ENABLING VEHICLE INTERACTION WITH TRAFFIC MANAGEMENT

Traffic Management 2.0 – Mobility as a Service Task Force

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2 Executive Summary

Some critical factors that have resulted from the recent growth of cities, greatly affect daily urban mobility: the car density with respect to the surface of the city; the urban structure that prevents radical viability transformation; the tourism flow (although usually concentrated in specific periods of the year); the inefficient use of the vehicles, and the daily people flows from the suburbs to downtown and vice versa, are such factors that contribute to the rise of environmental, mobility and social costs which are becoming difficult to sustain for today's cities. Cities, in their attempt to address these issues, are beginning to outline clear targets across the three pillars of sustainability: environment, quality of life and social welfare. Within this context, a new concept as Mobility as a Service (MaaS) can be defined as the integration of various forms of transport services into a single mobility service accessible on demand. For the user, MaaS offers added value through a single application to provide access to mobility, with a sole payment channel instead of multiple ticketing and payment operations. MaaS aims at providing an alternative to dependency on car ownership that may be seen as convenient, flexible, reliable and cheaper.

This document addresses the evolution of traditional Traffic management (focusing on road infrastructure) in multi-stakeholders' MaaS value chain based on the implementation of the TM2.0 ("cooperation between traffic managers and service providers") concept; the specific use cases described are coming from real-life initiatives.
Although, MaaS offers added value through a single application to provide access to mobility, with a sole payment channel instead of multiple ticketing and payment operations, the optimisation and more efficient use of the city transport system is also pursued, which can be reached through the deployment of seamless multimodal interactive traffic management measures. Moreover, a successful MaaS service brings new business opportunities. Around the world, there are currently various MaaS pilots, trials and business cases developed and launched. This work investigates also the evolution of the interactive Traffic management in the MaaS world from the business point of view.

3 General Introduction

TM2.0 and Mobility as a Service 'MaaS' are two important systems that have the potential to organise and operate mobility systems in a more efficient and effective way. However, at the moment, TM2.0 and MaaS are two parallel trends that and not yet fully connected.

Traffic Management is the difficult and important task of managing and optimising road capacity: the speed, volume and direction of traffic. With technological and organisational developments brings new opportunities to manage all types of traffic better, namely closer cooperation between (navigation) service providers and road operators. At present, this collaboration is predominantly limited to re-routing of traditional car traffic but cities are increasingly developing more multimodal transport systems and deploying Mobility as a Services applications.

Therefore, better information and re-routing functionalities for all transport modes and users is required and as such, the need for more integrated multimodal traffic management becomes clearer. To attempt the implementation of integrated multimodal traffic management in the MaaS world pushes traffic management beyond the existing borders to enabling an optimised mobility system based on multimodal,

seamless, flexible, reliable, user-friendly, all inclusive, price-worthy and environmentally sustainable travelling.

As both TM2.0 and MaaS reach mature stages of development and the mobility challenges continue to increase, this topic has received a lot of attention from both members of TM2.0 and the MaaS Alliance. Therefore, it was agreed in November 2018 to establish a dedicated Task Force that would work closely with the MaaS Alliance to answer the following key questions:

- Is it possible to build synergies between the two systems and if so, what benefits can be expected by connecting TM2.0 and MaaS?
- How can these systems be connected?
- Which actors are relevant to connect TM2.0 and MaaS?
- What aspects can motivate TM2.0 and MaaS actors to work together?
- What is the short-term and long-term prospect of this collaboration?

4 TM2.0

The TM2.0 platform aims to agree on common interfaces, principles and business models, which can facilitate the exchange of data and information between road vehicles and Traffic Management and Control Centres. The ultimate goal is to improve the total value chain for consistent traffic management and mobility services while avoiding conflicting guidance information on the road and in vehicles.

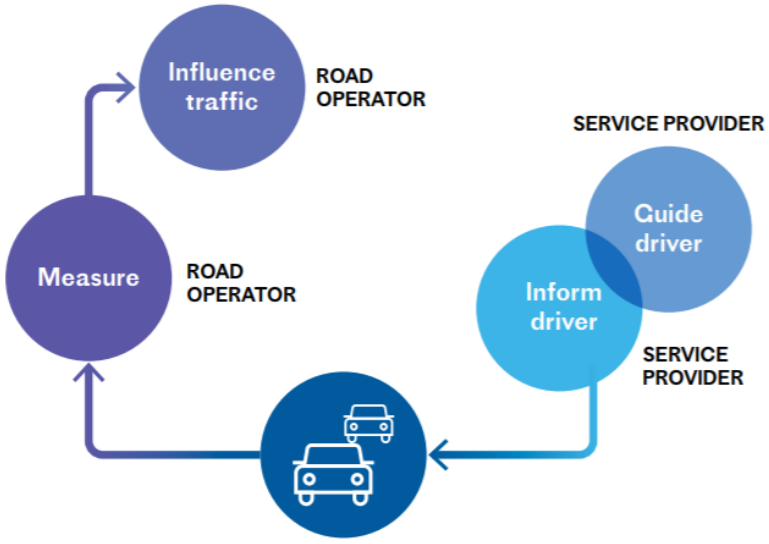


Figure 1

TM1.0: The Road Operator or Public Authority has traditionally been measuring the traffic and then, based on these measurements, tried to influence traffic via road signs and announcements. The Service Providers on the other hand were better placed to guide the traffic.

TM2.0 aims to close this loop and facilitate interactive traffic management. The Road Operator sends its Traffic Management Plans as these are decided by the Public Authorities to the Service Providers operating in the area, who then send tailor-made information to their customers with regards to routing provided via the in-car navigation device.

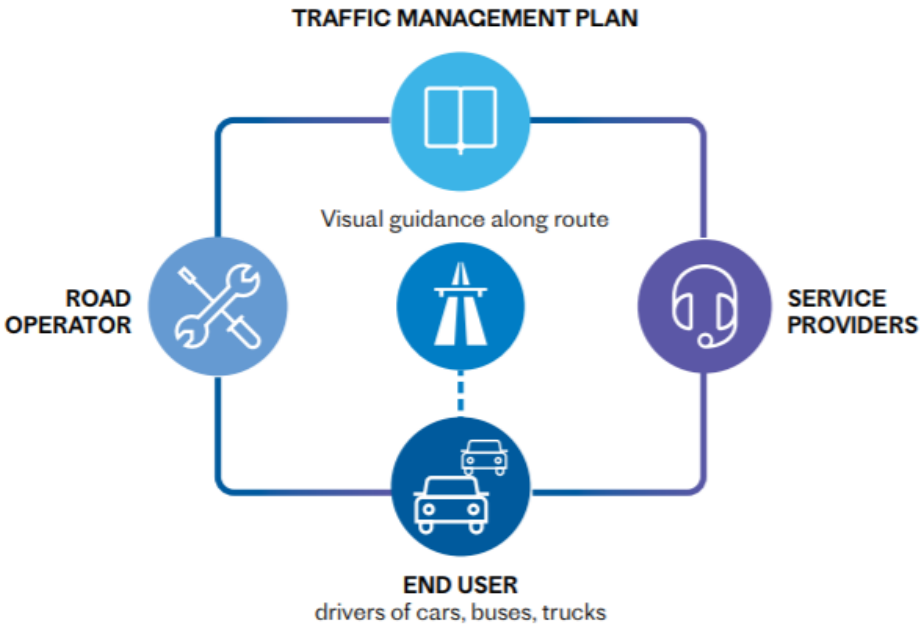


Figure 2

Closing this loop requires the coherence of:

- Traffic management plans provided by road authorities with
- Dynamic traffic information provided by traffic service providers with
- Guidance provided by navigation service providers

The TM2.0 Process:

- Collects data from all available sources feeding into the traffic management
- Data is fed into the statistics and modelling exercises performed by the Public Authorities when managing traffic. This is where we go into data processing
- Implementation of traffic management under the concept of TM 2.0 involves all means of information transmitters working towards informing and guiding the driver. All show the same information and follow the coherence principle.

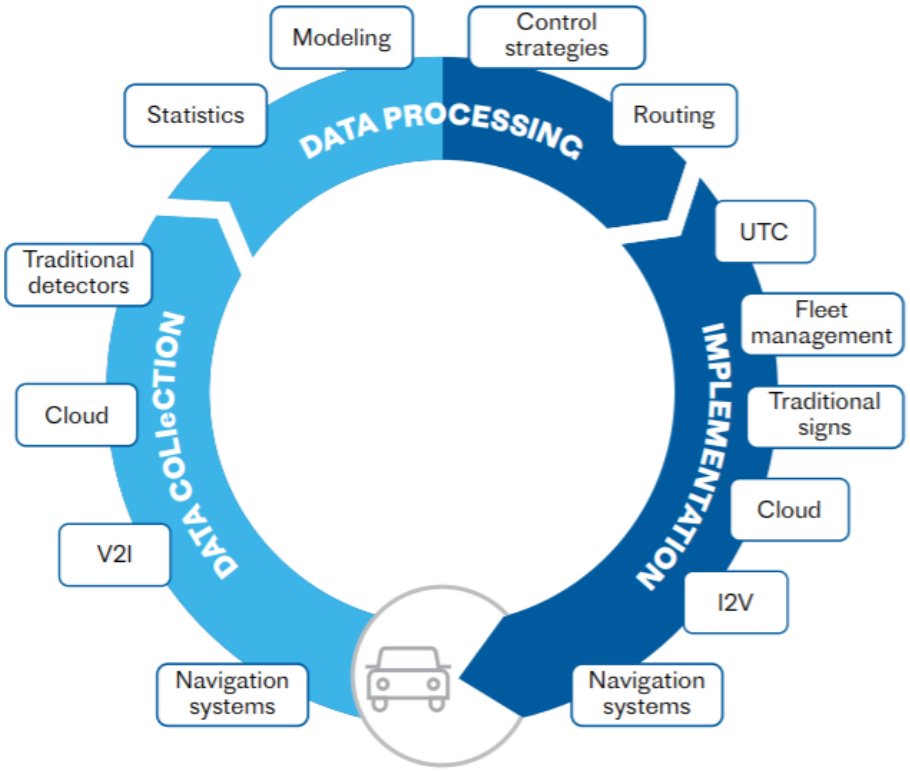


Figure 3

The TM2.0 concept can have far-reaching benefits for different stakeholders:

Traffic Managers/Public Authorities	Drivers	Traffic Information Service Providers
Avoid congestion and traffic collapse	Avoid congestion = more relaxed driver	Provide best route option for the destination (not the fastest)
Avoid unnecessary emissions	Receive relevant information inside the vehicle	Provide information beyond congestion
Improve TMP complementing or replacing loop detectors and enhancing accuracy	Improve road safety with through smoother traffic flow	Provide solution not problem well in advance (best route option vs congestion info)
TMP measures reach driver directly	Best route options aligned with TMPs	Regional info becomes part of an integrated service
FCD-enabled TM even in roads with no ITS (scaleable)		

Table 1

In TM 2.0 Service Providers do not compete on the information but on its quality and on how to best route customers while taking the priorities of public authorities into account. In exchange, the public authorities open their information on their traffic management plans and measures to all cooperating Service Providers. TM 2.0 provides an informed view of the road network that leads to optimization of Traffic Management.

4.1 Traffic Management Functions

Traffic Management Function	Description	Roles and Responsibilities

Object Control	Monitoring/Operation Tunnels, Bridges, road closures/dynamic lane operation , dynamic speed limit operation	Road Operator(s) + Service Providers
Incident Management	Vehicle Breakdown/accident removal, road closure/dynamic lane operation, dynamic speed limit operation	Road Operator(s) + Emergency Services + Police Services, + Service Providers
Road Works (incl. long-term roadworks (new lane markings)	Planning/implementation of road construction/maintenance, Provision of updated HD maps (incl. new lane topology), Automated vehicles guidance	Road Operator(s) + Service Providers
De-icing (incl. Support under adverse weather conditions)	Implementation of road de-icing (applying salt to roads) Distribution of information about precipitation, wind velocity and direction related to driving direction, road friction, visibility	Road Operator(s) Road Operator (s) through road sensors , local weather stations, Service Providers
Enforcement	Enforcing/inspecting compliance traffic regulations by road users (violating speed limit, lane closures, parking illegally on hard shoulder, drink/drug driving, dangerous driving. ISA support with provision of updated and trustworthy high definition map including accurate location of traffic signs and speed limits	Road Operator(s) + Police Services + support by (Navigation)
Network Optimisation	Monitoring and implementation of control strategies/measures to smooth traffic volumes/flow (diversion routes, posting messages on VMS, traffic lights/traffic controllers, speed-timegap-lane recommendations to connected vehicles), Dynamic lane assignment to automated trucks , Dynamic lane assignment to automated vehicles.	Road Operator(s) + (Navigation) Service Providers
Travel and Route Information	Distribution of relevant travel and route Information (traffic jams, road closures, accidents) to drivers via roadside stations/display units, website, social media, apps. Smart routing (as an outcome of data exchange between TMC and service provider)	Road Operator(s) + Service Providers

Table 2

5 Mobility as a Service 'MaaS'

Mobility as a Service (MaaS) is the integration of various forms of transport services into a single mobility service accessible on demand. For the user, MaaS offers added value through a single application to provide access to mobility, with a sole payment channel instead of multiple ticketing and payment operations. MaaS aims at providing an alternative to dependency on car ownership that may be seen as

convenient, flexible, reliable and cheaper. The main building blocks of Mobility as a Service are: access to multimodal mobility services, single journey planning and ticketing options for the user, as well the provision of reliable and advanced travel information from the planning phase until the end of journey. As MaaS models become more mature, it is easy to predict various other value-added linked services (e.g. mobility-related integration of payment for parking or tourism or entertainment services consumed during the journey) that can be combined to the MaaS offering.

