Ministry of Infrastructure
and Water Management

Blueprint for an API
From Transport Operator to MaaS Provider

Version 1.1

MaaS
Mobility as a Service

Blueprint for an

Application Programming Interface (API)

from Transport Operator
to MaaS Provider

a first technical milestone towards Mobility as a Service

Version 1.1
21-10-2019

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1 Introduction

Mobility as a Service (MaaS) offers the opportunity for seamless travel using any available transport mode. For MaaS to be successful, transport operators are required to share their transport services and availability of their assets in a digital form. To facilitate MaaS providers and thus enable the deployment of MaaS services, transport operators are also required to standardize the digital form to facilitate access to their information. Fig. 1 below depicts the concept of having standard-based APIs from Transport Operators (TO) to or from MaaS Providers (MP).
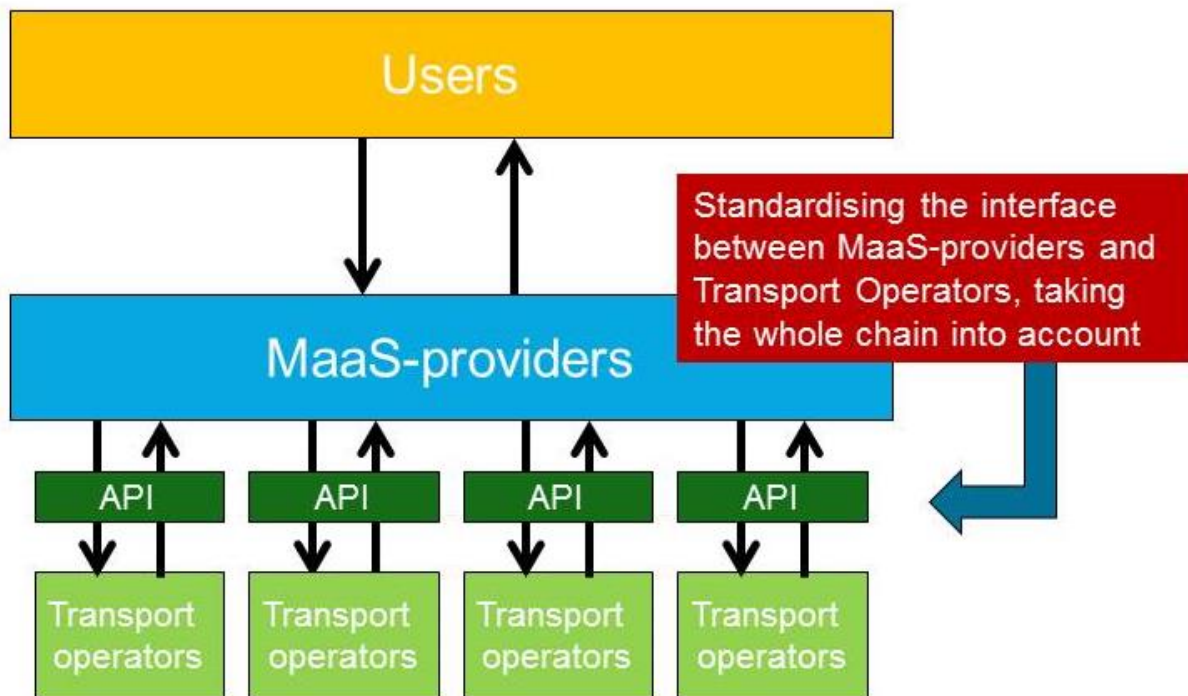
Fig. 1: Standard-based APIs for Transport Operators to/from MaaS providers

2 Goal of this document

In this Blueprint for an Application Programming Interface (API) from Transport Operators to MaaS Providers we look into the necessary functional requirements for the interoperability between transport operators. The goal of this document is to:
- Define the necessary scope for full interoperability between transport operators for the deployment of MaaS services, always keeping the customer journey in mind to determine which calls are needed between MaaS-providers and Transport Operators.
- Define the necessary parameters and values to fulfill this scope
- Define the available parameters in various already available APIs and propose amendments where applicable.

3 Who is involved

This document has been written to consolidate the work of:
- The technical working group of 20+ on-demand car operators involved in deploying interoperable services to support MaaS-development in the Netherlands, including the eMaaS project team at the University of Twente.

- The 24 consortia that have signed the framework agreement of the Ministry of Infrastructure and Water Management in the Netherlands, who have reviewed the work starting from v0.7.
- The 65 participants in the precompetitive dialogue phase of the MaaS-Programme of the Ministry of Infrastructure and Water Management in the Netherlands, who have reviewed the work starting from v0.8.

4 What is in this version

Version 1.1 has been updated by the Transport Operator – MaaS Provider (TO-MP) API working group after an in-depth analysis of the functionalities presented in the previous version and their possible implementation limitations. To improve the capabilities of the TO-MP API, the major changes presented in version 1.1 are:

- Update of the planning phase, including time-to-live for the availability of assets.
- Update of booking phase, including the definition of booking states and temporary reservation of assets.
- Update of Trip Execution (TE) phase, including the definition of TE states and the allocation of specific assets for specific trips.
- The API specification has been adjusted to a consistent and uniform REST format.
  - o All API calls for the planning, booking, and trip execution phases have been defined and/or updated.
  - o A clear indication of the endpoints for Transport Operators (TOs) and MaaS Providers (MPs) within the TO-MP API has been made.
- The appendices have been extended. Including now a list of terms and definitions for a better understanding of the TO-MP API setting, and a summary of the Dutch passengers' characteristics dictionary.

In addition, annexed to this version of the TO-MP API blueprint, a quick start guide for developers has been created. This guide includes some examples and supportive documentation aiming to facilitate the implementation of the TO-MP API. The quick start guide (wiki) as well as the current developments of the TO-MP API can be consulted at:

https://github.com/efel85/TOMP-API

Likewise, a digital version of the necessary API calls is available for consultation at: https://app.swaggerhub.com/apis-docs/efel85/TOMP/1.1 (see also *Table 1* in §7, p. 10).

5 To be added after this version

In no particular order, the following developments are envisioned for future versions:
- Further (continuous) refinement after testing and implementation
- Specification of payment/ticketing-API from ETC
- Dynamic navigation to appropriate resources for API-calls listing asset characteristics, using HATEOAS or other.
- Standardization of support calls (e.g. flat tire is 001)
- Addition of infrastructure assets, e.g. EV charging stations
- Determine pagination and rate limiting requirements
- Define and describe OAuth scopes for flows
- Calls for feedback and ratings between users and transport operators

6 User Stories

To facilitate the definition of parameters and values that are required for full interoperability in MaaS, user stories have been defined from three different perspectives: the User, Transport Operator (TO) and MaaS Provider (MP).

By using these three perspectives, the chances are increased that all necessary functionalities for MaaS are taken into account. These functionalities can then be related to the necessary interface specifications between the Transport Operator and MaaS Provider. This document does not set up any requirements for the human-machine-interface (HMI) between Users and MaaS Providers.

Definitions within the User Stories

Definition	Meaning
API	Application Programming Interface, using REST-APIs as architectural style
User	Customer wanting to make a journey
Maas Provider	Provider of travel advice, information, booking and invoicing
Transport Operator	Owner of (any) transport assets. This can be a bike sharing or car sharing platform, public transport operators, taxi companies, ferry operators etc.
Required for MaaS	Yes = mandatory Conditional = mandatory for some operators Optional = mandatory for no operators
User	Competence = is the user able Conditions = is the user compliant Authentication = confirmation of identity/profile/token

Part 1: From a USER perspective

Item	1.1
Who	As a USER
What	I want to depart from STARTLOCATION and arrive at DESTINATION
Why	To define from where to where I need mobility services for my trip
Required for MaaS	STARTLOCATION=yes DESTINATION=conditional
Comments	*Some transport operators require the asset to be brought back to a specific station or zone. This requires knowledge about the desired destination or trip (single, return, multi-leg).*

Item	1.2
Who	As a USER
What	I want to know the PRICING of my trip
Why	To determine how expensive my trip will be
Required for MaaS	PRICING=yes
Comments	

Item	1.3
Who	As a USER
What	I want to receive a single INVOICE for my entire trip
Why	To simplify my cost overview
Required for MaaS	INVOICE=yes
Comments	

Item	1.4
Who	As a USER
What	I want to give a RATING and see other ratings of a transport operator
Why	To leave my feedback or determine if I want to use a certain transport operator
Required for MaaS	RATING=optional
Comments	

Item	1.5
Who	As a USER
What	I want to be able to REPORT an issue
Why	In case the asset I want to use has a problem/damage/issue
Required for MaaS	REPORT=yes
Comments	*Maybe this doesn't have to be available in an API, but needs to be covered by B2B arrangements. A User want the MaaS Provider to solve any issues, as this is their travel interface. A booking should only be made if an asset has no known technical issues, a transport operator should facilitate this.*

Item	1.6
Who	As a USER
What	I want to be able to select an asset based on COMPETENCES of the vehicle
Why	To fit with the criteria for my trip
Required for MaaS	COMPETENCES=yes

Comments	*E.g. selection of number of seats, type of vehicle, range, fuel type etc.*
	• *Proposals:*
	    o *No of passengers*
	    o *Propulsion (e.g. hydrogen)*
	    o *Vehicle class*
	    o *Brand*
	    o *Type*
	    o *Bicycle type (men, women, tandem)*
	    o *Steering wheel on left or right*
	    o *Colour*
	    o *State of charge (%)*
	    o *Exclusive yes/no (in case of ridesharing)*
	    o *Type of access/key*
	    o *Towing hook*
	    o *Airconditioning*
	    o *Cabrio*
	    o *Child's seat*
	    o *Winter tires*
	    o *Allowed to travel abroad*
	    o *Pets allowed*
	    o *Smoking allowed*
	    o *Underground parking allowed*
	    o *Easy accessibility to location (lift, escalator)*

Item	1.7
Who	As a USER
What	I want to receive SUPPORT during my trip
Why	In case I want to be guided along my travel, get additional suggestions or need any kind of support.
Required for MaaS	SUPPORT=yes
Comments	*Added in v0.9*

