on mobility service operators;
- In Flanders, Athumi (the Flemish Data Utility Company) works on interoperability principles across sectors;
- BOSA is involved in a number of standardisation exercises, including in the mobility sector. The ICEG initiative, launched with De Lijn, the Flemish Region, and the FPS Mobility and Transport, worked on standardising data for public transport schedules and stops. It adheres to the OSLO framework described in recommendation 4 (Table 1).

Many policymakers and public transport operators consulted as part of this project have focused on interoperability and, more precisely, "standardisation" (full interoperability) as a priority. This contrasts with private sector stakeholders, especially those already proficient in cross-platform data management, who note that weak interoperability is not a barrier to MaaS development. These stakeholders argue that a number of solutions already exist to ensure different systems may communicate, without requiring full standardisation. Past ITF work has also stressed this point (ITF, 2023): promoting a single data sharing syntax or standard may stifle future innovations and favour certain stakeholders over others. Exposure through well-documented APIs may be sufficient. As argued in the section "Enabling, Protecting and Cooperating: a conceptual framework for the governance of MaaS", working towards harmonisation should constitute the favoured way forward.

Stakeholders within the MaaS ecosystem already benefit from a number of tools supporting harmonisation efforts. First, a wide variety of mobility data standards and specifications already exist (see Groen, Baguet and van Mol, 2023 for a comprehensive review). Many of these are compatible and convertible via interpreters (e.g. GBFS is compatible and convertible to NeTEx/SIRI, GTFS is compatible with NeTEx and SIRI, TOMP-API is built on GBFS and NeTEx but expands these standards). Some frameworks also exist to efficiently map some standards to others (e.g. OSLO). The Data Sharing Coaliation's Data Sharing Canvas proposes to use proxies to connect data spaces. Proxies would translate "data space-specific transactions to their harmonised equivalents, thereby facilitating interoperable transactions and creating and understanding of concepts like trust and security across data spaces" (Bastiaansen, 2022, p. 18).

While interoperability is necessary for MaaS to function, it should be seen as a process of incentivised convergence rather than as one of strict standardisation. Considering the market is still in its early stages, highly incentivising a common and consistent lexicon and facilitating convergence towards similar data schemas makes sense but imposing a single data syntax would risk creating barriers to entry, limiting innovation and imposing an important burden on smaller market actors. A variety of experts in the field (see review in ITF, 2023) recommend rather seeking pivotal points of interoperability and minimum interoperability mechanisms.

Pivotal points of interoperability (PPI) refer to similar concepts and approaches developed in bespoke solutions to address similar problems. They include functionally similar features that can be used as starting points to enhance interoperability. All in all, PPIs refer to a "method for approaching consensus among stakeholders, with the goal of agreeing on 'common ground' in areas of high complexity and diversity" (MaaS Alliance, 2021, p. 21).

Once the pivotal points of interoperability have been identified, minimum interoperability mechanisms - a concept developed by the Open and Agile Smart Cities (OASC) Network (Open and Agile Smart Cities and Communities, 2024) – should be defined. They represent the "minimal but sufficient level of interoperability for data, systems, and services". MIMs offer, for instance, a standardised way to describe the context of the data (e.g. date of collection, date of last update, details about what exactly has been recorded), or models to structure data in a way that facilitates automated exchanges (Valentino, 2019). MIM is not about inventing new semantics, new models, or new standards: where dominant standards already exist, the MIMs would point to their main characteristics. Where there is none, the MIMs would try to reconcile different approaches to offer a "minimum viable product" (Open and Agile Smart Cities and Communities, 2023).