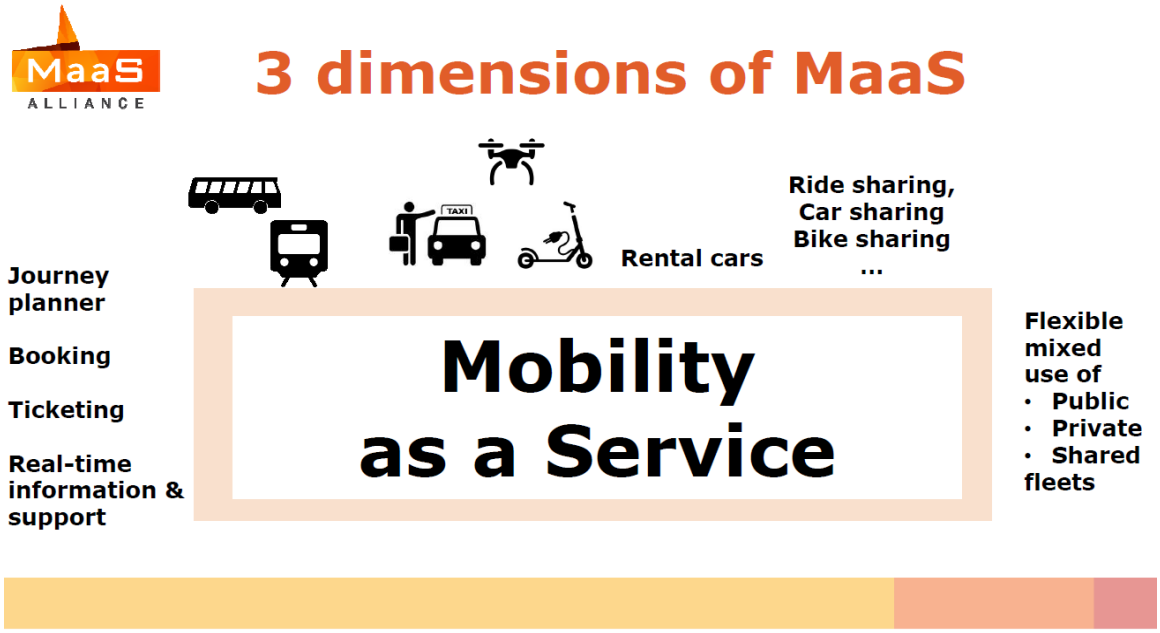


Figure 4

Although the main motivation behind MaaS is to provide better, digitally-enabled mobility services for the end-user, it has also many important wider benefits. A successful MaaS service brings new business opportunities and ways to organise and operate the various transport options as a seamless multimodal service. According to market evidence, MaaS has the potential to attract new customers and create demand for public transport where previously it did not exist. Therefore, MaaS has a clear potential to reduce the environmental impact of transport, like CO2 emission, air pollution and congestion. MaaS aims at optimisation and more efficient use of the city transport system (and this builds an important link to traffic management and TM2.0). It aims to solve the mobility challenges of larger cities with soft measures and consequently reduce the need for public funding and subsidies in the transport sector. MaaS can be the mobility sector's response to the call of the circular economy – it builds on the existing services, but upgrades the ways they are combined, integrated and consumed reducing inefficiencies in the system.

Around the world, there are currently various MaaS pilots, trials and business cases developed and launched. MaaS is challenging current players in the transport industry, urging them to rapidly position themselves in the reformed ecosystem and to find new partners and business models driven by optimization, resource efficiency and environmental responsibility – yet also meeting the growing needs of well-informed, digitally orientated and demanding customers and taking good care of social inclusion.

The Mobility as a Service market is estimated to grow some 30-35% annually and become a market of more than a trillion euros by 2030. Although the MaaS concept was invented in Europe, the market is currently developing the fastest in China, thanks to an extensive boom of shared mobility services providing users with new cost-efficient mobility options. In Europe and globally there are several MaaS applications and

solutions already at place[1], with varied level of complexity and maturity. All most mature MaaS services are still at local scale, targeting region of one city or one urban area. In addition to several private and public driven initiatives some EU-funded projects are also strongly contributing to the development of the MaaS ecosystem, in particular MyCorridor, MaaS4EU, IMOVE, MaaSive and Galileo4Mobility.

The content of the MaaS offering varies case by case, in terms of the scope of services, the regional coverage and the business model. At the moment, there is no "killer app" or solution in the market. It is advisable that the market develops an open and roaming ecosystem of multiple service providers instead of a "winner takes it all" vision. The success of a MaaS solution always lies in the use of the best local sourced ingredients. To develop an intelligent and well-functioning ecosystem, not only new mobility and ICT services are required, but also the mobility system should be taken to the next level. This can be achieved by using the most advanced traffic management system and releasing the full power of data.

The multimodal mobility solution that focuses on goods (sometimes referred as syncromodality or DaaS, Delivery as a Service) and the combination of transport of passengers and goods are still relatively undiscovered fields. The key components in the advancement of DaaS could include the establishment of cargo market places or freight brokerages and building links with on-demand transportation services and sharing economy, namely ride-sharing.

The development of this new, prominent mobility service market will however rely heavily on access to data and ticketing, open APIs (Application Programming Interface) and interoperability of the systems. In addition to access to data, an imperative requirement is the high quality of data being exchanged. Interoperable systems, supported by open architecture and standardised sub-element features, such as booking, payment, ticketing, authentication and security, are similarly crucial elements to catalyse the development of the MaaS market. MaaS providers and operators are committed to respect the highest standards of the data privacy. In MaaS services, privacy is not just a GDPR compliance question, but an inherent element of trust between the service provider and the customer.

As explained above, for existence of MaaS the availability of dynamic, high-quality data is a necessite, similarly interesting it is to study how the data gathered by MaaS operators could be used to enrich and qualify the other data sets of transport systems. The data gathered by MaaS services are often location- and time-specific and provides also information about user behaviour and preferences. This data, when anonymised, would become very handy and invaluable when combined with conventional data sets and sources used for traffic management, and transport and urban planning purposes. Emergence of MaaS also brings up the question if and how the traffic management operations could be extended to non-vehicle travellers, like cyclist and pedestrians. On the longer run drones will add new piece to the puzzle requiring seamless interaction of ground-based traffic and urban air management.

5.1 Mobility as a Service Functions

MaaS Function	Description	Roles and Responsibilities
Journey planning	Provides a listing of the service offering. Combines optimal use of transport modes based on selected criteria (e.g. price, time,	MaaS Operator based on the data received from cities (network), Transport Service Providers (services), User

[1] Updated information about different MaaS services is available at the MaaS Alliance website: https://maas-alliance.eu/maas-in-action/

	convenience).	(preferences).
Booking	The end-user makes a decision on the service that he/she intends to purchase. The MaaS operator issues the necessary travel documents to the end user. The MaaS operator informs the service providers of the transaction so that they can book the required capacity.	MaaS Operator
Payment	Can be executed as a pay-as-you-go scheme or e.g. as a monthly subscription to a customised mobility bundle. Takes care of the financial transaction with the end-user and the revenue-sharing between the MaaS operator and the service providers involved in the service delivery.	MaaS Operator
Execution of the journey	The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction.	MaaS Operator, Transport Service Providers in interaction with Road Operators.

Table 3

6 Connecting TM2.0 & MaaS

In order for TM2.0 and MaaS to collaborate, it was essential to better-understand in the following order, (1) what specific collaborative activities could be undertaken, (2) how they would be carried out and (3) why the actors involved would undertake the collaboration in the first place. The following chart visualizes the overall framework of the TF's scope of work.

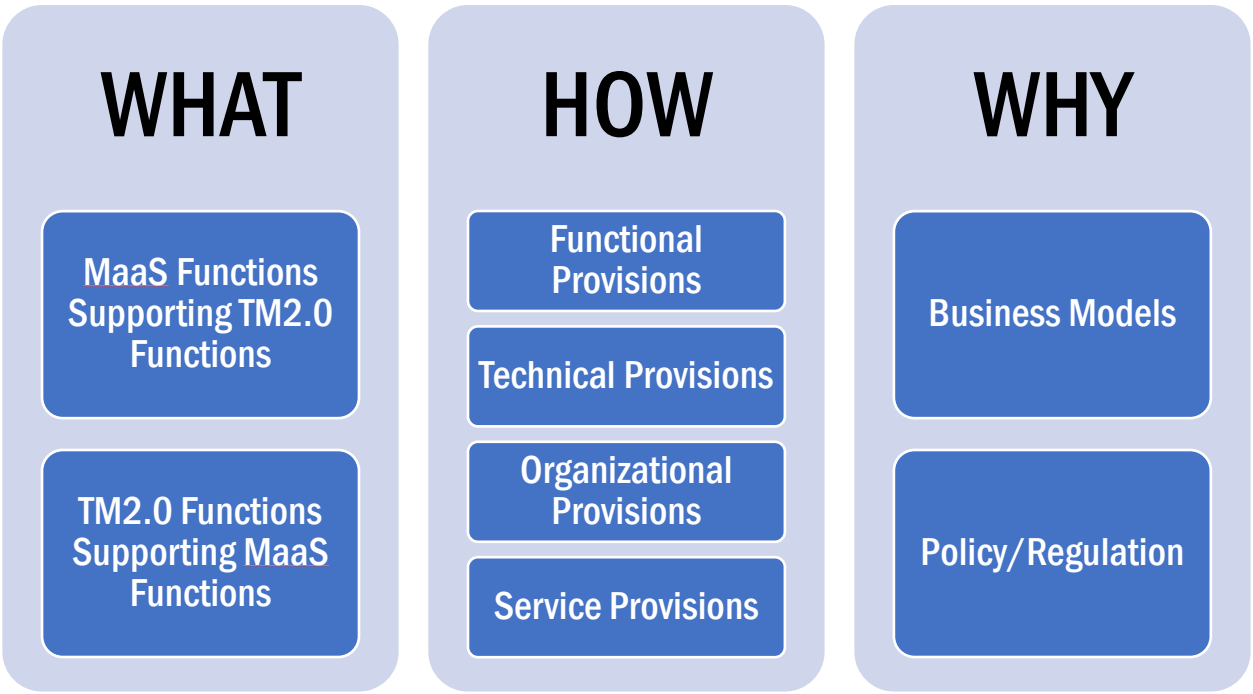


Figure 5

6.1 Areas of Collaboration – the 'WHAT'

As mentioned in section 5.1 and 6.1, TM2.0 and MaaS are centered around specific functions. There are many areas of potential collaboration between TM2.0 and MaaS in which the execution of the defined functions can support each other's systems. The TF looked at which TM functions can be supported by MaaS activities and vice-versa. The summary of the results can be found below:

6.1.1 TM2.0 Supporting MaaS Use Cases

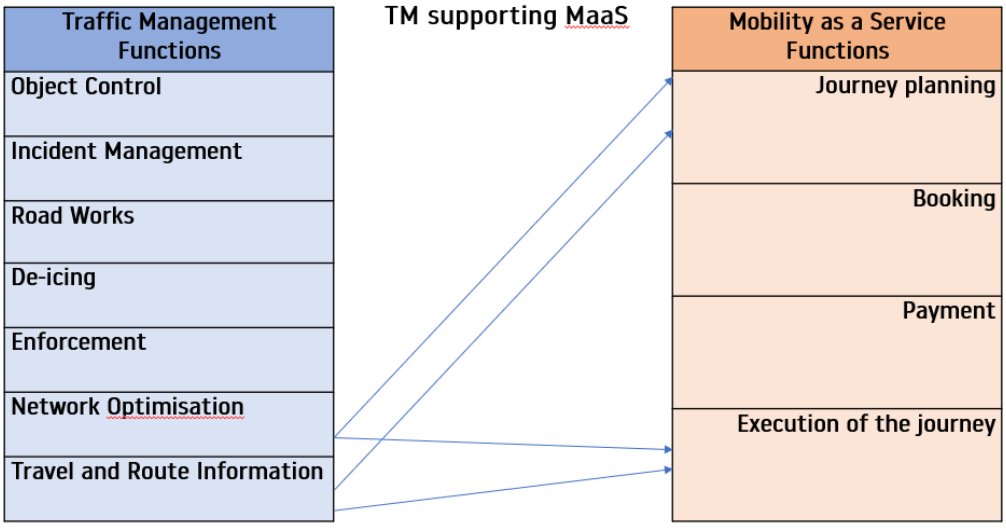


Figure 6

- Travel and Route Information → Journey Planning (Pre-trip)
  Accurate and comprehensive information about the road network status (both traffic flow information, incidents/accidents, road works etc.) can help MaaS operators to deliver "fact-based journey" planning to its customers. It can help avoiding presenting travel options that are impossible or not ideal to carry out.