Part 2: From a MaaS Provider perspective

Item	2.1
Who	As a MAAS PROVIDER
What	I want to know which travel means are available around STARTLOCATION which allow to reach DESTINATION
Why	To give travel advice to the USER
Required for MaaS	STARTLOCATION=yes DESTINATION=conditional
Comments	*The destination is not always relevant, but some assets need to be brought back to their specific station or zone or even if a one way trip is possible, to a specific zone or station at destination location*

Item	2.2
Who	As a MAAS PROVIDER
What	I want to know if the trip starts at STARTLOCATION and ends at DESTINATION
	Or will end at the STARTLOCATION
Why	To define my travel options to the USER
Required for MaaS	STARTLOCATION=yes
	DESTINATION=conditional
Comments	Covered by user story 2.1
	The destination is not always relevant, but some shared bikes need to be brought back to their specific station or zone or even if a one way trip is possible, to a specific zone or station at destination location

Item	2.3
Who	As a MAAS PROVIDER
What	I want to know the ACCEPTABLE DISTANCE for the USER from LOCATION X to STARTLOCATION
Why	To define the travel options to the USER
Required for MaaS	ACCEPTABLE DISTANCE=optional
	LOCATION X=optional
Comments	*A user can have a preference for maximum distance he/she wants to walk to reach a bicycle.*
	Proposed standard value = 500 meters

Item	2.4
Who	As a MAAS PROVIDER
What	I want to know the CONDITIONS of a transport operator
Why	To define the travel options to the USER
Required for MaaS	CONDITIONS=yes (but can be periodical)
Comments	*E.g. business conditions, user conditions for the rental of the asset etc. These can be updated every week or month (t.b.d.), and do not necessarily have to be requested with each query*

Item	2.5
Who	As a MAAS PROVIDER
What	I want to be able to place a BOOKING with a TRANSPORT OPERATOR
Why	To book an asset beforehand
Required for MaaS	BOOKING=conditional
Comments	*This could also be done without a USER requesting a booking. In this case the booking risk lies with the MAAS PROVIDER instead of the TRANSPORT OPERATOR. In this case, the TO's own clients might not have access to the assets if the MP books everything in advance.*

Item	2.6
Who	As a MAAS PROVIDER
What	I want the USER to be able to OPEN/CLOSE/PAUSE the asset through my interface
Why	To make the use of the asset as easy as possible
Required for MaaS	OPEN=conditional
	CLOSE=conditional
	PAUSE=optional
Comments	*Requires information on the locking systems of operators. Pausing is an optional function to allow different pricing models when asset is temporarily parked by user*

Item	2.7
Who	As a MAAS PROVIDER
What	I want to give my USER on-the-fly USAGE INFORMATION about the asset usage and the booking from the TRANSPORT OPERATOR
Why	To avoid having to keep and update all the information myself
Required for MaaS	USAGE INFORMATION=conditional
Comments	*A transport operator could like to send real-time usage instructions (e.g. "please unlock the bike now using the QR-code") to the User through the MaaS-provider interface.*

Item	2.8
Who	As a MAAS PROVIDER
What	I want to patch my USER through to the HELPDESK of the TRANSPORT OPERATOR in case of issues
Why	To deliver the best support possible
Required for MaaS	HELPDESK=yes
Comments	*A Transport Operator can give specific support about the asset in case of issues. A direct link between User and Transport Operator is required, the MaaS Provider can facilitate this link through their service. As a reference, insurance companies offer similar assistance, where a neutral helpdesk can take on the 'image' of the insurance provider that manages the specific contract of the User.*

Item	2.9
Who	As a MAAS PROVIDER
What	I want to be able to CANCEL/MODIFY a transaction or booking
Why	To inform the TRANSPORT OPERATOR about any changes
Required for MaaS	CANCEL=yes MODIFY=yes
Comments	*MaaS providers need to be able to cancel or modify transactions or bookings on behalf of their users.*

Item	2.10
Who	As a MAAS PROVIDER
What	I want to know if my USER can share a journey or booking with a USER from another MAAS PROVIDER
Why	To efficiently make use of available transportation through carpooling or ridesharing
Required for MaaS	No
Comments	*This allows higher occupancy of available assets through ridesharing and carpooling*

Item	2.11
Who	As a MAAS PROVIDER
What	I want to receive information on public transport USER stops and line information
Why	To plan an efficient route for my USER and give the necessary SUPPORT along the journey
Required for MaaS	No
Comments	*For planning purposes, e.g. information on kerbs, ramps, lights, displays, linetype and transport operator*

Part 3: From a Transport Operator perspective

Item	3.1
Who	As a TRANSPORT OPERATOR
What	I want to know from when to when (TIME T1 to TIME T2) the USER wants to use my assets
Why	To define if this fits my offer of assets
Required for MaaS	TIME T1(START TIME/DAY)=conditional TIME T2(END TIME/DAY)=conditional
Comments	*This is optional, only required in case of usage restrictions of the Transport Operator or to implement the option to book an asset beforehand (long-term).*

Item	3.2
Who	As a TRANSPORT OPERATOR
What	I want to know the DESTINATION of the USER
Why	To determine if my assets are suitable or available
Required for MaaS	DESTINATION=conditional
Comments	*The destination is not always relevant, but some shared bikes need to be brought back to their specific station or zone or even if a one way trip is possible, to a specific zone or station at destination location*

Item	3.3
Who	As a TRANSPORT OPERATOR
What	I want to know if the USER has the right USER COMPETENCE
Why	To determine if the USER is allowed to use my assets
Required for MaaS	USER COMPETENCE=yes
Existing API's	Not available/necessary in GBFS, use other MaaS-API specs.
Comments	*E.g. the user should have a driving license, correct contact details, a membership etc. This could be a liability issue that needs to be covered with insurance providers.*

Item	3.4
Who	As a TRANSPORT OPERATOR
What	I want to know if the USER complies with my USER CONDITIONS before starting a trip
Why	To determine if the USER is allowed to use my assets
Required for MaaS	USER CONDITIONS=yes
Comments	*E.g. user is not on a blacklist, registered member*

Item	3.5
Who	As a TRANSPORT OPERATOR
What	I want to give a RATING and see other ratings of a USER
Why	To leave my feedback about and determine if USER can use my asset
Required for MaaS	RATING=optional
Comments	*A transport operator might want to rate a user or determine if a user is allowed to use an asset based on their rating*

Item	3.6
Who	As a TRANSPORT OPERATOR
What	I want to be able to receive USER AUTHENTICATION
Why	To confirm the identity of the USER using my asset
Required for MaaS	USER AUTHENTICATION=yes
Comments	*Authentication provides the transport operator with a confirmation of a user's identity, profile or token.*

Item	3.7
Who	As a TRANSPORT OPERATOR
What	I want to be able to notify the MaaS provider to CONTACT the USER
Why	In case of problems, emergencies or other issues
Required for MaaS	CONTACT=yes
Comments	*A transport operator can give specific support about the asset in case of issues. A direct link between user and transport operator is required, the MaaS Provider can facilitate this link through their service (see also item 2.8).*

Item	3.8
Who	As a TRANSPORT OPERATOR
What	I want to be able to CANCEL/MODIFY a transaction or booking
Why	To inform the MAAS PROVIDER about any changes
Required for MaaS	CANCEL=yes MODIFY=yes
Comments	*Transport operators need to be able to cancel or modify transactions or bookings in case an asset is unavailable or delayed.*

7 Process Flows

Together with the eMaaS project team from the University of Twente, process flows for the customer journey have been defined. This helps to scope the necessary functions required in the API building blocks.

The goal is to accommodate different business models within these functional flows. Since the focus lies on sharing asset information, both, the asset information from free-floating

systems (bike sharing, car sharing, ride sharing, taxi) and the information from (virtual) station- or fixed-route- based systems (such as public transport, (virtual)mobility hubs or station-dependent transportation) can be shared through the functional descriptions provided in this chapter.

Functional Blocks

The Transport Operator to MaaS Provider (TO-MP) API is composed of 8 functional blocks. Fig. 2 below aims at giving a general overview of the different functional modules within the TO-MP API.
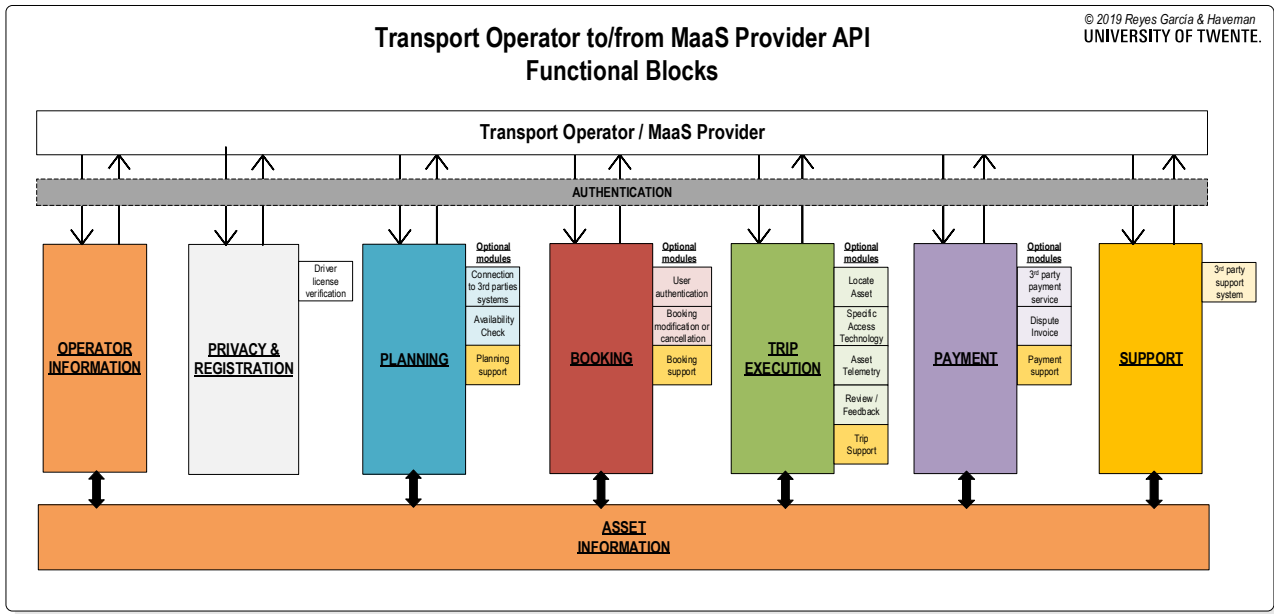