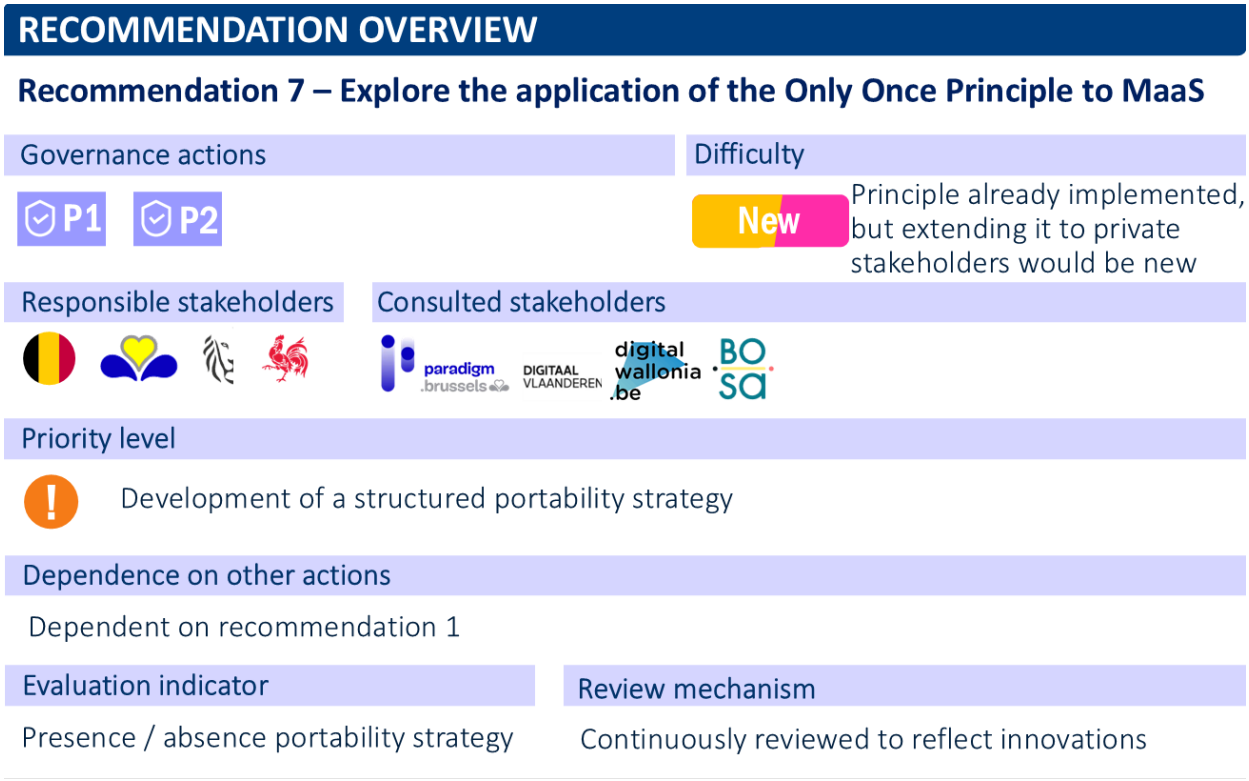
The concept of MIMs has been developed in the smart city sector. A number of MIMs have been developed through the OASC network, tackling different subjects relevant to smart cities such as contextual information management; shared data models for smart city data; personal data management; geospatial information, etc. (Open and Agile Smart Cities and Communities, 2023). MIMs have been formally adopted

by all members of the OASC network, which currently encompasses over 150 cities (Open and Agile Smart Cities and Communities, 2024).

The OASC recommends that these minimum interoperability mechanisms should be led by a public body, who would lead this work within a specific working group that would gather all relevant stakeholders. The MaaS Governance Authority could explore this solution and communicate with stakeholders within the MaaS ecosystem to ensure interoperability barriers are lifted or minimised. It could also take this leading role in developing and implementing MIM, building on the existing interfederal working group on data harmonisation. Principles and formats should be defined through the working group, approved by the MGA, and made available to all stakeholders.

The MaaS Network Coordinator should be in charge of ensuring interoperability principles evolve overtime to reflect the increased maturity of the market, as well as technological evolutions. The Belgian MaaS ecosystem can learn from the EHDS's approach to interoperability: the European Health Data Space Board is in charge of contributing to and sharing best practices about technical specifications, standards, and policies to improve interoperability.

Recommendation 7 - Explore the application of the Only Once principle to MaaS



To provide an intermodal, integrated trip for a customer, information about that customer must be shared among mobility operators and MaaS providers. Such information may relate to the identity or other personal information pertaining to the traveller, which would then allow each actor involved in delivering joined-up trips to ascertain what access rights the traveller may have. Without this data being shared, MaaS users would need to provide the same data to a variety of public transport operators, mobility service operators, and MaaS providers; which would deter from using MaaS solutions. Yet, sharing information about users is challenging, as their privacy needs to be protected to the highest standard.

The question of personal data portability has been extensively discussed and regulated by the EU, if not specifically for mobility. According to the Only Once Principle (EU Regulation 1024/2012 applied through the Only Once Law of 5 May 2014), moral and physical persons within the European Union should only be required to provide information about themselves to public authorities one single time. To implement this Only Once Principle, public authorities have been required to set up the right infrastructure to support the safe sharing of this data. The governance and technical infrastructure to support this has already been developed in Belgium: service integrators like BOSA, BCED or FIDUS (Box 9) organise the safe sharing of authentic data among institutions in Belgium to support requests made by citizens. Administrations are now obligated to ask citizens for an identification number (social security number or national ID number) and use service integrators to retrieve data from authentic sources, rather than asking citizens for the same data again (easy.brussels, 2020).