- Travel and Route Information → Execution of the Journey (On-trip)
  Accurate and comprehensive information about the road network status (both traffic flow information, incidents/accidents, road works etc.) can help MaaS operators offer travelers up-to-date preference-based options during trip. This helps travellers make fact-based decisions during the trip in the event of disturbances.

- Network Optimisation → Journey Planning
  When network optimization measures are activated and made aware to MaaS operators, the geographic areas affected can be considered when providing journey options to travellers.

- Network Optimisation → Execution of the Journey
  When network optimization measures are activated and made aware to MaaS operators, the geographic areas affected can be considered when providing journey updates and potential re-routing suggestions to travellers.

6.1.2 MaaS Supporting TM2.0: Use Cases

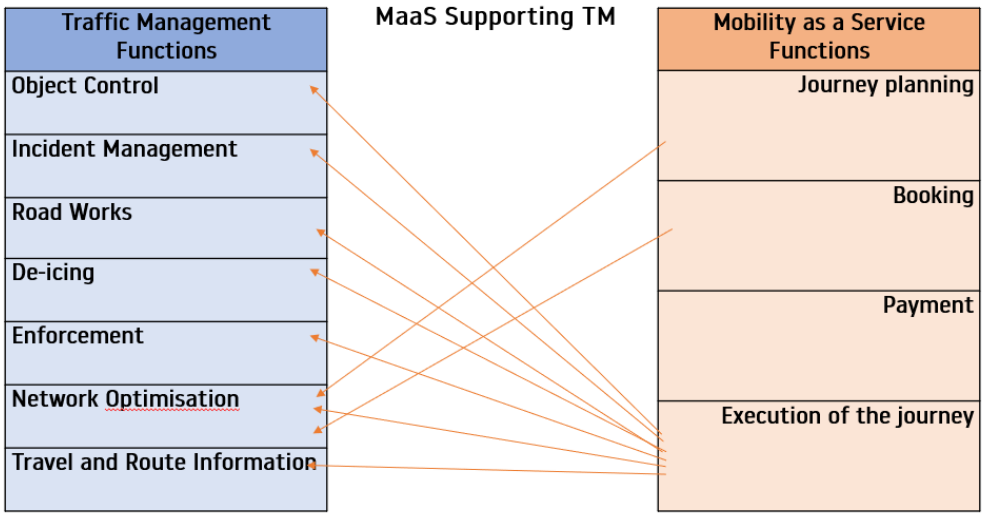


Figure 7

Journey Planning → Network Optimisation

Travellers confirmed travel decisions provide additional information about travel demand and travel use across different transport modes which traffic managers can take into account when deciding which TM network optimization measures for which parts of the network to take. MaaS operators can also help the efficiency of the network optimization process by presenting travel options to travellers which avoid sending travellers through the affected areas.

Booking → Network Optimisation

Payment incentives to encourage travellers to take travel decision (mode of travel/route of travel/timing of travel) to support network optimization operation.

Execution of the Journey → Network Optimisation

Based on prior travel information about network optimisation measures, travellers take journeys that support the network optimisation process → consequential congestion/disruptive network effects are avoided.

Execution of the Journey → Travel and Route Information

Customers of MaaS application can support the creation of accurate and comprehensive travel and route information by crowd sourcing relevant information about conditions affecting the use of the transport (road) network i.e. immediate notifications about accidents/incidents, road closures etc.

Execution of the Journey → Road Works

Based on prior travel information about road works and travel selection, travellers take journeys that avoid areas of the network which are affected by road works → consequential congestion/disruptive network effects are avoided.

Execution of the Journey → Enforcement

Reinforce traffic regulations – MaaS Operators confirming driver license of users etc.

Execution of the Journey → De-icing

Based on prior travel information about de-icing and travel selection, travellers take journeys that avoid areas of the network which are affected by de-icing operation. → Consequential congestion/disruptive network effects are avoided.

Execution of the Journey → Incident Management

Based on prior travel information about incidents and travel selection, travellers take journeys that avoid areas of the network which are affected by incidents and TM measures to resolve incidents (road closures, reduced speed limits etc.) → Consequential congestion/disruptive network effects are avoided.

Execution of the Journey → Object Control

Based on prior travel information about object control and travel selection, travellers take journeys that avoid areas of the network which are affected by temporary closures (road/tunnel/bridge etc.) → Consequential congestion/disruptive network effects are avoided.

6.1.3 MaaS & TM2.0

In summary, specific functions of TM2.0 can support MaaS functions and vice-versa. In some cases, the collaboration is bi-directional where both supports can support each other as indicated below.

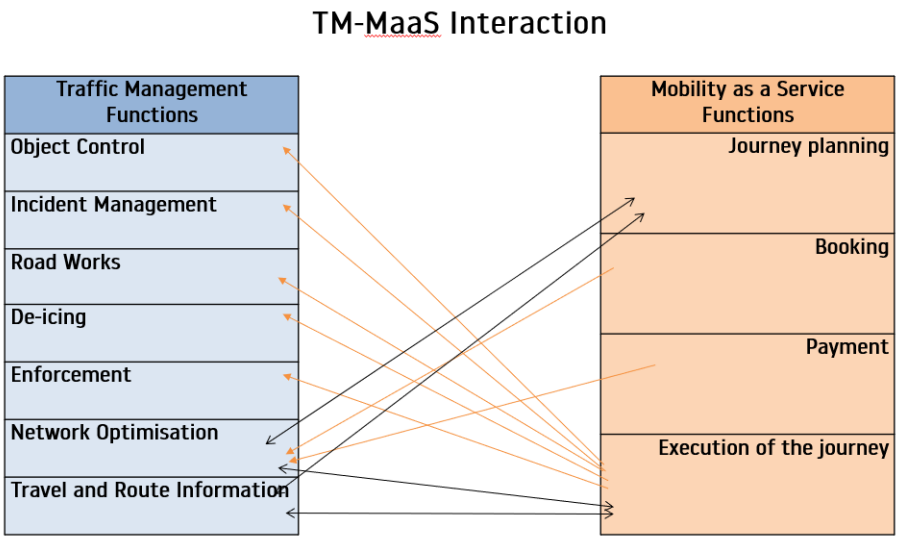


Figure 8

6.2 Enabling Provisions – the 'HOW'

In order to fulfil the use cases in the aforementioned section, it is important to better understand how this collaboration can take place and what aspects need to be considered. The TF identified that there are four key aspects to take into account:

Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
Describe the roles of the various stakeholders and the information flow between them i.e. traffic flow data from travel information service providers to MaaS Operators.	Provide for the technical means to fulfil the functional provisions i.e. the use of specific data format or API to exchange data.	Describe the procedural obligations of the various stakeholders i.e. whether or not there is a complete full circle of the 'feedback loop'.	Describe the various levels of services and their content for ITS applications and services i.e. real-time traffic information vs advanced predictive forecasting.

Table 4

For each of the use cases, the TF carried out an analysis to describe how the interaction could take place on a functional, technical, organizational and service level. However, before this analysis can take place, all the relevant actors plus the datasets available to conduct such interaction needed to be defined:

Data Provider	Datasets
Urban Air Operators (UAO)	Air Traffic Flow (real-time measured speeds + travel times), Air Traffic Events (route closures, accidents/incidents), Emission levels
Maritime Network Operator (MNO)	Water Traffic Flow (current measured speeds + travel times), Water Traffic Events (accidents/incidents)

Rail Network Operator (RNO)	Rail Traffic Flow (current measured speeds + travel times), Rail Traffic Events (traffic jams, rail network closures, rail works, accidents/incidents)
Road Network Operator – Traffic Manager (TM)	Road Traffic Flow (current measured speeds + travel times), Road Traffic Events (traffic jams, road closures, road works, accidents/incidents), EV Charging (location & availability), Weather (extreme), Construction, Road Parking (on-street and off-street location and availability, Emissions levels, Road Traffic Regulations (UVAR) Large Events.
Mobility Operators (all modes) (MO)	Static Schedules/Timetables/Routes, Real-Time Information (Delays/Disruptions/Cancellations), Fares/Pricing
(Traffic) Service Providers (SP)	MAP (Road Network, Addressing, Traffic Signs, PoI), Traffic Flow (current measured speeds + travel times), Traffic Events (traffic jams, road closures, road works, accidents/incidents), Historic Traffic (O/D, travel times, average speeds, traffic volumes, Predictive Traffic (O/D, travel times, average speeds, traffic volumes, EV Charging (location & availability), Weather (extreme), Parking (on-street and off-street location and availability
MaaS Operators (MaaS)	Actual Travel Demand, Expected Travel Demand, Price (incl. flexibility), Smart Mobility Tray, Location, Crowd Sourced Info, User Profile, Bookings
Mobility Integration Platforms (MIP)	Incidents/Accidents (all modes), Planned City Events, Attractivity of PoI, Expected C02 Impact, Usage of transport modes (mode choice), O/D Estimation, Price for Usage, Inter-change nodes, Travel Times (all modes)
Travellers (T)	Crowd-sourced data (closures, incidents, accidents etc.)

Table 5

As the table below indicates, for each of the use cases several actors can provide the same data:

	UAO	MNO	RNO	TM	MO	SP	MaaS	MIP	T
TM Travel and Route Info <> MaaS Journey Planning	X	X	X	X	X	X	X	X	X
TM Travel and Route Info <> MaaS Execution of the Journey	X	X	X	X	X	X	X	X	X
TM Network Optimisation <> MaaS Journey Planning				X			X		
TM Network Optimisation <> MaaS Execution of the Journey				X			X		

MaaS Booking > TM Network Optimisation							X		
MaaS Payment > Network Optimisation							X		
MaaS Execution of Journey > Object Control							X		
MaaS Execution of Journey > De-icing							X		
MaaS Execution of Journey > Incident Management							X		
MaaS Execution of Journey > Road Works							X		
MaaS Execution of Journey > Enforcement							X		

Table 6

This is important to highlight as there may be an overlap of different providers and therefore a decision should be made who to source what data from. This point will be further elaborated in section 7.3 under business models. A detailed overview of how the functional, organizational, technical and service provisions can be fulfilled for each use case can be found in section 9.1.