Fig. 2: Functional blocks of the TO-MP API

The different functions for the interface between MaaS Providers and Transport Operators are described as follows:

- ➢ Operator Information/General Information: Gives static information on the operator according to the GBFS(+) standard.
- ➢ Privacy & Registration: Offers the possibility for users to delete, sign-up or log-in into their account with the MaaS provider
- ➢ Planning: Gives information about availability, estimated travel time and costs.
- ➢ Booking: Allows booking of a specific asset for a specific place, time and date.
- ➢ Trip Execution: Allows access to asset and travel during booked period.
- ➢ Payment: Allows payment of the service. Supports different business models (i.e. pay-as-you-go or subscription-based).
- ➢ Support: Assists users in the solution of operational troubles encountered during any part of the process. Connects with optional support modules.
- ➢ Asset Information: Is defined as a separate module that can be used by other modules to supplement API calls with specific asset information where applicable. Assets can be vehicles or for example infrastructural assets.
- ➢ Optional modules: The more dynamic functional blocks have additional optional modules which are used for execution of sub-processes derived from the main functions which might not be desired or required depending on scope of the MaaS implementation and Business Models.

API Authentication

Fig. 3 below shows that the API features authentication for each call to allow secure communication and exchange of information between Maas Provider and Transport Operators.
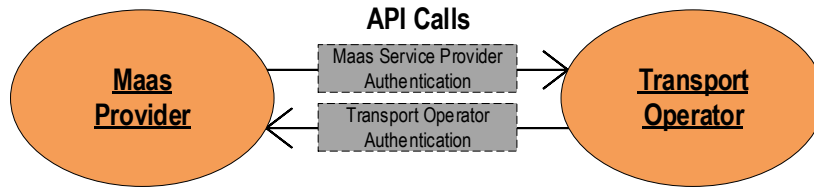
Fig. 3: API calls and authentication

MaaS Provider authentication and authorization should take place following OAuth 2.0 standards using either Authorized Code or Resource Owner password credentials flows/grant types. The flows are scenarios an API client performs to get an access token from the authorization server.

OAuth 2.0 provides the below mentioned flows suitable for the types of API clients we are looking for in MaaS. The relevant security schemes have been also included in the OpenAPI 3.0 description on Swaggerhub.

Authorization code – The most common flow, mostly used for server-side and mobile web applications. This flow is similar to how users sign up into a web application using their Facebook or Google account.

Resource owner password credentials (or just *password*) – Requires logging in with a username and password. Since in that case the credentials will be a part of the request, this flow is suitable only for trusted clients (for example, official applications released by the API provider).

A Transport Operator might require authentication to communicate with a MaaS Provider, for example to manage (update/cancel) a booking or to send a callback request. That makes bidirectional authentication necessary.

Operational view of the API

Fig. 5 to Fig. 9 on the following pages show an operational view of the API. These are separated in a technical process flow and a user journey. The figures are accompanied by a description of how the necessary functions between MaaS Provider and Transport Operator are fulfilled in the current API specification.

The API calls, as described in Swaggerhub (see Table 1), are also indicated in the process flow. Moreover, Optional Modules are shown throughout the operational flows to point out (external) procedures that can happen within the current process.

Table 1. Overview of API calls as described in Swaggerhub

Reference #	API call	Description
1. Operator information		Gives information about systems, stations, operating hours
1.1	GET/operator/stations	All stations contained in this list are considered public (i.e., can be shown on a map for public use). If there are private stations these should not be exposed here and their status should not be included [Source: GBFS].
1.2	GET/operator/alerts	Informs customers about changes to the system outside of normal operations. This feed is intended to inform customers about changes to the system that do not fall within the normal system operations. For example, system closures due to weather would be listed here, but a system that only operated for part of the year would have that schedule listed in the system-calendar.json feed[Source: GBFS].
1.3	GET/operator/operating-calendar	Describes the operating calendar for a system. An array of year objects defined as follows (if start/end year are omitted, then assume the start and end months do not change from year to year) [Source: GBFS].
1.4	GET/operator/operating-hours	Describes the hours of operation of all available systems of the transport operator [Source: GBFS].

1.5	GET/operator/information	Describes the system including System operator, System location, year implemented, URLs, contact info, time zone [Source: GBFS].
1.6	GET/operator/pricing-plans	Describes pricing of systems or assets [Source: GBFS].
1.7	GET/operator/regions	Describes regions for a system that is broken up by geographic or political region. It is defined as a separate feed to allow for additional region metadata (such as shape definitions) [Source: GBFS].
2. Planning		Gives information about transport asset availability pricing [free_bike_status and system_pricing_plans in GBFS].
2.1	POST/planning-options/	Returns available transport options for given coordinate and radius. Start time can be defined, but is optional. If startTime is not provided, but required by the third party API, a default value of "Date.now()" is used. [from MaaS-API /listing]. During the routing phase this service can be used to check availability without any state changes.
3. Booking		A booking is the main object exchanged between MP and a TO. This section contains the functionalities to reserve a leg (part of a trip) for one asset (or asset-type), including the non-happy paths (cancel, expire etc).
3.1	POST/bookings/	Creates a new Booking for the TO in Pending state. The ID of the posted booking should be the ID (optionally) provided in the planning phase (see 2.1 planning-options). A Booking may be modified in the response, e.g. location being adjusted for a more suitable pick-up location. In addition, the service may contain a meta attribute for arbitrary TO metadata that the TO needs later, and token attribute depicting how long the current state is valid.
3.2	POST/bookings/{id}/events	This endpoint must be used to alter the state of a booking through the operations CANCEL, EXPIRE and COMMIT.
3.3	GET/bookings/{id}	Returns the booking. In the 'meta'-field the digital tickets can be returned.
3.4	PUT/bookings/{id}	Optional - This endpoint should be used to adjust the parameters of the booking.
3.5	Booking [optional]	Endpoints that can facilitate the booking processes in but are not necessary for a minimal viable product. For example, for getting information, updating (parts of) a booking (not the state!) or adding and/or removing subscriptions (webhooks).
3.5.1	GET/bookings/	Returns bookings that have been created earlier, selected on state.
3.5.2	POST/bookings/{id}/subscription	Optional - subscribe to a specific booking (=leg & (type of) asset). This is an optional endpoint. This endpoint facilitates notifications in all the phases.
3.5.3	DELETE/bookings/{id}/subscription	To unsubscribe to a specific booking.
4. Trip Execution		Supports the complete trip execution process. It contains, for example, getting an available asset, assigning the asset to a leg, starting, pausing or finishing a leg (all by using the POST /legs/{id}/events), or updating a leg (not the state).
4.1	GET/legs/{id}/available-assets	Returns a list of available assets for the given booking. These assets can be used to POST to /legs/{id}/asset if no specific asset is assigned by the TO. If picking an asset is not allowed for this booking, or one already has been, 403 should be returned. If the booking is unknown, 404 should be returned.
4.2	GET/legs/{id}	Retrieves the latest summary of the leg, being the execution of a portion of a journey travelled using one asset (vehicle). Every leg belongs to one booking, every booking has at most one current leg. Where the booking describes the agreement between user/MP and TO, the leg describes the journey as it occurred.
4.3	PUT/legs/{id}	Updates the leg with new information. Only used for updates about execution to the MP. To request changes as the MP, the booking should be updated and the TO can accept the change and update the leg in turn.

(4.4)	POST/legs/{id}/events	This endpoint must be used to alter the state of a leg through the operations: PREPARE, ASSIGN_ASSET, RESERVE, SET_IN_USE, PAUSE, START_FINISHING and FINISH.
(4.5)	GET/legs/{id}/progress	Monitors the current location of the asset and duration & distance of the leg.
(4.6)	POST/legs/{id}/progress	Monitors the current location of the asset and duration & distance of the leg.
(4.7)	Trip Execution [optional]	Endpoints that can facilitate processes in the trip execution process, but are not necessary for a minimal viable product.
(4.7.1)	GET/legs/{id}/asset	Returns the specific asset used for this leg. If no asset is assigned, this will result in an asset object with only the asset type completed.
5. Payment		Arranges financial settlement for legs.
(5.1)	PATCH/payment/{id}/claim-extra-costs	Extra costs that the TO has to charge to the MSP. The MSP should consider what to do with these costs
6. Support		Support for the user while the trip is being executed.
(6.1)	PUT/support/{id}/request/{support-type}	Identifies a request for support from user via MP and modifies a support request.
(6.2)	GET/support/{id}/status	Identifies the current status of the support request.
7. General		General operations (e.g. notifications).
(7.1)	GET/bookings/{id}/notifications	Retrieves all notifications concerning events related to this booking.
(7.2)	POST/bookings/{id}/notifications	For notification between MP and TO in case of user no-show or if specific asset is not available or some other event occurs not covered by other API calls.