Box 9. FIDUS

Institutions of the Brussels-Capital Region can rely on FIDUS – a data exchange managed by Paradigm - to connect to authenticated data sources or access personal data held by other services of the Regional Government; FIDUS is responsible for data sharing between authenticated sources and local administrations. It has been developed specifically to manage exchanges between public authority departments including the Public Center for Social Help and public hospitals, but other institutions may also ask to use it as long as they have a legitimate motive for doing so. Institutions apply for access to data from an authenticated source through Fidus. Once access is granted, Fidus opens a webservice allowing real time data access. Access rights are limited to specific and vetted purposes: for example, an institution that has been granted access to car registration data to check whether applicants to car scrapping subsidies are eligible may not use that car registration data for any other purpose than processing applications for subsidies. Data that can be accessed through FIDUS encompasses National Registry data (name, age, sex, household type, home address, etc.), data about registered vehicles in Belgium, social security service data, enterprise identification data, and real estate data (cadastral maps, real estate transaction, property owners, etc.). Data is not centralised by FIDUS, but transits through FIDUS.

Public service integrators not only offer an example of how to manage data portability; they also offer an example of how to ensure that MaaS offers improve alignment with social policies, for example, by easing access to social pricing. Belgian public transport operators offer a wide range of socially priced subscriptions and tickets (see appendix in the companion report “Review of MaaS-relevant initiatives in Belgium”). Many of these offers are associated with a status (child or senior, recipient of social aid, large family, disability, residence) that could be verified using authentic sources: the National Register for ID, age and residence through BOSA, Federal Social Security Services (BCSS) for impairments and handicaps. Planning for a safe, real-time verification of social pricing status within MaaS apps would ease citizens’ access to social pricing, and ensure they remain eligible to adjusted tariffs when they travel across institutional boundaries. This may also encourage commercial mobility service operators to develop offers that are aligned with the public sector social pricing categories.

Evolutions in EU policy open the way towards citizens having greater control over their data. Regulation (EU) 2018/1724 establishes a single digital gateway plans for the development of an EU-wide network of portals to support citizens and businesses in their cross-border administrative procedures. These portals will include systems to transfer the official documents needed to support these procedures in a secured manner, at the request of the applicant.

The secured sharing of personal documents to support administrative procedures will rely on the Only Once Technical System (OOTS), planned in the Single Digital Gateway (SDG) Regulation and launched by the European Commission on 12 December 2023 (European Commission, 2023b; BOSA and European Commission, 2024). This technical system "replaces the need for user to search and download evidence for the sole purpose of re-uploading it in another governmental website" and "embodies the European values of user-centricity and personal control of one's data" (European Commission, 2023b). Rather than requesting the documents from issuing authorities and then transferring them to the authority processing their claim, citizens will now be able to ask processing authorities to request the data needed directly from the issuing authorities while allowing these issuing authorities to communicate this personal data. The Single Digital Gateway will allow them to request this document transfer.

BOSA's Directorate General for Simplification and Digitalisation has been involved in developing and testing the OOTS in 2023 and will onboard all 900 competent authorities in Belgium in 2024 (BOSA and European Commission, 2024). Sixteen partners in Belgium developed the technical infrastructure, the legal framework, and operational procedures (BOSA and European Commission, 2024) underpinning OOTS. The Brussels-Capital Region, Flanders, Wallonia, the French-speaking community, the German-speaking community and the Federal state signed a co-operation agreement to jointly implement the SDG Regulation. Through this project as well as its role as a service integrator, BOSA has developed extensive experience in the development and management of an infrastructure for the secured sharing of sensitive data. This project could serve as an inspiration for the future of the MaaS ecosystem.

Beyond official documents, The GDPR established the right to portability (Art. 20) for data subjects: citizens may request that any stakeholder that holds their personal data transfer it to another stakeholder. The Data Act extends that right to observed data and continuous portability for certain uses.

The Only Once principle can serve as a model for all personal data inputs and transmission within the MaaS ecosystem. Following this principle, users should no longer need to provide their personal information to multiple public transport operators, mobility service operators or service providers more than once. The information covered may pertain to their identity, their eligibility for social pricing, their drivers' licenses, public transport subscriptions, mobility service accounts, or preferences. This information should only be provided one single time and would then exist as a resource for service providers to access in an ecosystem that fully ensures users' privacy.