6.3 Business Models and Policy Frameworks – the 'WHY'

The two previous sections have explained what collaboration can take place between TM2.0 actors and MaaS operators and how it can take place, but the critically question to answer is why would these actors collaborate in the first place? The TF scoped this section of work on two core areas:

- What business model(s) can best explain this collaboration
- What existing policy frameworks facilitate this collaboration

6.3.1 Business Models

The business model work of the TF concerned three objectives, namely:

- To define business architecture, mainly identify the Actors, and their interactions
- To elaborate the TM2.0 – MaaS relationship from business model point of view
- To define Pricing and other incentive strategies

6.3.1.1 Definition of Actors and interactions

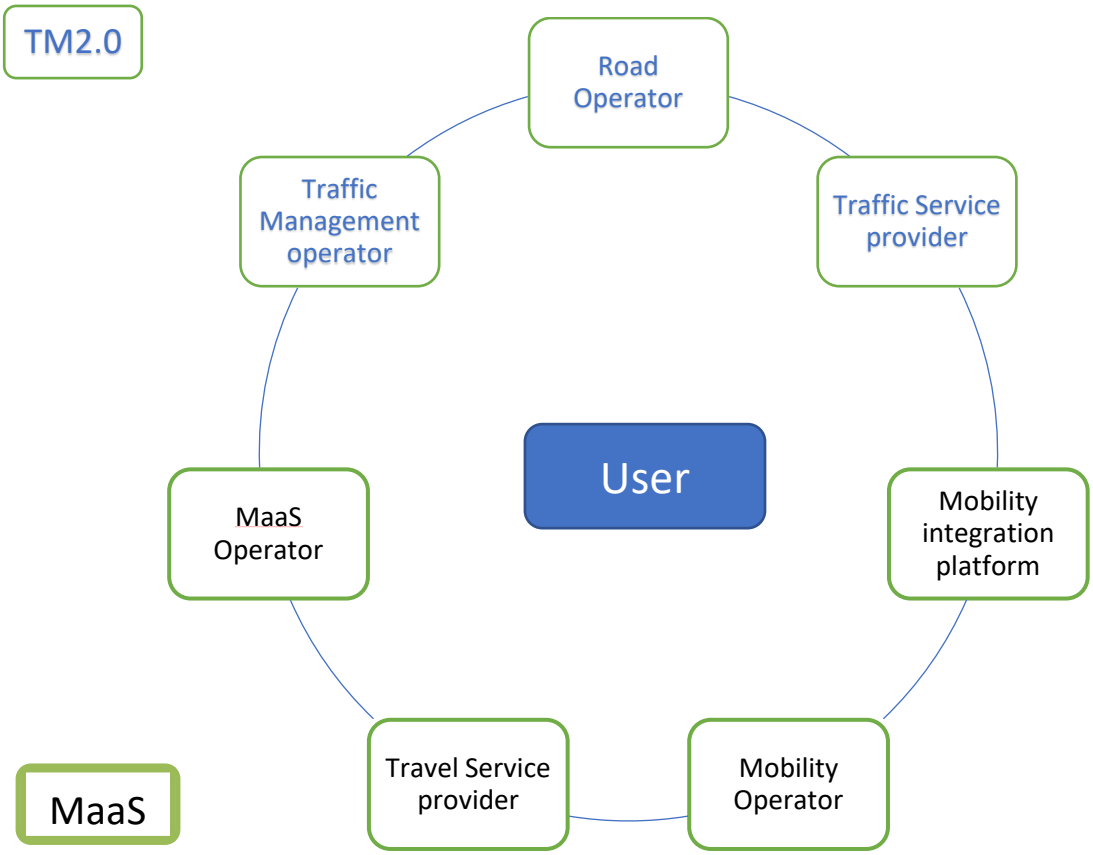
The following table shows the Actors identified by the TF team and their definition:

Actor	Definitions	Comments
Traffic and travel Information Service provider	Entity that provides digital added value services based on data to end users (B2C) and/or Mobility related Businesses (B2B2C)	Service provider could be divided between "Traffic": provide navigation, and real time traffic services And "Travel": related to services for other mobility modes for example public transport, and/or weather info
MaaS Operator	Entity that provides to end users access to purchasing various integrated mobility services & mobility added value digital services in an aggregated/packaged way through a MaaS platform	
Mobility integration platform	Entity that aggregates mobility information and delivers it to other mobility service providers, operators and/or MaaS operators (B2B)	
Road operator	Entity that owns and manages the maintenance of road infrastructure in order to maintain the efficiency and safety	
Traffic Management operator	Entity that performs traffic management operations taking into account guidelines and strategy set by Road Operator	
Mobility operator	Entity that provides physical mobility services to end users	Parking/E-mobility charging operators should be also included.
User	Entity that consumes end user services (added value services and/or mobility services) and/or uses the Road infrastructure	The user could be either person or company (for example in case of freight and MaaS - which could be a sub case)

The individual Actors have a specific business value in the market, but when they interact and collaborate together within a business "Eco-system", they develop a group dynamic, which is then transformed into added value for the entire Eco-system.

There are two Ecosystems relevant in the context of this report, namely, the TM2.0 (their interactions described in section 4), and the MaaS (described in section 5). The two together form a super-total, which is the TM2.0-MaaS Business Ecosystem.

The TM2.0-MaaS Business Ecosystem has the Actor: User, in the middle of the attention, being the consumer of all information and services, and the Actor: MaaS Operator, as the integration point between all actors. The following schema shows the Ecosystem's synthesis.



The following table shows the interaction matrix between MaaS Operator and the TM2.0 Ecosystem.

Business interaction (business value)	Traffic and travel Information Service provider	MaaS Operator	Road operator	Traffic Management operator	User
Traffic Information Service provider		Value added services (navigation algorithms, data, ecc.) enabling MaaS Operations	As by TM2.0 / traffic information and regulation (eg tolling price, etc...)	As by TM2.0 / road traffic events (eg. traffic jam, road works, accidents, etc...)	Value added services / profiling information

Business interaction (business value)	Traffic and travel Information Service provider	MaaS Operator	Road operator	Traffic Management operator	User
MaaS Operator	Single access point containing all the information coming from all the different service providers.		MaaS Operator can use the information about roads and "object control" coming from road operators to inform the users (e.g. infrastructural issues)	The MaaS operator can be user channel for TM related real time, forecasted and predictive traffic information .	The MaaS operator can provide accounts (access) to the users who want to connect to the MaaS platform.
Road operator	Provides information about roads and object control	Provides information about roads and object control		Provides rules and strategies	Provides infrastructure
Traffic Management operator	As by TM2.0 / road traffic events (eg. traffic jam, road works, accidents, etc…)	The TM operator provides related real time, forecasted and predictive traffic information and actual and planned traffic management measures, which will help the MaaS operator to offer the most suitable mode to the user (MAAS customer).	The TM operator provides related real time information to the Road Operator about the use of the network.		As by TM2.0 / road traffic measures

6.3.1.2 Business model exercise

The second objective of the Business modeling work is to identify the most relevant scenarios of TM2.0-MaaS relationship and model them from the business point of view. Each of the scenarios describes a specific solution/service, which has the following characteristics:

- It is addressing the Actor: User
- The solution is provided through the MaaS operator
- The solution includes the added value of the TM2.0 Eco-system

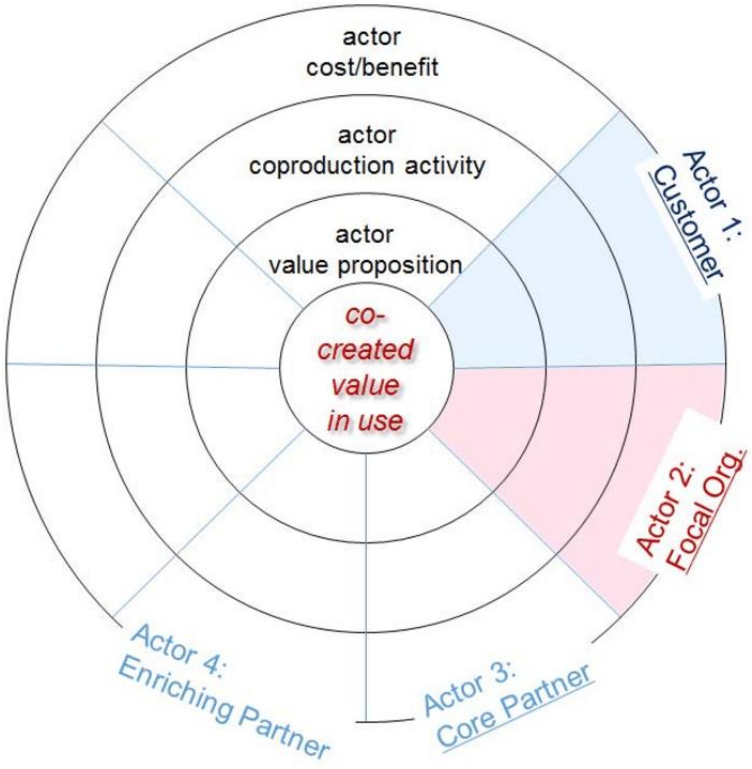
The methodology used is the BASE/X business model radar (BMR)- (Grefen and Turekten, 2018)[2]. The radar is used to depict all stakeholders that collaborate to provide the solution/service involved in the Ecosystem, i.e. the Actors of section 6.3.1.1 in the TM2.0-MaaS Ecosystem. The center of the circle of the radar shows the co-created value in use, which is in fact the solution/service developed by the collaboration of the Actors. One of the Actors is identified as the "Customer" (in this case is the User) and one is identified as

[2] Achieving Business Process Agility through Service Engineering in Extended Business Networks
Paul Grefen and Oktay Turetken, 2018, BPTrends

the Focal Organisation, which in this case is the MaaS operator. Then for each Actor the following information is defined:

- The value the Actor contributes to the solution
- The activities the Actor performs to generate this value
- The costs and benefits for the Actor in doing so

The following schema shows a typical presentation of the radar.



The TF defined the following scenarios as example case studies for the business modelling based on BASE X radar, namely:

- Case study 1:
  - Customer: User
  - Focal organization (provides the solution): MaaS Operator
  - Solution (Co-created value): Journey Planning
  - TM2.0 value: TM Travel and Route Info
- Case study 2:
  - Customer: User
  - Focal organization (provides the solution): MaaS Operator
  - Solution (Co-created value): Execution of the Journey
  - TM2.0 value: TM Network Optimisation

The results from the implementation of the BASE/X methodology are presented in Annex of the current report. The main conclusions from the business model exercise are:

1. MaaS framework can further enhance the TM2.0 Ecosystem by enabling a wider, user responsive and far more multi-modal approach to Network Management. On top MaaS is also facilitating business benefits to service providers
2. The Traffic Management Operator will have a series of potential benefits, which can be grouped in 3 main types:
    a. MaaS can become an additional information channel to the driver, and as such contribute to Network Optimisation, which is key business objective
    b. MaaS can provide user data, which can be helpful in improved predictive traffic information services or improved schedule of preventive maintenance
    c. New measures and strategies can be available such as multimodal planning and/or combination with Park & Ride
3. The Traffic Management Operator is seen as a Road Infrastructure Manager in the context of the exercise, however, it is an open question how the multi-modal nature of MaaS (by default) could be further exploited in favour of Traffic Management.
4. The Traffic Service Providers have also additional financial benefits through MaaS (for example, new customers and increased profits) as well as user feedback and data.
5. All Actors will have additional costs deriving from the need to develop new tools and increase system maintenance level, which however can be compensated by the identified benefits. Moreover, the service providers would need to operate in an open competition wise environment and collaborate with other service providers

6.3.1.3 Business Objectives; Pricing and incentives strategies

Various pricing models and strategies can be followed by the MaaS Operator. There are quite a few alternatives starting from traditional fee per service or subscription fee.

However, the focus of this section is the Pricing strategies that concern the cooperation between MaaS and TM2.0, and not MaaS alone. The pricing strategies should support in combination all Actors involved in the TM2.0 Eco-system, thus both Traffic Management Operators and Traffic Service Providers.

With respect to the Traffic Management Operators the basic objective should be to engage as many drivers in the MaaS information channel and as a result influence their travel behavior in favour of what is projected to be efficient traffic management measures: for example correct choice of route or re-routing and modal shift if there is a Network capacity problem.

With respect to the Traffic Service Providers, the basic objective would be to maximise financial benefits and attract new users.

A suitable pricing model could be Freemium based model: a minimum set of services, for example those satisfying the Traffic Management basic objective could be provided free of charge and added value services, provided by Traffic Service Providers could be provided with a fee.

Moreover, examples of incentive strategies, which may satisfy both Actors, could include but not limited to:

- Promotion (e.g. push notifications based on special offers or traffic conditions)
- Financial incentives (discounts, subscription packages)
- Loyalty schemes (better than using a single service)
- Socially responsible user profile (responsible behavior, healthier lifestyle)

6.3.2 Policy Frameworks

There are two key European policy frameworks that are relevant to support the collaboration between TM2.0 and MaaS. Both frameworks enable data access but there are differences in the scope of actors that the requirements apply and the level of technical and organizational requirements prescribed.

6.3.2.1 PSI Directive

The Directive on the re-use of public sector information provides a common legal framework for a European market for government-held data (public sector information).

All content that can be accessed under national laws on access to documents is, in principle, re-usable beyond its initial purpose of collection for commercial and non-commercial purposes. Conditions for re-use shall be non-discriminatory for comparable categories of re-use.

Charges for re-use should, in principle, be limited to the marginal costs of the individual request (reproduction, provision and dissemination costs). Public sector bodies are encouraged to apply lower charges or no charges at all. On request, public sector bodies must indicate the method used to calculate charges. Charges and other conditions for re-use have to be pre-established and published. If a request for re-use is refused, the grounds for refusal and the means of redress need to be explained.

Prohibition of cross-subsidies: if public sector bodies re-use their own documents to offer added-value information services in competition with other re-users, equal charges and other conditions must apply to all of them. Prohibition of exclusive arrangements: public sector bodies may not enter into exclusive arrangements with individual re-users, excluding others.