As a summary of the data exchanged provided by the API calls, Fig. 4 shows an overview of the data sets blocks and units exchanged between the Transport Operators and MaaS Providers within the TO-MP API.
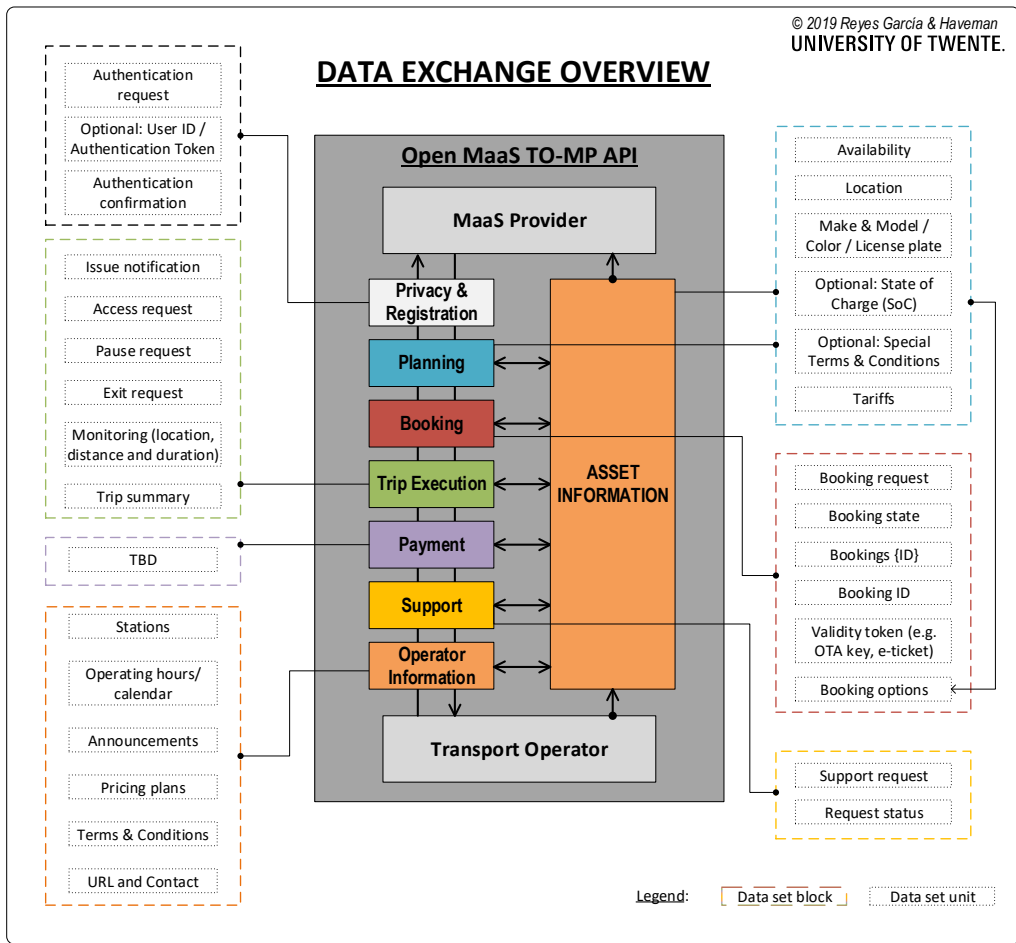

Fig. 4: Data exchange overview of TO-MP API

Privacy & Registration and Planning

The first operational block in the TO-MP API is the privacy and registration or deregistration block. This block offers the possibility for users to either delete, sign-up or log-in into their account with the MaaS Provider (MP). The TO-MP API would enable the possibility to use the costumer account with a specific Transport Operator (TO) to log-in into the MP system.

Planning forms the exploration phase of a trip, where options are explored by the User through the MP. The MP has an archive of (semi-)static general information which is periodically retrieved from the TO. Thus, the MP can check real-time availability of assets to give different travel options to the User. Table 2 below presents the functions between the MP and TOs within the planning process, which relate to the user stories presented earlier in §6 and to available API calls from similar API specifications.

Table 2. Functions between the MaaS Provider and Transport Operator within the planning process.

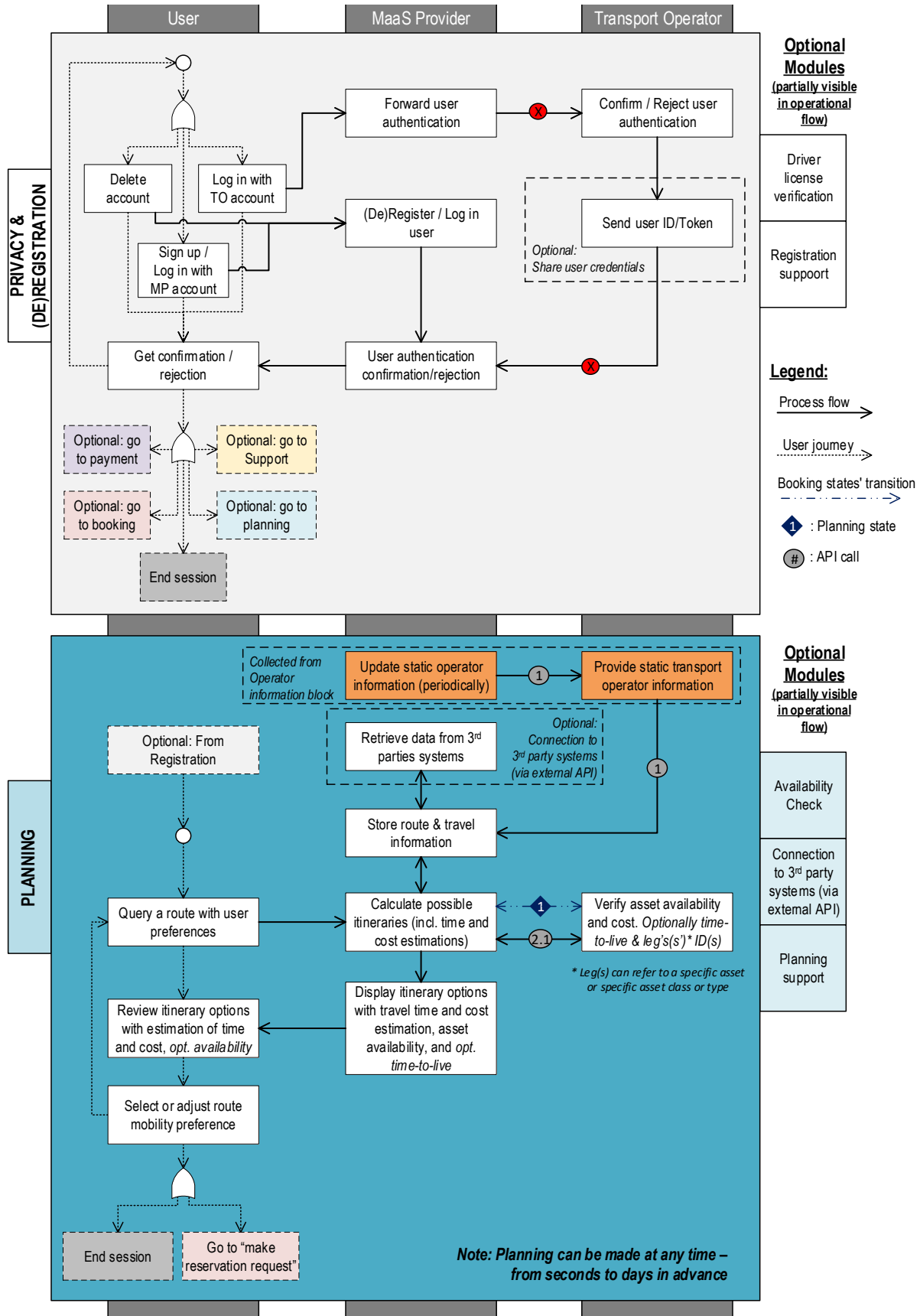| Category	Function	User Story	Reference
Planning	Update static operator information > provide static operator information	1.2; 1.6; 2.1; 2.2; 2.3; 2.4; 3.4	General Information [from GBFS]
Planning	Check availability of trips > Verify availability and temporarily reserve asset	1.1; 1.2; 2.1; 2.2; 2.3; 3.2	Asset availability and competences [from GBFS and amended]

Fig. 5: Operational view of the Registration & Planning modules

Booking

Booking is the phase where the User will commit to a certain travel option offered by the MaaS Provider (MP). This can be a result of the Planning phase, or in case Users know exactly which ticket or booking they want, the result of a new booking request directly. Table 3 below presents the functions between the MP and Transport Operators within this process, which relate to the user stories presented earlier in §6 and to available API calls from similar API specifications.

Table 3. Functions between the MaaS Provider and Transport Operator within the booking process.

Category	Function	User Story	Reference
Booking	Make booking request > Process booking	1.6; 2.5; 3.1; 3.2	Booking > POST/bookings/
Booking	Provide User Authentication > Request User Authentication	3.3; 3.4; 3.6	Components/securityschemes [from MaaS Alliance API]
Booking	Cancel / Modify Booking	1.5; 2.9; 3.8	Booking > PUT/bookings/{id}

In addition, Table 4 below describes the transition states that take place during the booking process. All these states are helpful to understand the steps and actions within the process of making a reservation. The booking states are also indicated in the operational flow presented in Fig. 6.