As argued under Recommendation 3, sovereignty is key to ensuring trust. Similar to service operators, citizens also need to remain sovereign over the use of their data, and to trust that their privacy will be protected. Public authorities can thus play a key role here. The concept of personal data pods, envisioned through the SOLID framework, offers one solution to technically implement this.

The Solid specification, developed by an international, open source and collaborative consortium, "lets individuals and groups store their data securely in decentralized data stores called Pods. Pods are like secure web servers for data. When data is stored in a Pod, its owners control which people and applications can access it" (Solidproject, no date). Solid's "personal data pods" (PDS) disconnects personal data storage from the services using it. The specification is compliant with existing personal data regulations (e.g. GDPR) and provides "a space where individuals can maintain their autonomy, control their data and privacy, and choose applications and services to fulfil their needs" (Solid, 2023). Data within pods use standard and interoperable data formats, allowing users to easily switch between pod providers and share their data with additional service providers (i.e. data portability). The approach relies on a decentralised architecture with personal data storage spaces.

The Solid specification and personal data pods are already used by a variety of stakeholders in Belgium, and in particular in Flanders. The Flemish platform "My Citizen Profile" provides every citizen with a

personal data pod to store administrative data. Through a "My Citizen Profile" front application, citizens can determine who can access their data and for how long. Data remains in the pod: it cannot be copied after being shared on a pod. This approach is also used by Athumi, which has developed its own “Athumi Pod Platform” to support a variety of use cases.

Storing personal data on secured personal data pods would be a way to ensure the degree of portability needed to support the development of MaaS offers truly tailored to the needs of end-users. Beyond this benefit, it could even allow to improve the potential social benefits of MaaS, by easing access to social pricing. To give even greater control to end-users, the principle of “writability”, enshrined in the European Health Data Space, could also be followed: it would allow individuals to add data into their pod. This data could, in the context of MaaS, pertain to their travel preferences.

In line with GDPR, any data portability system would need to ensure that personal data is processed in accordance with the information provided to data subjects (e.g. purpose of the processing, who has access to the data) and not beyond the scope to which data subjects consented.

Recommendation 8 – Enhance fairness and impartiality in the MaaS ecosystem

RECOMMENDATION OVERVIEW

Recommendation 8 – Address power imbalances to encourage participation

Governance actions	Difficulty
C2 C3	New

Responsible stakeholders

Priority level

Launch of interfederal working group

Reform

Dependence on other actions

None

Evaluation indicator

Presence of working group	Trust in ecosystem (stakeholder survey)

The lack of willingness to collaborate, co-operate or share data forms an enduring and significant barrier to the development of an effective multi-stakeholder MaaS ecosystem. Public transport operators and mobility service operators will work together only if there is a business case that is beneficial to both sides. Identifying and shaping such business cases will benefit from the clarity and structure provided by the MaaS foundation document; the coordination, facilitation and governance roles of the MNC and MGA; and the definition and deployment of the trust model. However, one final challenge is the perception among private sector stakeholders that PTOs benefit from an unfair advantage.

As stressed by stakeholders during consultations, power imbalances are inherent to any sector, with some stakeholders benefiting from greater resources, capacity, or experience. However, when some stakeholders believe that others are taking advantage of a preferential position, collaboration may be hampered (Breaugh and Nõmmik, 2024, p. 83).

Public transport service contracts in Belgium rest on the principle of competition *for* the market, rather than competition *in* the market: once the contract is granted, the PTO is the sole operator on the regulated market (OECD, 2022). The MaaS market, on the other hand, is not a regulated market. It is an open market that *should be* competitive. In Belgium, public transport operators such as STIB and De Lijn have been entrusted by regional governments with the task of developing MaaS platforms. In Brussels, the upcoming MaaS ordinance will provide an additional layer of regulation and has been developed to be complementary to the service contract. The MaaS ordinance will cover any MaaS providers' activities within the MaaS ecosystem – including STIB's. The MaaS ordinance will also set into law the fact that Floya is a public service. The service contract gave STIB the mandate to work and develop a MaaS solution.

The tension arising from PTOs being present in both open MaaS markets and closed PT markets may be a barrier to trust and collaboration among the wider network of stakeholders. While mobility providers are increasingly required to make their fare products available for integration in third-party MaaS offers, public transport operators do not face the same requirements. Public transport service contracts span years and are difficult to revise, while the ordinances governing private mobility service operations cover shorter periods and can more easily be revised. This mismatch creates a situation in which PTOs and other mobility service operators do not face the same conditions, requirements and responsibilities though they are both present within the same MaaS market. In particular, PTOs may benefit from the participation of private sector stakeholders in their own MaaS offers whereas the opposite is often more complicated. Private MaaS providers may also be unable to offer a product as competitive as the public transport-led MaaS offer, given that integration of public transport services will be limited.