The PSI directive was updated in 2019 to include the provision of public dynamic data and the use of APIs to exchange data.

6.3.2.2 ITS Directive

The ITS Directive (2010/40/EU) is a legal and policy framework to accelerate the deployment of intelligent transport systems for road and its interface with other modes of transport. Within the ITS Directive, specific Delegated Regulations on thematic topics have been adopted, three of which are relevant for TM2.0 & MaaS:

- Safety Related Traffic Information
- Real-Time Traffic Information
- Multimodal Travel Information

These Delegated Regulations establish the specifications necessary to ensure the accessibility, exchange and update of travel and traffic data and prescribe specific requirements on functional, technical and organizational provisions.

6.3.2.3 Supporting Enabling Provisions

	PSI Directive	ITS Directive		
		SRTI	RTTI	MMTIS
Functional Provisions	Public entities except museums, broadcasting.	Static and dynamic safety related traffic data from road authorities, road operators and service providers.	Static and dynamic traffic data from road authorities and road operators. Service providers included as part of a commercial service.	Static and dynamic multimodal journey planning data from transport authorities, transport operators, transport on demand service providers and infrastructure managers.
Technical Provisions	Prescribes the use of APIs to exchange data.	Prescribes the use of DATEXII to exchange data. MS to establish National Access Point (NAP) to facilitate access to data.	Prescribes the use of DATEXII to exchange data. MS to establish National Access Point (NAP) to facilitate access to data.	Prescribes the use of APIs and standards (Transmodel, NeTEx, SIRI,DATEXII,IATA,TAP-TSI EDIFACT) to exchange data. MS to establish National Access Point (NAP) to facilitate access to data.
Organizational Provisions	Public data providers can claim compensation to recover costs associated with data creation. Data cannot be 'sold'.	Free of charge.	No requirements concerning 'price/value' of data.	Public and private data providers can claim compensation to recover costs associated with data creation. Data cannot be 'sold'.
Service Provisions	N/A	Prescribes minimal data quality requirements (accuracy, updates etc.)	Prescribes minimal data quality requirements (accuracy, updates etc.)	Prescribes minimal data quality requirements (accuracy, updates etc.)
Geographical Scope	No restrictions	Comprehensive TEN-T Network*	Comprehensive TEN-T Network*	Entire Transport Network

Table 7

*Some MS like the Netherlands have decided to fully implement the delegated regulation on their entire transport network.

6.3.2.4 Legal Frameworks vs Data Providers

Data Provider	Datasets	PSI Directive	SRTI	RTTI	MMTIS

Urban Air Operators (UAO)	Air Traffic Flow (real-time measured speeds + travel times), Air Traffic Events (route closures, accidents/incidents), Emission levels				
Maritime Network Operator (MNO)	Water Traffic Flow (current measured speeds + travel times), Water Traffic Events (accidents/incidents)	X			X
Rail Network Operator (RNO)	Rail Traffic Flow (current measured speeds + travel times), Rail Traffic Events (traffic jams, rail network closures, rail works, accidents/incidents)	X			X
Road Network Operator – Traffic Manager (TM)	Road Traffic Flow (current measured speeds + travel times), Road Traffic Events (traffic jams, road closures, road works, accidents/incidents), EV Charging (location & availability), Weather (extreme), Construction, Road Parking (on-street and off-street location and availability, Emissions levels, Road Traffic Regulations (UVAR) Large Events.	X	X	X	
Mobility Operators (all modes) (MO)	Static Schedules/Timetables/Routes, Real-Time Information (Delays/Disruptions/Cancellations), Fares/Pricing	X			X
(Traffic) Service Providers (SP)	MAP (Road Network, Addressing, Traffic Signs, PoI), Traffic Flow (current measured speeds + travel times), Traffic Events (traffic jams, road closures, road works, accidents/incidents), Historic Traffic (O/D, travel times, average speeds, traffic volumes, Predictive Traffic (O/D, travel times, average speeds, traffic volumes, EV Charging (location & availability), Weather (extreme), Parking (on-street and off-street location and availability		X	X	
MaaS Operators (MaaS)	Actual Travel Demand, Expected Travel Demand, Price (incl. flexibility), Smart Mobility Tray, Location, Crowd Sourced Info, User Profile, Bookings				
Mobility Integration Platforms (MIP)	Incidents/Accidents (all modes), Planned City Events, Attractivity of PoI, Expected C02 Impact, Usage of transport modes (mode choice), O/D Estimation, Price for Usage, Inter-change nodes, Travel Times (all modes)				
Travellers (T)	Crowd-sourced data (closures, incidents, accidents etc.)		X	X	

Table 8

As the two tables demonstrate, the PSI Directive and ITS Directive frameworks combined can support many of the enabling provisions defined for each use case. Overall, the following conclusions can be made:

- Most of the datasets and actors required to support the collaboration between TM2.0 and MaaS are covered, especially those related to multimodal travel information and real-time traffic information.
- The relevant technical provisions to enable the use of APIs, standardized data formats and national access points are referenced.
- However, there are some notably differences between the legal frameworks which cause some imbalance, notably:
    - Geographical scope: TEN-T network of SRTI, RTTI vs whole network of MMTIS
    - Commercial services: SRTI free of charge vs PSI & MMTIS requesting 'compensation' vs RTTI no requirements

7 Conclusions & Next Steps

The TM2.0 – MaaS convergence can enable Road Operators to implement interactive multimodal traffic management and implement traffic management measures to optimize the multimodal network capacity thanks to the use of all vehicles and transport modes available by the deployment of network wide multi-modal management strategies (system optimization and equilibrium).

8 Annex

8.1 Case Studies

8.1.1 MyCorridor

MyCorridor is a 3-year project, funded by the Horizon 2020 programme and its overall objective is to achieve sustainable travel in urban and interurban areas and across borders by replacing private vehicle ownership by private vehicle use. The project looks into connecting services from various service providers and providing the traveller with alternatives to replace their own vehicle trip with combined shared vehicles and multimodal transport solutions. The project is part of the Mobility as a Service (MaaS) concept that puts users at the core of transport services, offering them tailor-made mobility solutions based on their individual needs.

Pilot demonstration of MyCorridor involves an eco-system of interoperable MaaS Issuers, covering together a cross-border Pan-European Corridor going through Greece, Italy, Austria, Germany, Czech Republic and the Netherlands. Each MaaS Issuer can operate one or more local or cross-border corridors that involve various typologies of mobile users. MyCorridor aims to be all-inclusive, and, as such, cover the needs of all types of travelers with varying profiles (needs and preferences). Basic user profiles – representing a significant share of the population - that will be supported during the Pilots of the project through the MyCorridor system are namely: 1. The "Commuter" 2. The "Tourist" 3. The "Businessman" 4. The "Spontaneous user" 5. The "Mobility-restricted" user (i.e. user with disabilities) 6. The "Low IT literacy user" (i.e. elderly user)

My Corridor aims to enable a paradigm shift for car users, by driving the "vehicle world" towards Mobility as a Service (MaaS): it aims to extend the Traffic Management 2.0 (TM2.0) at its borders by providing a solution that incorporates multi-modal, seamless, flexible, reliable, user-friendly, all inclusive, price-worthy and environmentally sustainable traveler move at cities and regions and most importantly across all Europe. However, the basis of My Corridor project is the TM 2.0 platform (i.e. as an enabler of MaaS), and therefore starting point are those mobility services related to the interactive traffic management envision of the "vehicle world".

These mobility services are clustered in four basic operational fields, which are 1) Traffic management applications, 2) MaaS Multi-modal PT applications interfaces concerning the planning, booking, ticketing and the use of the mobility multi-modal services, 3) MaaS vehicle related applications, and 4) Horizontal (non mobility) services concerning the purchasing.

8.1.2 Mobimart

"*Interreg III*" is a *FESR* (*European Fund for Regional Development*) program to facilitate the cooperation between EU regions aiming to avoid that national borders still represent an obstacle to the EU members' balanced development. For this reason, varied cross-borders initiatives are financed (or co-financed) by the European Union to simplify the members' integration and their commercial-social-cultural relationships.

Livorno is the Italian port which has been involved in the larger number of Interreg projects for Italy-France cooperation, with the purpose of monitoring, improving the digitalisation, enhancing the logistics processes efficiency, monitoring the logistics port operation (as to make them more efficient) and helping data interchange systems. The projects that involve the port of Livorno are fully financed, so resource acquisitions and investments in port developing and innovation period are possible, during the three-years 2018-2021.

MOBIMART is an "*Interreg*" EU "cross-border project". Its objective is to consider the transport services as "journeys" from origin to destination, independently from the transport mode and the morphological characteristics of the territories. The project core purpose is to create an integrated platform for allowing an intelligent communication system between all the different transport means (sea, road, railway and air transport) by simplifying people voyages and by helping people to access to the info-mobility data. According to the project requirements, the solution must be flexible, scalable, adaptable and not centralized. The project output will be a real-time integrated travel-plan, a suggested itinerary for the passengers who will travel in the five-regions cross-border area.

The innovative aspects of the project stand in these two core elements:

1. information interchange between systems, in order to help additional solutions developing (even after the project last deadline) as to enforce cross-border relationships;
2. Many outputs will be realized (websites, travel-planners, mobile apps, social networks).

MOBIMART will be structured in a three-years plan, made of two parts:

I. Mobility data standardization, which will be collected in a common platform;
II. New specific info-mobility systems with all the data coming from the eleven partners' territories.

The Tuscany Regional Authority, MOBIMART project leader, has always been committed in innovation and sustainable mobility at national and European levels. The Region has also set up the "*Regional transport observatory*", a full open-data repository with details about road graphs, traffic sensors, free-parking availability and real time information about traffic and real-time transport status.[3]

The Livorno port network authority (*AdSP-MTS*) is one of the project's partners and it leads to realize a cloud layer that will manage all the information coming from the transport network, from the *TPCS*[4] and *MoniCA*[5]. Anyway, new systems will not replace the already existing ones, new standard interfaces will be developed. Variable Message Panels and smart totems will be installed in the ports of the AdSP-MTS network (Livorno, Capraia, Piombino and Portoferraio).

Currently CNIT, on behalf of AdSP-MTS, is involved into the implementation of a service-oriented architecture (*SOA*) at the port of Livorno, encompassing and integrating information coming from the Port

[3] All the transport data collection from all the Tuscan transport offices is full available on the "*datiToscana*" web platform - http://dati.toscana.it/dataset/rt-oraritb
[4] Tuscany Port Community System - https://tpcs.tpcs.eu/
[5] Monitoring and Control Architecture (Livorno Port Monitoring System) - https://www.monicapmslivorno.eu/

Monitoring platforms. This architecture could be used in order to retrieve useful information regarding both seaside (*ETA*, *ETD*, Passengers Forecast, etc.) and passengers' mobility via *C-ITS*[6]. CNIT can provide a high integration level with the needed *ICT* component and the proper level of connectivity. In *MOBIMART*, it is possible to include *C-ITS* and Traffic Management information (using *DATEX II* standard) in order to increment road safety. It will be also possible to calculate alternative routes upon the occurrence of dangerous situations like accidents and roadworks. The "Firenze – Pisa – Livorno Highway" has a *DATEX II* node and a traffic control center which monitor the real-time traffic status. The control center communicates with CCISS ("*Centro di Coordinamento Informazioni sulla Sicurezza Stradale*", the Italian Highway *TM* agency) which provides traffic information at any time.

Knowing the state of the art of all the current available mobility applications in each node is fundamental, so partners have been called to fill a questionnaire due to explain what applications they use to inform passengers about public transport, who are the users, what is the potential useful data, what are the server-side technologies, what they expect to achieve as parts of MOBIMART consortium and what are their future info-mobility goals. The global output of our survey shows that almost all the partners:

1. use Open Trip Planner (*OTP*) services based on *GTFS* or *Transmodel* data;
2. want users to be part of the informative system thanks to feedbacks;
3. urgently need to provide strictly accurate information about the real-time status of the service (in order to calculate alternative routes in case of fortuitous events);
4. aim to add a ticketing and payment module to their mobility applications. This aspect is strictly important for implementing a MaaS ecosystem.

Every dataset must respect detailed specifications. *MOBIMART* partners have chosen "*GTFS*" as the common data standard for all the transport data because almost all the transport companies are already using and sharing their information using *GTFS* structures. *APIs* (Application Programming Interfaces) will enable the interaction between all the nodes and the cloud platform. A specific port layer will be created to consent the interaction and data interchange with the project cloud platform.