Table 4. Transition states of the booking process

| Phase	#	State	Description
Planning	1	Availability check	In the planning phase, a MP can check the real-time availability of assets from a TO. In this way, a MP can offer their Users an overview of which assets and options are currently available following the User's request (for a specific mode, a specific location or other User conditions). A time-to-live can optionally be added to the response to show the User how long the information will be valid for.
Booking	2	Availability request	Once the User has narrowed down their selection, the MP can send an availability request to the TO for a specific asset (or asset type) selection.
	3	Pending	This changes the booking state to PENDING and temporarily 'freezes' an asset while the User is finalizing the selection (i.e. while the User is having to choose multiple options for multiple legs of a journey). A time-to-live in the availability confirmation response is mandatory.
	4	Released	If a User decides to go for other options than the one(s) narrowed down, the PENDING state can be cancelled by the MP. The Booking State is changed to RELEASED.
	5	Expired	If the expiry time for the PENDING state is reached (as defined in the time-to-live in the availability confirmation), because the User has not (yet) made a selection, the booking state changes to EXPIRED and the corresponding asset(s) are no longer 'frozen' for the specific request.
	6	Confirmed	If a User confirms the selection of a given option, the asset (or asset type) is requested from the MP to the TO and the Booking State changes to CONFIRMED (in case the "authentication" and payment conditions are met) or to REJECTED (in case the "authentication" and/or "payment" conditions haven't been met).
	7	Rejected	
Trip Execution	8	Started	Once the confirmed asset is in use, the Booking State is changed to STARTED.
	9	Finished	Once the asset is returned, the leg is considered completed and the booking state is changed to FINISHED.
Booking & Trip Execution	C	Cancelled	If the asset confirmation is cancelled by the MP (which could also happen upon request from the User), the Booking State changes to CANCELLED, and the corresponding terms and conditions for cancellations between TOs and MPs apply. If the asset confirmation is cancelled by the TO (in case of a broken down vehicle, late return etc.), the booking state changes to CANCELLED, and the corresponding terms and conditions for cancellations between TOs and MPs apply.
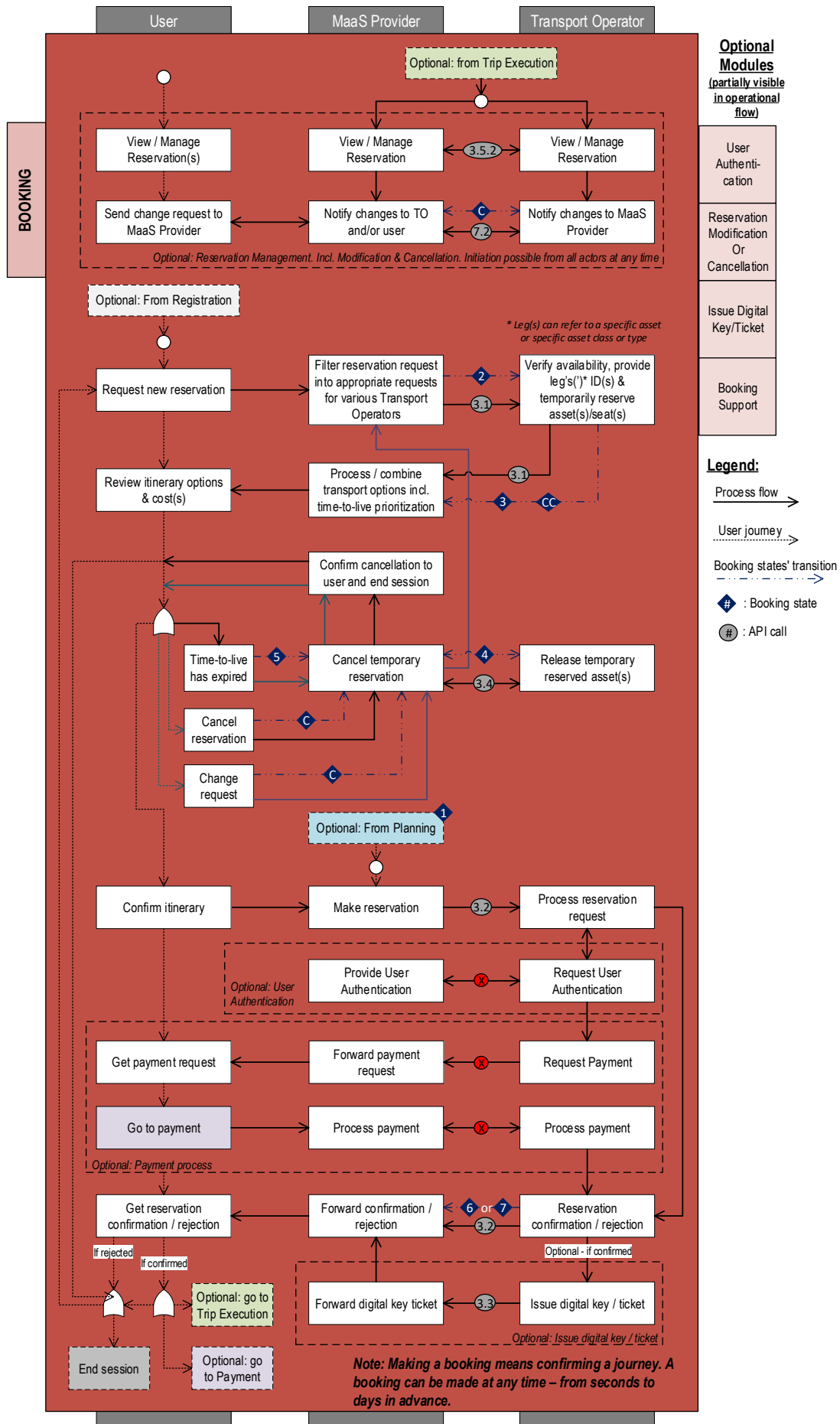
Fig. 6: Operational view of the Booking module

Trip Execution

The trip execution module offers all functionalities for the User during the trip. This includes breakdown into different legs, access to the asset, ending a leg and monitoring a trip. When all legs are concluded, summaries of the specific legs are exchanged to offer the User a complete overview of the executed trip. Table 5 below presents the functions between the MaaS Provider and Transport Operators within this process, which relate to the user stories presented earlier in §6.

Table 5. Functions between the MaaS Provider and Transport Operators within the Trip Execution process.

Category	Function	User Story	Reference
Trip Execution	Forward location request > provide location	1.1; 2.1	Asset availability and competences > free_asset_status [from GBFS] New proposal: GET/legs/{id}/progress
Trip Execution	Forward access request > grant / reject access	2.6; 3.6	New proposal: PUT/legs/{id}/events
Trip Execution	Monitor trip <> monitor use of asset	2.7	New proposal: POST/legs/{id}/progress
Trip Execution	Forward exit request > grant / reject exit	2.6	New proposal: PUT/legs/{id}/events
Trip Execution	Generate Trip Summary > Provide Leg Summary	1.3	New proposal: GET/legs/{id}
Trip Execution	Manage Review / Feedback <> Review / Feedback with respect to user	1.4; 2.8; 3.5	New proposal: POST/bookings/{id}/notifications
Trip Execution	Trip support (optional)	2.8; 3.7	New proposal: POST/bookings/{id}/notifications

In addition, Table 4 below describes the transition states that take place during the booking process. All these states are helpful to understand the steps and actions within the process of making a reservation. The booking states are also indicated in the operational flow presented in Fig. 6.

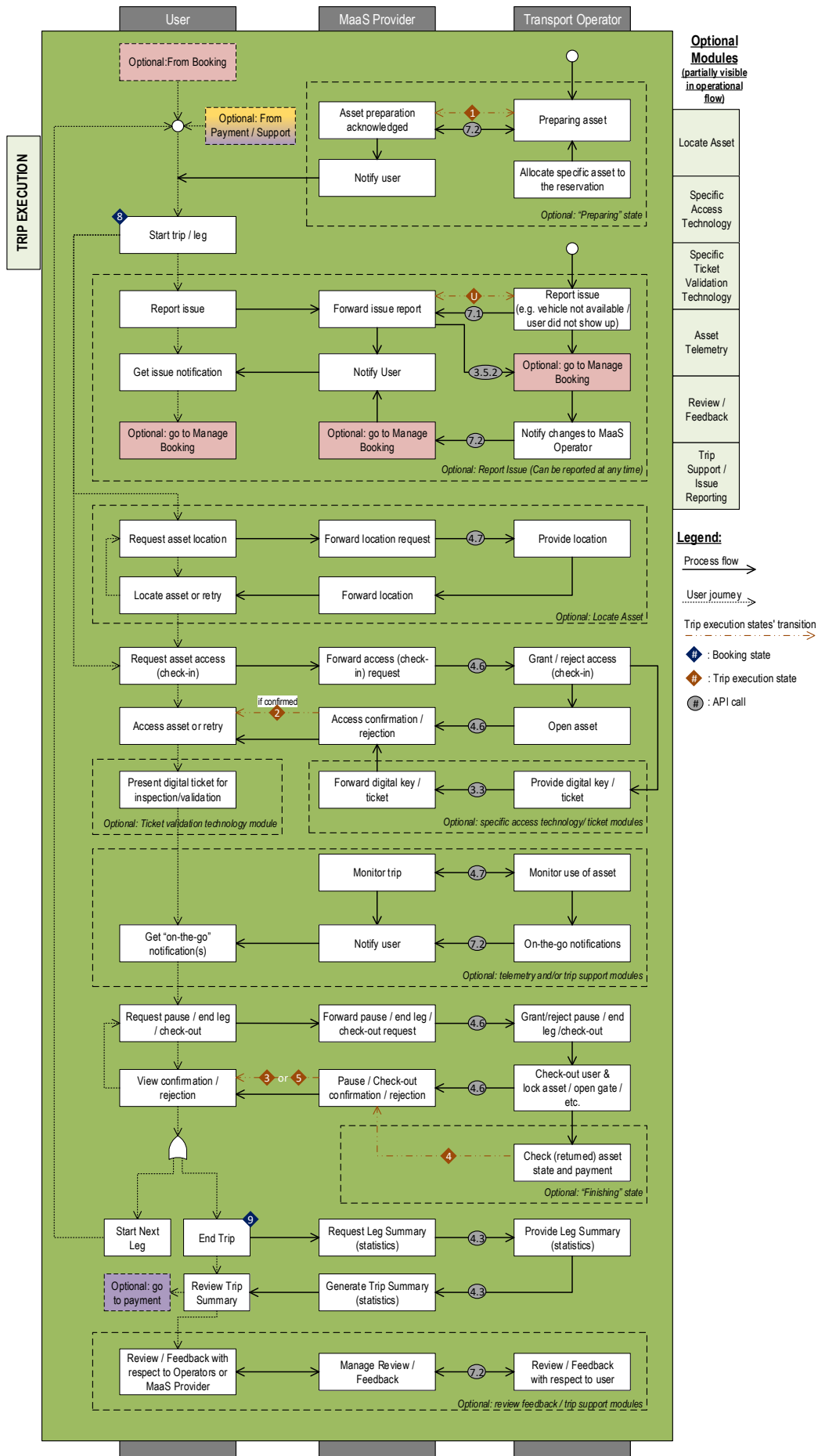| Trip Execution states		
#	State	Description
1	Preparing	When an asset is not yet being used by the user, but is being prepared (e.g. a taxi is coming towards the user, or a rental car is being cleaned before start of the rental).
2	In use	The user has started to use the asset. This can be acknowledged or confirmed either by the TO or MSP, depending on the type of asset.
3	Paused	If possible, an asset that is in use can be paused in order to apply a lower rate (e.g. when parked).
4	Finishing	When the asset is no longer being used by the user, but the Trip execution is not yet finished (e.g. during verification of damages, cleaning of asset, payment check, etc.). At this time the user could have continued with another leg of their trip.
5	Finished	The asset has been returned and the trip/leg is confirmed to be finished.
U	Issue	An issue has arisen during the trip execution, reported by the user through the MSP to the TO.