In Belgium, a legislator can intervene to define an activity as a public service – in this case, the MaaS ordinance is expected to define MaaS as a public service to be provided by STIB-MIVB. No assessment of market failure needs to be conducted. Yet, under EU law, market failure is increasingly required for an activity to qualify as a service of general interest. Moreover, in Brussels, private sector stakeholders have voiced concerns that a limited capacity to integrate public transport fare products within their own MaaS solutions would limit their ability to compete on the market and in turn, their willingness to participate in the MaaS ecosystem. This emerging lack of trust, as well as a need to align with EU best practices, should be duly considered.

Similar situations in other European countries have led to investigations and/or sanctions. In Spain, the state-owned railway company Renfe was investigated by the EU on suspensions of restricting competition. Renfe refused to provide third parties with real-time data. As a consequence, the Renfe online ticketing service platform offered a much wider variety of products than third party platform. After this investigation, Renfe had to commit to sharing its real-time data as well as all content that would be displayed on its own online platform. Should the company not respect this commitment, the Commission would impose a fine of up to 10% of the company's worldwide turnover (McClimont, 2023). In Germany, the Deutsche Bahn was forced by the German Federal Cartel Office to grant access to its real-time traffic data to third party route-planning platforms. Before this, Deutsche Bahn had refused to share data about delays, cancellations or platform changes with rival platforms (Masson, 2023). Addressing this situation in Belgium is thus necessary not only to improve trust in the market, but also to ensure fair competition.

Additionally, PTOs are committed to improving their digital fare products. They are working together to do this through their subsidiary BMC, which has developed expertise that will be vital to the development of

MaaS. There are, however, no direct communication channels between public authorities and BMC. Public authorities do not establish public service contracts (or any contract, for that matter) with BMC's activities – only with BMC's four members – and have no way of directly regulating its activities or establishing roles for BMC via a future MaaS ordinance. The emergence of MaaS and the wider data infrastructure that enables it implies a revision of public transport regulations. Consistency in data sharing requirements (cf. recommendation 5) may constitute a first step.

This is a sensitive and complex topic; it cannot be addressed in the short term and implies political decisions and prioritisation as well as thorough collaboration between regional authorities, the federal government, the PTOs and BMC. The MGA and MNC will bring key insights to the table: their work on the trust model will lead them to consult a variety of stakeholders and understand the barriers to trust that may be related to the current regulatory framework. However, this topic could not be tackled by the MGA on its own as it would require collaboration with legal experts and competition authorities. EU guidance on public transport regulation will be key to this process; the federal level is expected to play a central role to bridge the scale of the EU with that of regional public transport regulation.

Interviews suggested that integration within MaaS products did not necessarily impact public transport service providers' ticket sales. This highlights an important and unresolved issue regarding the position of PTOs within the MaaS ecosystem: they form the backbone of the urban mobility system, but they may perceive lower benefits associated with MaaS and tend to have fewer resources and skills to devote to data sharing and interoperability. This should be kept in mind when revising existing public transport regulations.

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International Transport Forum

Reaching Critical MaaS

Interregional Cooperation for Seamless Mobility in the Brussels-Capital Region

Mobility as a Service (MaaS) is not just about apps. It is about offering people access to different mobility operators' services combined into a single, compelling offer. The creation of a dynamic MaaS-ecosystem is an objective of the three Belgian regions and the federal government. As part of the EU-funded project 'Adapting cooperation mechanisms for the deployment of mobility services on an interregional scale', implemented in collaboration with Brussels Mobility and DG REFORM, the ITF has focused on a specific challenge: that of steering the development of a MaaS ecosystem that serve residents' mobility needs, even when their trips extend beyond the region's administrative boundaries.

Successfully deploying MaaS in the Brussels-Capital region requires co-ordination, alignment and enhanced interoperability with similar initiatives in Flanders and the Walloon regions. It also requires alignment with Federal and EU initiatives and policies in a number of domains related to MaaS both directly (e.g. public transport and mobility policies and MaaS-specific rules) or indirectly (e.g. data and digital governance and competition policy) linked to MaaS. To address this challenge, the study provides recommendations to guide the development of an interregional governance framework for MaaS, one that would provide clarity on key concepts, ensure greater trust among ecosystem stakeholders, and ground technical discussions in a stable, supportive policy foundation.

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