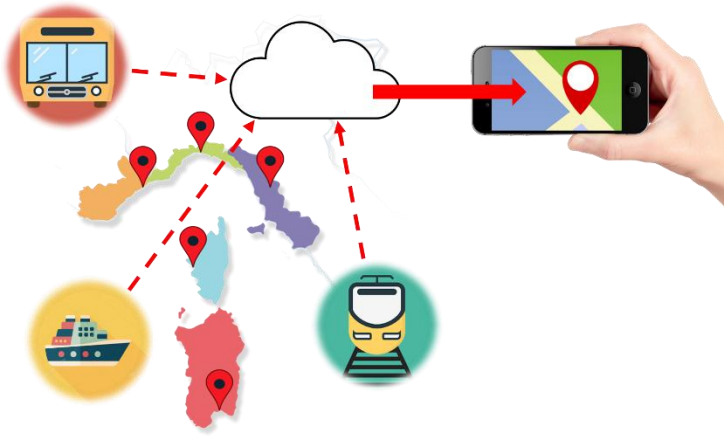


Figure 9 - MOBIMART project objective

The MOBIMART eleven Italian and French partners can be divided in two groups:

[6] Cooperative Intelligent Transport System - Digital connectivity between vehicles, between vehicle and road users, between vehicles and transport infrastructure to improve road safety, traffic efficiency, comfort and driving optimization.

A. *Regional Transport Offices:* Tuscany (project leader, responsible of the project register), Liguria, Sardinia, Corse, Provence-Alpes-Côte d'Azur (PACA);
B. *Other Transport Offices:* Livorno Port Authority, Sardinia Port Authority, Province of Livorno, Province of Sassari, Municipality of Genova, Municipality of Pisa.

In particular, the Regional Transport Offices manage the scheduled data, the other partners have to manage all the real-time information. Every node hast to share data with the Regional node which it belongs to, if not in the correct format, the Regional Office will convert it. Regional transport offices will track all the available transport services with details about the service status. Even the status of the digital service ("Active", "Down", "In maintenance" etc.) will be tracked.

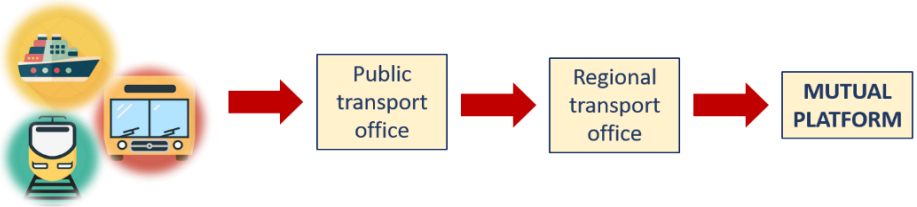


Figure 10 - MOBIMART real-time data flow

The "not-regional" transport nodes have to make sure that the real time status of the service is constantly up-to-date, for a real-time user information, with details concerning eventual delays and other useful information. Regarding the municipalities involved in the project, it will be also possible to inform drivers about the city parking slots availability (via real-time *REST* interfaces).

As already mentioned before, the Livorno port network database will feed the *MOBIMART* info-mobility app. The port monitoring system database has been fully analyzed in order to understand its structure and its ER scheme. In particular, CNIT has developed a web-app that will generate an up-to-date *GTFS* file by clicking on the appropriate button. It's important to define the objects and the tables that *GTFS* refers to, then it will be possible to extract the proper data.

GTFS files are just *CSV .txt* files collected in a *.zip* archive. It's strictly important to select the useful data automatically from the *MoniCA Port Monitoring System* database, in order to transfer them to the *MOBIMART* project database. The data concerning ferries and cruises come from the Italian *AIS* system (*PMIS*): we can obtain reliable ferries forecasts (from the current date, for the next fifteen/twenty days).

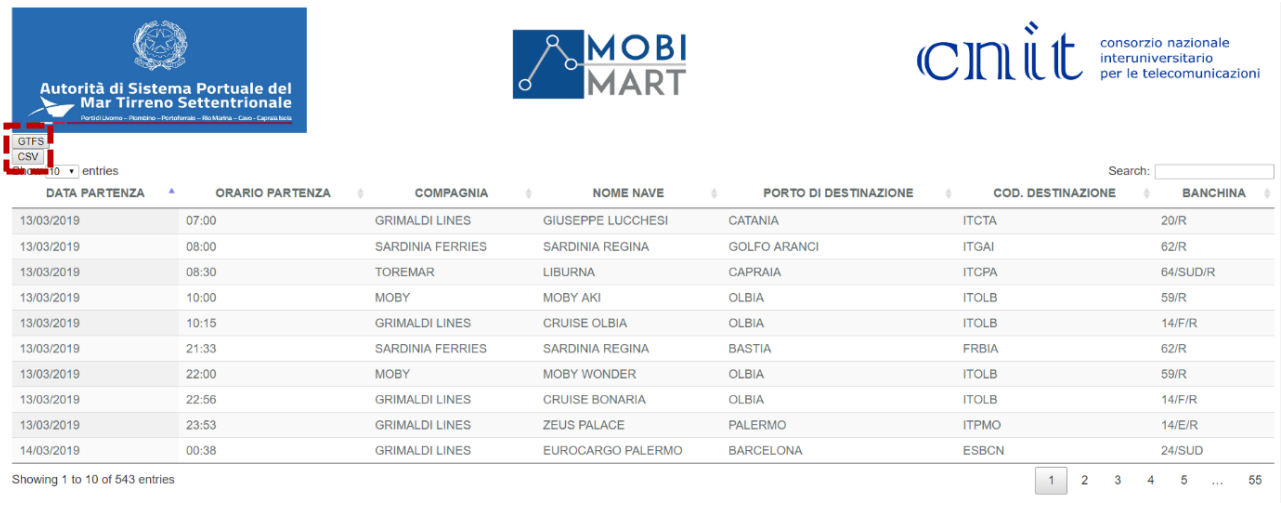


Figure 11 - MOBIMART web app - Port of Livorno: ferries data

This first version of the *MOBIMART-MoniCA* interoperability interface has two "triggered" buttons (see the image above) which generate a complete up-to-date *GTFS* file using MoniCA DB records.

One of the main goals of *MOBIMART* project is to investigate the technological aspects that can enable *MaaS* services following the MaaS recommendations[7]. *MOBIMART* represents the first step for building a *MaaS* platform, a "user-centric" solution based on applications which offer multimodal trips with a single electronic ticket from the trip starting point to its destination. *MOBIMART* will offer both a proper website and a mobile-friendly service: user will be able to download the *iOs/Android* apps on their smartphones.

Disposing of all the public transports open data, including the real-time state of the resources, is the fundamental precondition for implementing a MaaS offer atop. Open standard formats will be used for exchanging scheduled and real-time public transport information. *MOBIMART* will work in the first step, with *GTFS* and *GTFS Real Time*[8] formats. Further, the *MOBIMART* platform will achieve a wider transparency, enabling the conversion in other eligible formats, like the *CEN Transmodel* standards *NeTEx* ("Ne*twork Timetable Exchange")* and "*SIRI*" ("*Standard Interface for Real-time Information*"). Geographic and ticketing information will be included, and applications will utilize and consume data in in an interoperable way. With *MOBIMART*, all the public transport timetables will be re-engineered, in order to offer an available and integrated service.[9] Both car-rental and bike-sharing information will be integrated in the system. If a transport service is unavailable, people should take another mean of transport or another vehicle without buying additional tickets.

MOBIMART will also obtain information about users' preferences. Public authorities must collect, anonymize and aggregate all the incoming data, monitoring how they are managed and processed according to the *EU* privacy rule, the "*General Data Protection Regulation*" (*GDPR, EU regulation 2016/679*)[10]. Data must respect established requirements (availability, accuracy, integrity, up-to-date) and structures, in order to ensure interoperability and trust. Due to implement a mutual multimodal platform, it's important the sharing of best practices between partners, this is the reason why partners have to ensure the complete portability of both personal and not personal data.

MOBIMART platform will be an *OpenTripPlanner* service which will work on *OpenStreetMap* layers. Geographical data will be open and fully available without restrictions. Standardizing data will be the first step for implementing a future "single-ticket" solution, based on the paths procured from the dynamic travel-plan. Furthermore, all the players involved need to take care of the security level of information sharing processes among different systems: the distributed attack surface enabled by different systems in communication needs to be protected with fine grained and standard security policies that mitigate the security risk within the single part of the system (e.g. a single service connected to MaaS platform) as well as protecting the whole MaaS platform from cyber-attacks. In this way MOBIMART will interact with MoniCA[11] establishing secure information flows.

[7] https://maas-alliance.eu/wp-content/uploads/sites/7/2018/11/Data-MaaS-FINAL-after-plenary-1.pdf
[8] This will let users be informed about the status of the service ("on schedule" or not).
[9] In this sense, passengers who have just arrived in a seaport should take a bus or a train in a few minutes.
[10] User must be informed about personal data processing.
[11] This platform is also based on several international standards (e.g. oneM2M, NIST SP 800-115, NIST SP 800-30, NIST SP 800-92, OpenAPI Spec) to streamline integration process of new services or third-party existing services and to assure an high security level.

New business processes can be generated, and also third parties, such as private transport operators will seamlessly participate to the MaaS ecosystem and increase benefits.

Tuscany area has a very high logistic potential: the Pisa-Livorno-Piombino-Elba coastal zone can be seen as a single "complex logistics node" where the Livorno Port Authority plays a central and strategical role in a multi-modal transport ecosystem. Info-mobility innovation services will be part of the "*smart-port*" system with data coming from different sources. Optimizing logistics flows (both physical and informative ones) is strictly important to be compliant with the *ITS* paradigm.

The availability of *MaaS* services should be a convenient opportunity for the environment… and for users. In this sense, *MaaS* solution users (both tourists and commuters) should get economic benefits, such as discounts, special prices, tax reductions by travelling using public transport. In this way, *MOBIMART* project can be considered as a valid starting point, because it will help travelers while choosing the most suitable mean of transport. This is the reason why it's crucial to insert port data and information in the complex regional mobility platform.

If we analyze the current trends, we can observe that our cities are evolving into smart cities, where public transport will play a strategic role. In this regard, using *MaaS* will be a valid alternative to the car ownership. *MOBIMART* could be a sort of first step for building an innovative and user-centric *MaaS* ("*smart mobility*") platform.

8.1.3 Amsterdam Case Study

Introduction to case study Amsterdam

Since 2018 the Ministry of Infrastructure and Water Management in the Netherlands has adopted the maxim "Smart mobility, Dutch reality", to indicate the ambition to deploy scalable and durable smart mobility solutions in the country. The region of Amsterdam is featured in a number of these deployments, in the fields of TM2.0 and MaaS, with various projects intersecting each other. In this case study description we aim to indicate the synergies arising from the implementation of the initial stages of TM2.0 and MaaS through the Socrates 2.0, MaaS pilot Zuidas and the Partnership Talking Traffic by reviewing how these projects intersect and interact.

Socrates 2.0 pilot site Amsterdam [2]

Socrates 2.0 aims to investigate different cooperation models between public traffic managers, private service providers and OEMs through four use cases in four European cities. These cooperation models investigate possible future roles for these actors and their potential impact to make traffic management more effective and look for synergies on a network scale. This network management requires closer public-private collaboration, as route- and travel advice given to road users has to be coordinated to keep network capacity under congestion thresholds. The use cases focus on optimizing the route advice given to road users, routing them to their final destination taking parking capacity into account, improving roadworks information by validation through crowd sourcing and distribution of environmental zone information. The region of Amsterdam is aiming to use the outcomes of Socrates

2.0 to understand how to improve network capacity and optimize travel advice in the future, as large roadworks are planned.

MaaS pilot Zuidas [3]

The Zuidas business district in the Amsterdam Metropolitan Area, as the region's most important international office location, has expanded rapidly in recent years and the growth is expected to continue at a similar rate in the foreseeable future. The negative aspect of the growth is an increasing pressure on infrastructure, and if the travel behaviour of residents, commuters and visitors remains unchanged, traffic congestion is also set to worsen considerably. To accommodate the growing number of travelers, this year preparatory work has started on the so-called Zuidasdok project. From late 2019 onwards, this work will cause major disruption for road, rail and metro travelers for the long duration (around ten years) of the project.
The City of Amsterdam and major employers in and around Zuidas see Mobility as a Service as an opportunity to improve the distribution of traffic, because it can offer travelers more accessible way to use the form of transport that is most appealing to them at a given time.