Fig. 7: Operational view of the trip execution module

Payment

The payment module offers two alternative payment models that can also be used in conjunction: a subscription model and a pay-as-you-go model. A subscription model can be used to determine how much time/distance/credits/etc. a User has spent for the trip and subtract the necessary value. A pay-as-you-go model provides the opportunity for direct invoicing and payment after a trip has been completed. Additionally, the payment module offers a submodule for special payments such as the payment of a deposit, the payment of a fine, payment for damage to the vehicles, etc.

| Functions between MaaS-provider and Transport Operator			
Category	*Function*	*User Story*	*Reference*
Payment/SM	Request / receive payment <> Request / receive payment	1.2; 1.3	t.b.d.
Payment/SM	Manage payment <> manage payment	1.2; 1.3	t.b.d.
Payment/PAYG	Collect total trip costs > calculate trip costs	1.2; 1.3	t.b.d.
Payment/PAYG	Manage dispute <> manage dispute	1.4; 1.5	t.b.d.
Payment/PAYG	Request / receive payment <> Request / receive payment	1.2; 1.3	t.b.d.
Payment/SM	Manage payment <> manage payment	1.2; 1.3	t.b.d.
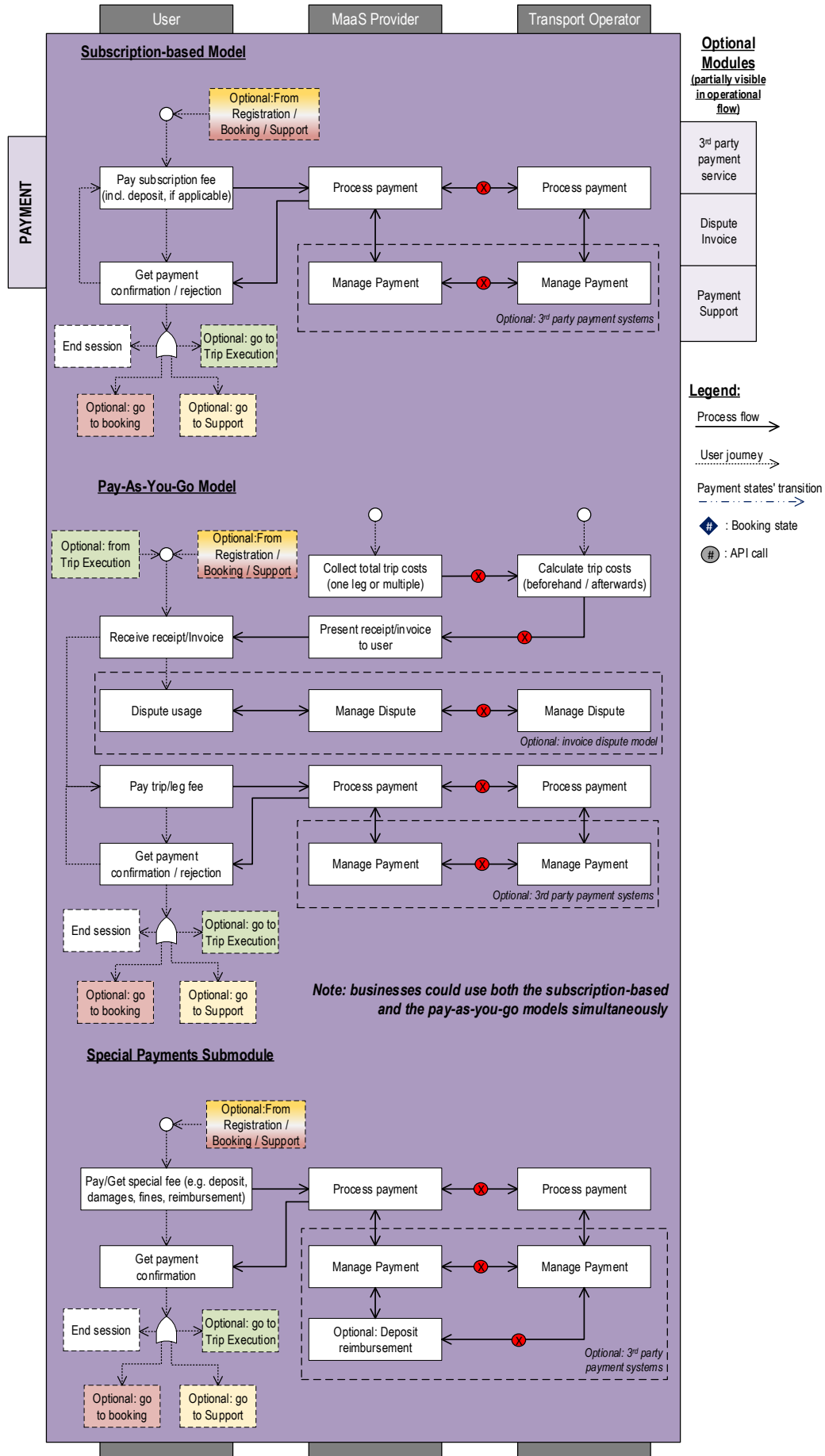
Fig. 8: Operational view of the payment module

Support

The support module offers functional blocks that refer to the technical assistance to the user in case of an issue experienced during any of the other modules. Within this module, optionally, 3rd party systems could be used to solve the user problem.
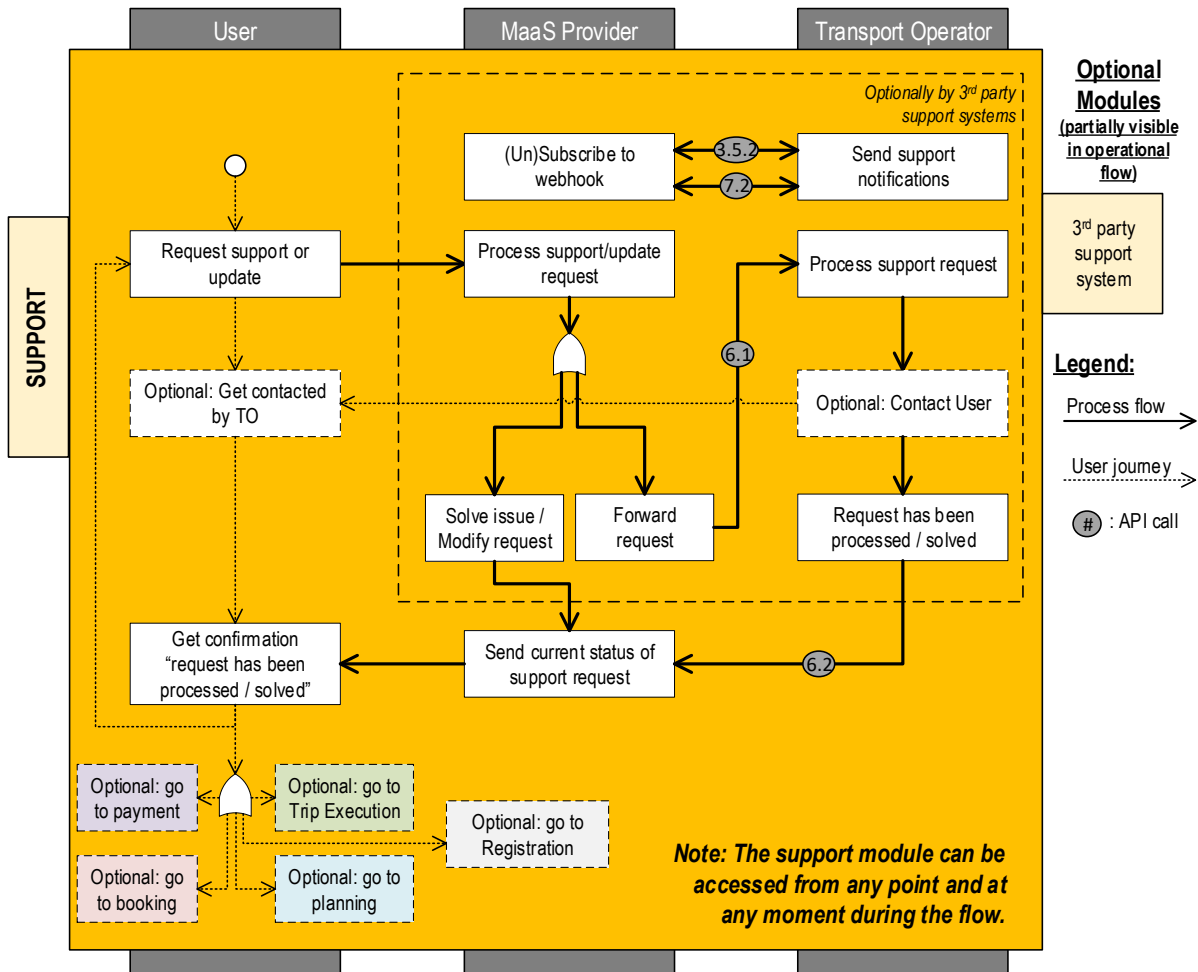

Fig. 9: Operational view of the support module

8 **GBFS+ recommendations**

The following additions to GBFS have been proposed by the technical working group to the GBFS community. The acceptance of these suggestions and future phasing is still to be defined. A national GBFS+ standard can be implemented to speed up developments in the Netherlands.

1. Deep links, Add rental_url to free bikes and stations
There is already a change-requests (from others) for an extension of the standard, covering exactly our wishes. So we include request #25 in GBFS+, which enables deep links.

2. Type_of_system
We will add type_of_system in the "system info" file. Allowed values are [free_floating, station_based, virtual_station_based]

3. Type_of_bike
We add a file "Types_of_bikes" which describes the different bike types (type_id, name, gears, electric, description, img_url)
In free-bike-status file we add the field type_of_bike
(our first proposal on OpenBikeShare Github)

4. TTL
The time to live (TTL) for real-time data feeds will be at most 30s, so that traveller has always the most actual information about the availability of bicycles.

There are some other topics to cover to make an awesome bike standard in the future, but more research has to be done. Possible topics are:

- Which fields should be compulsory?
- Operation area: For a free-floating system we would like to indicate where you can return your bike (for example you are only allowed to return the bike within the city). In this https://github.com/NABSA/gbfs/issues/65 thread there is already a discussion about this idea.
- Virtual stations: We would like to introduce virtual stations (a virtual location where you allowed to park your bike) within GBFS so operators comparable with Donkey Republic are supported as well. We created a proposal. The exact location of a virtual zone should be presented as GeoJSON polygon in station_information.json.
- Option to define a radius around a bike or bikesharing station for location-specific API-calls
- Option to OPEN/CLOSE/PAUSE an asset

9 Technical Specifications

The technical working group suggests to implement this interface using REST-APIs. Other quality specifications are:

Criteria	Value
Time To Live	Max. 30 seconds
Reliability	95%
API-call max radius around asset	500 meters
API-call min radius around asset	10 meters
Pagination of API-responses	t.b.d. after testing of v1.0
Rate limiting	t.b.d. after testing of v1.0

10 To-do's and risks

- Opening and closing of assets can vary greatly between different transport operators. Some regard this technology as their own intellectual property and are not willing to offer external access. This is a risk for common API development and might require further harmonization in the future.
- Which service/helpdesk functions are required for the User?
- Options for ticketing and payment of legs/trips
- Central registry of available stations/hubs/operators and assets, with unique ID's

11 **Appendix**

A.1 - List of terms and definitions

This appendix presents the terms and definitions that served as a reference for the development of the functionalities covered by the TO-MP API.

TERM	DEFINITION	SOURCE
Availability	The ability of an asset to perform a required function under given conditions at a given instant in time, or over a given time interval, assuming that the required external resources are provided.	Adapted from UNISIG (2016)
Booking	The process of making a reservation for space on a means of transport for the movement of people or goods.	Adapted from EC 1305/2014
Booking Process	The process involving those steps necessary to make a reservation, possibly including: - Query of route - Select preferred option - Request reservation - Accept terms and conditions (incl. payment) - Get reservation confirmation	TOMP-API WG (2019)
Booking State	The situation at a particular time during the booking process.	
- Started	User requested the usage or reservation of an asset(s) or a seat(s).	
- Pending	The requested seat(s) or asset(s) is/are temporary reserved for the user. Reservation is pending for payment.	
- Released	If a User decides to go for other options than the one(s) narrowed down, the PENDING state can be cancelled by the MP. Then the booking state is changed to RELEASED.	
- Confirmed	Reservation has been paid and the seat(s) or vehicle(s) has/have been granted for the user	
- Cancelled	The reservations has been cancelled by one of the parties involved	
- Changed	If a reservation needs to be changed after it has been CONFIRMED by the User or TO (e.g. different asset has been assigned, different starting time), the MP will indicate it to the other party and the booking state will change to CHANGED.	
- Finished	Reservation period has ended and the utilization of the asset or seat is no longer valid.	
(passenger) Journey	A collection of segments which satisfies transportation of a passenger for a given origin and destination.	IATA (2018)
Mass transit	Large-scale public transportation with high carrying capacity, such as buses, subways, and trains.	Byars, M., Wei, A., & Handy, S. (2017)
Motor vehicle	A road vehicle propelled by an engine or motor (internal combustion engine, or electric motor, or some combination of the two) and used for the transportation of passengers, property, or freight	
Multi-modal travel	Travel using more than one travel mode.	
Multimodal access	A system that meets the needs of bicyclists, pedestrians, transit users, passenger vehicles, and other motor vehicle users. A system providing multimodal access integrates different transportation modes to allow co-existence and easy switching between modes	California State Bicycle and Pedestrian Plan in Byars et al. (2017)
Multimodal connectivity	The ease with which people can switch between modes on the same trip. For example, pedestrian and bicycling access to transit stops and stations	Byars et. al (2017)
Passenger vehicle	A motor vehicle with at least four wheels, used for the transport of passengers, and comprising no more than eight seats in addition to the driver's seat.	Organisation Internationale des Constructeurs d'Automobiles (OICA)

TERM	DEFINITION	SOURCE
Private transportation	Transport services owned and operated by private entities, such as privately-owned shuttles	Adapted from Byars, M., Wei, A., & Handy, S. (2017)
Public transportation	Transport services owned and operated by state, regional, or local public agencies.	
Rebooking	A change of reservation and/or other changes which do not require ticket reissuance or exchange	IATA (2018)
Reservation	The allotment in advance of seating or sleeping accommodation for a passenger or of space or weight capacity for baggage, cargo or mail. This term is also applied to hotel, car and other types of travel services.	
Rideshare	When a driver, or a passenger, shares an open seat(s) in a vehicle with one or more passengers that have similar travel paths and schedules. Traditional forms of ridesharing include carpooling and vanpooling and current use includes sharing space in a ride sourced vehicle.	Byars et. al (2017)
Ride sourcing	A rideshare service that connects passengers to drivers, typically through a digital application and typically for a fee. Drivers and companies work for-profit and typically offer rides that are not incidental to their own trips.	
Shared Mobility	When a transportation mode, such as an automobile or bicycle, is used by more than one person either for moving a person or personal goods. Mode-usage typically occurs at the same time, but may also refer to sequential use, i.e. a leasing a shared bicycle. Although it can reduce miles travelled per person, it may or may not be efficient in terms of mode used or emissions per person. *This includes*: public transit options, car sharing; personal vehicle sharing (peer-to-peer car sharing and fractional ownership); car-pooling; van-pooling; ride-splitting, bike sharing; scooter sharing; shuttle services; micro transit; ridesharing; e-Hail (taxis); shuttle services; neighbourhood jitneys; ride sourcing; transportation network companies; ride-hailing; paratransit; and more. It can also include courier network services or flexible goods delivery, which provide for-hire delivery services using an online application or platform (such as a website or smartphone app) to connect couriers using their personal vehicles, bicycles, or scooters with freight (e.g., packages, food), and commercial delivery vehicles providing flexible goods movement.	
Station	Location or facility where air or surface transportation originates, stops and/or terminates, and where passengers and/or cargo can be taken on or off.	
Traffic	The vehicles, pedestrians, ships, or planes moving through an area or along a route.	
Transport	Take or carry (people or goods) from one place to another by means of a vehicle, aircraft, or ship.	Oxford Dictionary
Transportation	The action of transporting someone or something or the process of being transported	
Transit	Public or private transportation service that moves passengers in mass and usually has fixed routes, stops, and fares. Operates within cities or regions rather than between cities or regions.	Byars et. al (2017)
Travel	The action of going from one location to the other, from origin to destination.	
Travel mode	The means by which travel is done. Common travel modes for people include passenger car (driving alone or shared ride), public transit (bus, subway, or train), walking, and bicycling. Common travel modes for freight include land (road, rail, and pipelines), maritime, and air transportation.	

TERM	DEFINITION	SOURCE
Vehicle sharing	Provides short-term, on-demand access to a transportation mode without sole, direct ownership, thus reducing the overall number of vehicles including automobiles, bicycles, and scooters.	

References

Byars, M., Wei, A., & Handy, S. (2017)	Sustainable Transportation Terms: A Glossary	Retrieved from https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2759
EC 1305/2014	COMMISSION REGULATION (EU) No 1305/2014 – Annex II, Glossary	Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1305&from=EN
EC 62/2006	COMMISSION REGULATION (EU) No 1305/2014 – Annex B, Glossary	Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R0062&from=EN
IATA (2007)	International Air Transport Association (IATA) — Ticketing Handbook 39th Ed.	Retrieved from https://www.travelready.org/PDF%20Files/IATA%20-%20Ticketing%20Handbook.pdf
IATA (2018)	International Air Transport Association (IATA) — Passenger Glossary of Terms	Retrieved from https://www.iata.org/whatwedo/passenger/Documents/IATA-Passenger-Glossary-of-Terms.xlsx
OICA	OICA statistics web page	Retrieved from http://oica.net/wp-content/uploads/stats-definition1.pdf
Oxford Dictionary	Online	https://www.lexico.com. Accessed on 30 July 2019
TO-MP API WG	Dutch working group for a Transport Operator to MaaS Provider	https://github.com/efel85/TOMP-API/
UNISIG (2016)	Glossary of Terms and Definitions - SUBSET-023 v.3.3.0	Retrieved from https://www.era.europa.eu/filebrowser/download/1091982_en

A.2 – Passenger characteristics' dictionary

This appendix presents the main classification of the corresponding codes for passenger characteristics as defined in the (Dutch) dictionary of passenger characteristics (*woordenboek reizigerskenmerken*) by the Traffic and Transport Knowledge Platform (CROW-KpVV, 2019). By using these codes, it is possible to clearly establish what are the passengers' needs to successfully complete a (multi-leg) journey. For a full description of the codes and terms please consult the original source at:

https://github.com/efel85/TOMP-API/blob/master/documents/Woordenboek%20Reizigerskenmerken%20CROW.pdf