Partnership Talking Traffic [3]

In the Partnership Talking Traffic, public and private parties in the Netherlands are working together to access knowledge and data which can subsequently be made available in real time, for individual road users, via tailor-made applications. These are innovative services that enable road users to see beyond their windscreen. One important development within Talking Traffic is that road users not only communicate with one another, but also with the infrastructure. Within the Partnership Talking Traffic, a new generation of intelligent traffic light installations (iTLIs) has been developed, that know which cars, cyclists or buses are approaching them. This fact makes it possible to harmonise traffic flows more efficiently, via dynamic traffic light controls. iTLIs are also able to give 'priority' to certain traffic flows above other, for example cyclists, emergency services or public transport. The traffic light can also automatically ensure that a convoy of trucks can pass through green in one light change. This reduces stopping and starting thereby saving time, fuel and CO2 emissions, as well as money.

Potential synergies between developments

It is all about the guidance of the traveler from A to B. The focus of Socrates 2.0 is the optimal guidance of the traveler at road network level through the cooperation of traffic managers and service providers. Talking Traffic supports the traveler at the nodes equipped with iTLI in this network. MaaS Zuidas offers different means of transport for the travel from A to B. The cooperation with traffic managers and service providers will enable MaaS Zuidas to offer the most suitable mean of transport. This means that the outcomes of Socrates 2.0 can be used to understand and improve not only traffic management strategies, but also multimodal strategies to mitigate congestion on the roads around Amsterdam in a coordinated way. Which triggers will encourage road users to try on-trip multimodal alternatives, and which roles can the public and private stakeholders play? How can road network capacity be optimized further, also using coordinated iTLI-scenarios to improve traffic flow across networks operated by different traffic managers?
This region of Amsterdam is an interesting testing ground for these developments with several traffic managers involved, as three major public investments are deployed more or less simultaneously and the synergies can be further explored and evaluated.

Recommendations

Public actors should use the evaluations of the Socrates 2.0, MaaS pilot Zuidas and Partnership Talking Traffic to understand how these projects have impacted traffic- and travel management in the region and consider which policy measures are needed to harness the synergies between these developments in the future.

Also, all stakeholders should keep close track of the evolving congestion of road traffic and use of multimodal (public, shared, bike) transport in the region in the coming years and produce an operational toolkit to mitigate problems proactively based on the knowledge that has been produced by these initiatives.

Service providers currently involved in traffic information should evolve to incorporate on-trip multimodal alternatives to the car, potentially expanding the possible measures available to tackle congestions as it occurs.

Amsterdam has a bike parking guidance system. The Zuidas business district has three bike parking garages. The information of this parking guidance system can be used to stimulate the use of bikes.

8.1.4 Regiomove (PTV)

The three-year RegioMOVE research project has been commissioned by the Karlsruhe Verkehrsverbund (KVV) and funded by the German state of Baden-Wuerttemberg and the European Fund for Regional development (EFRE), with a budget of around €5m. RegioMOVE will develop a new mobility concept that combines different mobility services to ensure easier access to transport. The project aims to lay the foundation for the development of a multimodal network using Mobility on Demand-driven transport services.

Actual transport demand from end users becomes the pivotal issue when developing appropriate mobility schemes, so as well as the traditional modes of transport, such as walking, cycling and motorized private and public transport, MaaS concepts will also include car- and bike-sharing, as well as ride-pooling services.

To obtain the operational data on vehicle fleets required for the implementation of innovative and climate-friendly service concepts, system- and service-related specifications, such as maximum waiting times, detours and pick-up/drop-off concepts, will be collated, and a transport model will be used to simulate these concepts, including intermodal routes.

Work Package ‘Provider’ Use Case

A Multimodal journey planner that provides the best path between an origin and a destination;

- It manages both private and public transport.
- High flexibility thanks importing network and transport information
- The path is optimum according to:
    - vehicle type;
    - the date and time of the journey;
    - the real time traffic situation;

- the traffic events.

User Stories:

1. Optimize park and ride

Martin would like to avoid using the car but would not like to increase too much his travel cost and time. So he would be happy to be advice by the journey planner of the solution if he can park the car in the parking place and use the PT.

Martin would like that the time and cost to park would be considered and stays under some configurable threshold. Martin would like that the park cost would be computed on a configurable temporal scale with a default of 8 hours (parking time for a working day).

Martin would like that the park availability is computed on real time base and that the park is considered free on the base of a minimal configurable number of free parking slots.

2. Comfortably reduce emission

Antonio is a fan of using bicycles. He would like to be able to be advice how to combine bicycle and public transport to arrive at work.

He would like to use only a reserved park for bikes also taking into account parking availability and cost. In case of unavailability he would like to be informed about the possibility to bring the bike with him when riding on the PT. In this case ideally, he would be able to use the bike at the end of his route.

3. Car sharing in congestion charging zones.

Luca need to enter the downtown but he is not allowed to use his private car. He can't use public transport because he brings his old grandmother thus he would like to use some car sharing service to arrive exactly close to the grandmother's home.

4. Car sharing to connect to public transport

Samantha lives in a city zone not reached by car sharing service. She just finished a party in the center of the city and she needs to use two tramlines to arrive at home. Unfortunately the first tramline is experiencing a disruption and for this reason she needs to reach directly the second tramline at some kilometers of distance. Moreover, because it is night, the bus lines have very long waiting time. So she would like to use the closest car / bike sharing service just to arrive at the second tramline.

5. Avoid too crowded public transport vehicles

Thomas is an old man who loves to use public transport but needs to be seated. So he would like to be advised about the sequence of public transport vehicles to be used whee it is easy or not too difficult to be seated. He understands that this information could be based on the past but he would like, whenever it is possible, to be advised about a route calculated on the basis

of the current availability of seat places.

6. Healthy commuting with bike sharing

Jacob lives outside the city. He would really like to minimize the use of his car and to lose some weight. So he would be happy to be advised about a good place to park his car and to use a bike sharing service. He cannot enter in the center of the city by car. He would like to configure either the maximum number of kilometers/time by bicycle or by car.

7. Moving without private cars

Mathias does not own a car. So he needs fastest combination of modes (PUT, Car sharing, bike sharing) to arrive at work. Taxi are not available because they are too expensive for him. He is not sure about his preferences about the list of means to be used, he would like to have a list of different options on which to choose, ordered as function of the travel time. The number of modes, can be larger than 2 but no larger than 3.

8.2 Use Case - Enabling Provisions

8.2.1 TM Travel and Route Info <> MaaS Journey Planning

TM Travel and Route Info <> MaaS Journey Planning	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
TM Travel and Route Info: Distribution of relevant travel and route Information (traffic jams, road closures, accidents) to drivers via roadside stations/display units, website, social media, apps. Smart routing (as an outcome of data exchange between TMC and service provider) MaaS Journey Planning: Provides a listing of the service offering. Combines optimal use of transport modes based on selected criteria (e.g. price, time, convenience) and by taking into account the traffic conditions Objective(s) of Collaboration: Fact based journey planning – avoiding presenting travel options impossible/not ideal to carry out. Providing a trip offer integrating all information related to network status, for an effective trips planning across the network, ensuring a time-effective and cost-effective travel experience since the pre-trip phase. Avoids Vice-versa, intention OD matrix derived from journey planning can be an input for accurate forecast for travel and route info considering all potential factors to arise.	TM Real Time traffic information and forecast MaaS Intention OD Matrix	1. API Connections 2. Bulk Feed Data Transfers (Standards ref in ITS Directive) . Bi-lateral transfer . Via NAP/ Intermediary transfer	Level 1 – TMC/SP provides information to MaaS Operator Level 2 –Complete Feedback Loop between MaaS Operators and Traffic Managers. Traffic Managers and MaaS Operators confirm receipt of information and inform/explain how it has been used/taken into account including in the prediction the intention OD Matrix	Level 1 – Real Time Traffic Information Level 2 – (Advanced) Predictive Forecasting

8.2.2 TM Travel and Route Info <> MaaS Execution of the Journey

TM Travel and Route Info <> MaaS Execution of the Journey	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions

TM Travel and Route Info: Distribution of relevant travel and route Information (traffic jams, road closures, accidents) to drivers via roadside stations/display units, website, social media, apps. Smart routing (as an outcome of data exchange between TMC and service provider) MaaS Execution of the Journey: The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction Objective(s) of Collaboration: Always offering to the traveler up-to-date preference-based options during trip in order to improve time of reaction and efficiency of the travel itself. The feedback channel, containing real-time information of the trips enhances the accuracy of the real-time travel information.	TM Real Time traffic information and forecast MaaS Real-time information regarding travel demand distribution and choices	1. API Connections 2. Bulk Feed Data Transfers (Standards ref in ITS Directive) . Bi-lateral transfer . Via NAP/ Intermediary transfer	Level 1 – TMC provides information to MaaS Operator Level 2 – Complete Feedback Loop between TMC and MaaS operator. Traffic Managers and MaaS Operators confirm receipt of information and inform/explain how it has been used/taken into account by including in the real-time traffic information in the real-time Journey update, as well as the real-time journey data into TMC.	Level 1 – Real Time Traffic Information Level 2 – Real-Time Journey Adaptation

8.2.3 TM Network Optimisation <> MaaS Journey Planning

TM Network Optimisation <> MaaS Journey Planning	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
TM Network Optimisation: Monitoring and implementation of control strategies/measures to smooth traffic volumes/flow (diversion	TM Real time traffic information as well as	1. API Connections 2. Bulk Feed Data Transfers (Standards	Level 1 – TMC provides information to MaaS	Level 1 – Real Time Traffic Information

routes, posting messages on VMS, traffic lights/traffic controllers, speed-time, gap-lane recommendations to connected vehicles), Dynamic lane assignment to automated trucks , Dynamic lane assignment to automated vehicles. MaaS Journey Planning: Provides a listing of the service offering. Combines optimal use of transport modes based on selected criteria (e.g. price, time, convenience) and by taking into account the traffic conditions Objective(s) of Collaboration: Providing a trip offer integrating all information related to network status, for an effective trips planning across the network, ensuring a time-effective and cost-effective travel experience since the pre-trip phase. The TM should also propose specific recommendations (measures) in case of incidents or emergencies that will be reflected in the journey planning. Vice-versa, intention OD matrix derived from journey planning can be an input for traffic management strategies applied to reach equilibrium across the road network.	network optimization measures (routes/time affected) MaaS Intention OD Matrix	ref in ITS Directive) . Bi-lateral transfer . Via NAP/ Intermediary transfer	Operator Level 2 – Complete Feedback Loop between MaaS Operators and Traffic Managers. Traffic Managers and MaaS Operators confirm receipt of information and inform/explain how it has been used/taken into account including in the control strategies the intention OD Matrix.	Level 2 – Advanced Traffic Control Strategies

8.2.4 TM Network Optimisation <> MaaS Execution of the Journey

TM Network Optimisation <> MaaS Execution of the Journey	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
TM Network Optimisation: Monitoring and implementation of control strategies/measures to smooth traffic volumes/flow (diversion routes, posting messages on VMS, traffic lights/traffic controllers, speed-time, gap-lane recommendations to connected vehicles), Dynamic lane assignment to automated trucks , Dynamic lane assignment to automated vehicles.	TM Real time traffic information as well as network optimization measures (routes/time affected)	1. API Connections 2. Bulk Feed Data Transfers (Standards ref in ITS Directive) . Bi-lateral transfer	Level 1 – TMC provides information to MaaS Operator Level 2a – Complete Feedback Loop between TMC and	Level 1 – Real Time Traffic Information Level 2a – Adcanced Traffic Control Strategies

MaaS Execution of the Journey: The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction Objective(s) of Collaboration: Always offering to the traveler up-to-date preference-based options during trip in order to improve time of reaction and efficiency of the travel itself. The feedback channel, containing real-time information of the trips has an impact on the decision making at traffic management side, enabling a real-time reaction to demand spread across the road network. At the same time, control strategies can be actuated through the MaaS offering with the final objective to incentive modal shift (also in case of incidents or emergencies).	MaaS Real-time information regarding travel demand distribution and choices; incentives for implementation of traffic control strategies in the MaaS ecosystem	. Via NAP/ Intermediary transfer	MaaS operator, by including in the real-time traffic information in the real-time Journey update, as well as the real-time journey data into TMC Level 2b – Complete Feedback Loop between TMC and MaaS operator, by using the MaaS operator as an actuation channel in order to implement TM strategies through the real-time journey adaptation in a consistent manner	Level 2b – Real-Time Journey Adaptation

8.2.5 MaaS Booking > TM Network Optimisation

MaaS Booking > TM Network Optimisation	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Booking: The end-user makes a decision on the service that he/she intends to purchase. The MaaS operator issues the necessary travel documents to the end user. The MaaS operator informs the service providers of the transaction so that they can book the required capacity. TM Network Optimization:	MaaS (annoymised) real-time travel demand (trips/bookings incl. service, location and timing)	1. API Connections 2. Bulk Feed Data Transfers (Standards ref in ITS Directive) . Bi-lateral transfer . Via NAP/	Level 1 – No Feedback Loop between MaaS Operators and Traffic Managers. MaaS Operators provide Information to Traffic Managers.	Level 1 – Real-Time Info Exchange Level 2 – Predictive Forecasting

Monitoring and implementation of control strategies/measures to smooth traffic volumes/flow (diversion routes, posting messages on VMS, traffic lights/traffic controllers, speed-time gap-lane recommendations to connected vehicles), Dynamic lane assignment to automated trucks , Dynamic lane assignment to automated vehicles. Objective(s) of Collaboration: Passengers confirmed travel decisions provide additional information about travel demand and travel use across different transport modes which traffic managers can take into account when deciding which TM network optimization measures for which parts of the network to take.	TM Network optimization measures (routes/time affected)	Intermediary transfer	Level 2 Complete Feedback Loop between MaaS Operators and Traffic Managers. Traffic Managers and MaaS Operators confirm receipt of information and inform/explain how it has been used/taken into account.	

8.2.6 MaaS Payment > TM Network Optimisation

MaaS Payment > TM Network Optimisation	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Payment: Can be executed as a pay-as-you-go scheme or e.g. as a monthly subscription to a customised mobility bundle. Takes care of the financial transaction with the end-user and the revenue-sharing between the MaaS operator and the service providers involved in the service delivery. TM Network Optimization: Monitoring and implementation of control strategies/measures	MaaS Payment incentives incl. applicable transport services, location and timing TM Network	1. API Connections 2. Bulk Feed Data Transfers (Standards ref in ITS Directive) . Bi-lateral transfer . Via NAP/ Intermediary	Level 1 – No Feedback Loop between MaaS Operators and Traffic Managers. MaaS Operators provide Information to Traffic Managers. Level 2	Level 1 – Real-Time Info Exchange Level 2 – Predictive Forecasting

to smooth traffic volumes/flow (diversion routes, posting messages on VMS, traffic lights/traffic controllers, speed-time gap-lane recommendations to connected vehicles), Dynamic lane assignment to automated trucks , Dynamic lane assignment to automated vehicles. Objective(s) of Collaboration: Payment incentives to encourage travellers to take travel decision (mode of travel/route of travel/timing of travel) to support network optimization operation.	optimization measures (routes/time affected)	transfer	Complete Feedback Loop between MaaS Operators and Traffic Managers. Traffic Managers and MaaS Operators confirm receipt of information and inform/explain how it has been used/taken into account.	

8.2.7 MaaS Execution of Journey > TM Object Control

MaaS Execution of Journey > TM Object Control	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Execution of Journey The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction. Object Control Monitoring/Operation Tunnels, Bridges, road closures/dynamic	Previous steps (planning & booking) relevant for data exchange – execution of journey function as a direct consequence would not involve further data exchange	N/A	N/A	N/A

lane operation, dynamic speed limit operation. Objective(s) of Collaboration: Based on prior travel information about object control and travel selection, travellers take journeys that avoid areas of the network which are affected by temporary closures (road/tunnel/bridge etc.) → Consequential congestion/disruptive network effects are avoided.				

8.2.8 MaaS Execution of Journey > TM De-icing

MaaS Execution of Journey > TM De-icing	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Execution of Journey The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction. De-icing Implementation of road de-icing (applying salt to roads). Distribution of information about precipitation, wind velocity	Previous steps (planning & booking) relevant for data exchange – execution of journey function as a direct consequence would not involve further data exchange	N/A	N/A	N/A

and direction related to driving direction, road friction, visibility Objective(s) of Collaboration: Based on prior travel information about de-icing and travel selection, travellers take journeys that avoid areas of the network which are affected by de-icing operation. → Consequential congestion/disruptive network effects are avoided.				

8.2.9 MaaS Execution of Journey > TM Incident Management

MaaS Execution of Journey > TM Incident Management	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Execution of Journey The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction. Incident Management Vehicle Breakdown/accident removal, road closure/dynamic lane operation, dynamic speed limit operation	Previous steps (planning & booking) relevant for data exchange – execution of journey function as a direct consequence would not involve further data exchange	N/A	N/A	N/A

Objective(s) of Collaboration: Based on prior travel information about incidents and travel selection, travellers take journeys that avoid areas of the network which are affected by incidents and TM measures to resolve incidents (road closures, reduced speed limits etc.) → Consequential congestion/disruptive network effects are avoided.				

8.2.10 MaaS Execution of Journey > TM Road Works

MaaS Execution of Journey > TM Road Works	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Execution of Journey The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction. Road Works Planning/implementation of road construction/maintenance, Provision of updated HD maps (incl. new lane topology),	Previous steps (planning & booking) relevant for data exchange – execution of journey function as a direct consequence would not involve further data exchange	N/A	N/A	N/A

Automated vehicles guidance Objective(s) of Collaboration: Based on prior travel information about road works and travel selection, travellers take journeys that avoid areas of the network which are affected by road works → Consequential congestion/disruptive network effects are avoided.				

8.2.11 MaaS Execution of Journey > TM Enforcement

MaaS Execution of Journey > TM Enforcement	Functional Provisions	Technical Provisions	Organizational Provisions	Service Provisions
MaaS Execution of Journey The MaaS operator ensures that the service is delivered seamlessly and provides the end-user with information on possible delays, changes in routing or other relevant information. While changes may be caused by delays of the service providers, typically the MaaS operator is responsible for the customer support and interaction. Enforcement Enforcing/inspecting compliance traffic regulations by road users (violating speed limit, lane closures, parking illegally on hard shoulder, drink/drug driving, dangerous driving. ISA support with	Previous steps (planning & booking) relevant for data exchange – execution of journey function as a direct consequence would not involve further data exchange	N/A	N/A	N/A

provision of updated and trustworthy high definition map including accurate location of traffic signs and speed limits Objective(s) of Collaboration: Reinforce traffic regulations – MaaS Operators confirming driver license of users etc.				

8.3 Business model BASE/X Radar results

8.3.1 Case study 1: TM Travel and Route Info <> MaaS Journey Planning

8.3.1.1 Cost Benefit per Actor

Actor	Cost	Benefit
User	Profile – Declared trip data Purchase Ticket fee	Accurate pre trip information → Correct choice for comfortable/on time trip Lees effort for multimodal trip
MaaS operator	Operational and maintenance costs Marketing costs Investment costs for development of the application and integration with other service providers/mobility operators Risk of failure because of novel business Costs for purchasing data/added value services	Profit from novel market Greater market share New service opportunity → New business model as a e-marketplace for mobility For a city: improvement of quality of service User data
Travel and Traffic Service provider	Integration and interface development costs Increased operational and maintenance costs Open to comparison/competition with other SPs in the same time	New customers and new sales channel New sources of data Increased profit Feedback from users for service quality

Actor	Cost	Benefit
		User data
Mobility operator	Integration and interface development costs Increased operational and maintenance costs Open to comparison/competition with other MOs in the same time	New customers and new sales channel New sources of data Increased profit User data User feedback Aggregated Travel data Multimodal Data analytics
Mobility integration platform	Integration and interface development costs Increased operational and maintenance costs	New customers (MAAS operators) New sources of data, enabling new services Increased profit User generated data
Traffic management operator (and/or Multimodal mobility management)	Integration and interface development costs Develop new tools for forecasting, prediction models etc Increased operational and maintenance costs Interaction with multimodality Take into account constraints from concession contracts	Support by MAAS for improved predictive traffic information services User data (OD related data → improve accuracy of traffic data) Multimodal demand data Increased road capacity via multimodal planning Combine it with park and ride

Actor	Cost	Benefit
		Increased access of users to traffic information (MAAS is a new info channel) According to the infomation coming from users, the road operator can decide the best moments to implement preventive maintenance, avoiding critical dates and horaries (for example commuters' "peak hours" or city public events).
Road operator	Adapt road strategies to multimodality and new business models	Increased road capacity via multimodal planning Increased tolling based on improved service According to the information coming from users, the road operator can decide the best moments to implement preventive maintenance, avoiding critical dates and horaries (for example commuters' "peak hours" or city public events).

8.3.1.2 Co-production activity per Actor

Actor	Co production activity
User	Uses the service (journey planning) Provides user feedback allowing the system to learn more

Actor	Co production activity
MaaS operator	Aggregates/orchestrates value added services & information and provides journey planning
Travel Service provider Traffic Service provider	Provides added value services concerning the journey planning Accurate and real-time traffic information enables fact based journey planning which optimizes mobility system
Mobility operator	Provides pre-trip scheduled and/or real time information about services and capacity regarding his/her mobility service for the journey planning
Mobility integration platform	Provides pre-trip scheduled and/or real time information (leading to possible rerouting) of all mobility operators supported, for the journey planning
Traffic management operator	Provides real time traffic information, forecasts and prediction for road network as well as re-routing suggestions
Road operator	Sets strategies for timely / comfortable / affordable / safe use of the road

8.3.1.3 Value proposition per Actor

Actor	Value proposition

Actor	Value proposition
User	Customer Trip demand data / Profile data User feedbacks
MaaS operator	Fact based and comprehensive (Accurate , personalised, integrated and) multi modal trip plan Tailor made according to User behaviour and preferences
Travel and Traffic Service provider	Accurate added value services and information
Mobility operator	Accurate and timely information
Mobility integration platform	Accurate and timely information
Traffic management operator	Accurate and timely information
Road operator	Sets the ground for a timely / comfortable / affordable / safe road trip planning

8.3.2 Case study 2: TM Network Optimisation <> MaaS Execution of the Journey

8.3.2.1 Cost Benefit per Actor

Actor	Cost	Benefit
User	Profile – Actual Trip data On trip support fee (possible but not mandatory)	Accurate on trip information Lees effort for multimodal trip
MaaS operator	Operational and maintenance costs Marketing costs Investment costs for development of the application and integration with other service providers/mobility operators Risk of failure because of novel business Costs for purchasing data/added value services	Profit Profit from novel market New service opportunity → New business model as a e-marketplace for mobility For a city: improvement of quality of service User data
Travel and Traffic Service provider	Increased operational and maintenance costs Open to comparison/competition with other SPs in the same time	New customers and new sales channel New sources of data Increased profit Feedback from users for service quality User data
Mobility operator	Integration and interface development costs Increased operational and maintenance costs Open to comparison/competition with other MOs in the same time	New customers and new sales channel New sources of data Increased profit

Actor	Cost	Benefit
		User data Aggregated Travel data Multimodal Data analytics
Mobility integration platform	Integration and interface development costs Increased operational and maintenance costs	New customers (MAAS operators) New sources of data enabling new services Increased profit User generated data
Traffic management operator (and/or Multimodal mobility management)	Integration and interface development costs Develop new tools for forecasting, prediction models etc Increased operational and maintenance costs Interaction with multimodality Take into account constraints from concession contracts	Feedback channel, containing real-time information of the trips has an impact on the decision making at traffic management side, enabling a real-time reaction to demand spread across the road network. Congestion avoidance, travel times improvements (better QoS), pollution reduction (CO2 and other emmisions) Control strategies can be actuated through the MaaS offering with the final objective to incentive modal shift (also in case of incidents or emergencies). Combine it with park and ride Increased access of users to traffic information (MAAS is a new info channel)
Road operator	Adapt road strategies to multimodality and new	Increased road capacity via on trip information and

Actor	Cost	Benefit
	business models	applying control strategies Increased tolling based on improved service

8.3.2.2 Co-production activity per Actor

Actor	Co production activity
User	Uses the mobility services Receives and reacts to real time information en-route Provides user feedback to stakeholders
MaaS operator	Aggregates/orchestrates added value services & real time information
Travel and Traffic Service provider	Provides added value services such as real-time traffic information which optimizes travel suggestions provided to end user
Mobility operator	Provides real time information and service updates regarding his/her mobility service

Actor	Co production activity
Mobility integration platform	Provides real time information
Traffic management operator	Provides real time traffic information and forecasts for road network as well as re-routing suggestions based on TM strategies and plans
Road operator	Sets strategies for timely / comfortable / affordable / safe use of the road

8.3.2.3 Value proposition per Actor

Actor	Value proposition
User	Customer Trip data / Profile data User feedbacks
MaaS operator	FACTUAL & COMPREHENSIVE (Accurate , personalised, integrated) and multi modal real time information and traffic management suggestions Tailor made according to User behaviour and preferences

Actor	Value proposition
Travel and Traffic Service provider	Accurate added value services and real time information
Mobility operator	Accurate real time information
Mobility integration platform	Accurate real time information
Traffic management operator	Accurate real time information & network optimization measures (routes/time affected)
Road operator	Sets the ground for a timely / comfortable / affordable / safe road trip execution