Category	Code	Name
Passenger's assistance tool	HR-01	Standard wheelchair
	HR-02	Electric wheelchair
	HR-03	Foldable wheelchair
	HR-04	Wheelchair - not securely fixed
	HR-05	Wheelchair - self-balancing two-wheeler
	HR-06	Wheelchair - Different
	HR-07	Rollator – or walker
	HR-08	Rollator - different
	HR-09	Mobility scooter - Standard
	HR-10	Mobility Scooter - Different
	HR-11	Variable assistance tool
	HR-12	Dog
Vehicle tool	HV-01	Belt – exemption seatbelt duty
	HV-02	Belt - extension
	HV-03	Seat - booster seat
	HV-04	Seat - child seat category 1
Additional requirement - transport	AV-01	Transportation – individual
	AV-02	Transportation - in (wheelchair) bus
	AV-03	Transportation - last in / first out
	AV-04	Transport – if passenger car, then in the front
	AV-05	Transport – in passenger car
	AV-06	Transport - in the front and in passenger car
	AV-07	Transport - in the front, regardless of type vehicle
	AV-08	Transport – low entry
	AV-09	Transport - combi with others except …
	AV-10	Transportation - no combi other target group
	AV-11	Transport – shortened travel time
Additional requirement - guidance	AB-01	Guidance - room-room transfer
	AB-02	Guidance - door-to-door
	AB-03	Counselling - necessary / medical counsellor
	AB-04	Guidance - variable companion
Additional requirement - extra passenger	AER-01	Shared travel – for free
	AER-02	Shared travel – reduced fee
	AER-03	Housemate
Characteristics	K-01	Characteristic - blind / visually impaired
	K-02	Characteristic - deaf / poor hearing
	K-03	Characteristic – cognitively limited
(Guided) Independent travel	ZR-01	Public transport advice
	ZR-02	Public transport stop at max 100 meters
	ZR-03	Public transport stop at max 250 meters
	ZR-04	Public transport stop at max 500 meters
	ZR-05	Public transport stop at max 1000 meters
	ZR-06	public transport stop at (variable) meters

Category	Code	Name
	ZR-07	Public transport stop: required - accessible by motor
	ZR-08	Public transport stop: required - non-visual
	ZR-09	Transfers: max 0 times
	ZR-10	Transfers: max 1 times
	ZR-11	Transfers: max 2 times
	ZR-12	Transfers: max 3 times
	ZR-13	Multimodal trip
	ZR-14	Night-blind
	ZR-15	Use of bicycle - partly
	ZR-16	Use of bicycle - fully
	ZR-17	Use of train - partly
	ZR-18	Use of train - fully
	ZR-19	Use of bus - partly
	ZR-20	Use of bus - fully
	ZR-21	Use of own transport - partly
	ZR-22	Use of own transport - fully
	ZR-23	Use of the boarding place/platform
	RR-01	Kilometre budget
Travel rights	RR-02	Mobility budget
	RR-03	Transboundary transport - Valys

A.3 – APIs available on the transportation ecosystem

This appendix provides and overview of available commercial and non-commercial APIs on the market.

Name	Website	Service	License
BoMaaS / FLOU.io	https://tapahtumat.tekes.fi/event/bomaas2310 https://app.swaggerhub.com/apis/FLOU	Ticket sales (example) Service registry catalogue	Creative commons 4.0
SUTI	http://www.suti.se/	Exchange of demand responsive traffic information between clients and providers	Membership
NeTEX	http://netex-cen.eu/	Exchange of Public Transport schedules and related data (topology and fare information)	GPL license managed by CEN standards process
GTFS	General Transit Feed Specification https://developers.google.com/transit/gtfs/	Public transportation schedules and associated geographic information	Google - Apache 2.0
GBFS	General Bikeshare Feed Specification https://github.com/NABSA/gbfs	Bike sharing system, service and status information	Open standard, community on Github
MaaS-API	http://www.maas-api.org/	Booking and listing	MIT license / Alliance Membership
Uber API	https://developer.uber.com/docs/riders/ride-requests/introduction	Uber ride requests	Developer dashboard membership
IPSI	Interoperable Product Service Interface https://oepnv.eticket-deutschland.de/en/fachpublikationen/themenportal-ipsi/	Mobile ticketing, ticket purchase, conditions for sale of tickets	License with VDV
Wiener API	http://akirk.github.io/Wiener-Linien-API/	Public transport schedules	Open government data Wien (OGD)
OTP	Open Trip Planner http://www.opentripplanner.org/	Multimodal trip planner Passenger information and transportation network analysis	Open source
OTM	Open Trip Model www.opentripmodel.org	Exchange real-time logistics data	Creative Commons 4.0
TripGo API	https://developer.tripgo.com/ https://developer.tripgo.com/specs/#	Plan door-to-door trips using a large variety of public and private transport. It integrates real-time information and, for selected providers, allows users to book and pay for transport.	Apache License 2.0 Free testing below a threshold of API calls
Combitrip	https://www.combitrip.com/combitrip-api.php	APIs for maps, autocomplete an journey planning.	For small non-commercial use it is free for the first 500 daily requests.

A.4 – Overview of the User stories used as parameters for the MaaS functionalities applicable to the TO-MP API

The following overview summarizes the user stories in categories, GBFS(+)/MaaS-API options and specifies requirement for MaaS

Nr.	User Story	Category	Existing API description used in this document	Required for MaaS
1.1	As a USER, I want to depart from STARTLOCATION and arrive at DESTINATION, To define from where to where I need mobility services for my trip	PLANNING	GBFS MaaS-API	Yes
1.2	As a USER, I want to know the PRICING of my trip, To determine how expensive my trip will be	PRICING	GBFS	Yes
1.3	As a USER, I want to receive a single INVOICE for my entire trip, To simplify my cost overview	PRICING	No	Yes
1.4	As a USER, I want to give a RATING and see other ratings of a transport operator, To leave my feedback or determine if I want to use a certain transport operator	TRIP EXECUTION	No	No
1.5	As a USER, I want to be able to REPORT an issue, In case the asset I want to use has a problem/damage/issue	TRIP EXECUTION	No	Yes
1.6	As a USER, I want to be able to select an asset based on COMPETENCES of the vehicle, To fit with the criteria for my trip	PLANNING	GBFS+	Yes
2.1	As a MAAS PROVIDER, I want to know which travel means are available around STARTLOCATION which allow to reach DESTINATION, To give travel advice to the USER	PLANNING	GBFS MaaS-API	Yes
2.2	As a MAAS PROVIDER, I want to know if the trip starts at STARTLOCATION and ends at DESTINATION,	PLANNING	GBFS MaaS-API	Yes
2.3	As a MAAS PROVIDER, I want to know the ACCEPTABLE DISTANCE for the USER from LOCATION X to STARTLOCATION , To define the travel options to the USER	PLANNING	GBFS+?	No
2.4	As a MAAS PROVIDER, I want to know the CONDITIONS of a transport operator, To define the travel options to the USER	PLANNING	GBFS MaaS-API	Yes
2.5	As a MAAS PROVIDER, I want to be able to place a BOOKING with a TRANSPORT OPERATOR , To book an asset beforehand	BOOKING	MaaS-API	Conditional
2.6	As a MAAS PROVIDER, I want the USER to be able to OPEN/CLOSE/PAUSE the asset through my interface, To make the use of the asset as easy as possible	TRIP EXECUTION	GBFS+?	Conditional
2.7	As a MAAS PROVIDER, I want to give my USER on-the-fly USAGE INFORMATION about the asset usage and the booking from the TRANSPORT OPERATOR, To avoid having to keep and update all the information myself	TRIP EXECUTION	No	Optional
2.8	As a MAAS PROVIDER, I want to patch my USER through to the HELPDESK of the TRANSPORT OPERATOR in case of issues, To deliver the best support possible	TRIP EXECUTION	No	Yes
2.9	As a MAAS PROVIDER, I want to be able to CANCEL/MODIFY a transaction or booking , To inform the TRANSPORT OPERATOR about any changes	BOOKING	MaaS-API	Yes
2.10	I want to know if my USER can share a journey or booking with a USER from another MAAS PROVIDER	PLANNING	No	No

3.1	As a TRANSPORT OPERATOR , I want to know from when to when (TIME T1 to TIME T2) the USER,	PLANNING	GBFS MaaS-API	Conditional
3.2	As a TRANSPORT OPERATOR , I want to know the DESTINATION of the USER, To determine if my assets are suitable or available	PLANNING	GBFS MaaS-API	Conditional
3.3	As a TRANSPORT OPERATOR , I want to know if the USER has the right USER COMPETENCE, To determine if the USER is allowed to use my assets	PLANNING	No	Yes
3.4	As a TRANSPORT OPERATOR , I want to know if the USER complies with my USER CONDITIONS before ,	PLANNING	No	Yes
3.5	As a TRANSPORT OPERATOR , I want to give a RATING and see other ratings of a USER, To leave my feedback about and determine if USER can use my asset	TRIP EXECUTION	No	Optional
3.6	As a TRANSPORT OPERATOR , I want to be able to receive USER AUTHENTICATION, To determine if and how USER may use my asset	PLANNING	MaaS-API	Yes
3.7	As a TRANSPORT OPERATOR , I want to be able to CONTACT the USER, In case of problems, emergencies or other issues	TRIP EXECUTION	No	Conditional
3.8	As a TRANSPORT OPERATOR, I want to be able to CANCEL/MODIFY a transaction or booking , To inform the MAAS PROVIDER about any changes	PLANNING	MaaS-API	Yes

A.5 – Authors, collaborators and stakeholders involved

Edoardo Felici – *Ministry of Infrastructure and Water Management*
Edwin van den Belt – *DAT Mobility*
J. Roberto Reyes García – *University of Twente*
Robert Baart – *Trevvel/Paxx*

Jef Heyse and Himanshu Gautam – *Radiuz*
Martijn van der Linden – *Mobiliteitsfabriek*
Pim van der Toolen – *Intraffic*
Reinald Bronkhorst – *Stapp.in*
Rob Verkerk and Gerke Henkes – *Nazza*
Ross Curzon-Butler – *Cargoroo*
Stefan de Konink – *Stichting OpenGeo*
Steven Haveman – *University of Twente*
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