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**Intelligente Verkehrssysteme –
Städtische IVS –
Modelle und Festlegungen für neue Modi;
Englische Fassung CEN/TS 17413:2020**

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Urban ITS –

Models and definitions for new modes;

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Nationales Vorwort

Dieses Dokument (CEN/TS 17413:2020) wurde vom Technischen Komitee CEN/TC 278 „Intelligente Transportsysteme“ ausgearbeitet, dessen Sekretariat von NEN (Niederlande) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Gemeinschaftsarbeitsausschuss NA 052-02-71 GA „Gemeinschaftsarbeitsausschuss NAAutomobil/DKE: Intelligente Verkehrssysteme“ des DIN-Normenausschusses Automobiltechnik.

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Datenreferenzmodelle und Austauschformate zur Nutzung von Diensten im öffentlichen Verkehr wurden bereits normiert und sind vorhanden. Trotzdem haben Untersuchungen ergeben, dass Bedarf für die Aufnahme von Notfallverkehrsmodi in Datenreferenzmodelle besteht, um einen nahtlosen Übergang für einen Reisenden zwischen allen Modi zu gewährleisten. Beispiele für diese neuen Modi sind Carsharing und Fahrradvermietungen, Car-Pooling und intelligentes Parken (Park & Ride).

Dieses Dokument legt ein Datenreferenzmodell fest, dass die Integration dieser Modi in städtische multimodale Dienste ermöglicht (z. B. Reiseplanungssystem).

Im Weiteren berücksichtigt dieses Dokument zu Beginn statistische Daten, aber auch unter bestimmten Aspekten (dynamische) Echtzeitinformationen, um effiziente Informationen für Reisende zu ermöglichen.

Nationaler Anhang NA (informativ)

Begriffe

Die Benummerung der folgenden Begriffe und Abkürzungen ist identisch mit der Benummerung in der englischen Fassung.

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>

3.1 Allgemeine Begriffe

3.1.1

Attribut

(en: attribute)

Eigenschaft einer Entität

3.1.2

konzeptuelles Datenmodell

(en: conceptual data model)

Beschreibung einer realen Domain bezogen auf Entitäten, Beziehungen und Attribute in einer implementierungsunabhängigen Art und Weise, um eine Struktur bereitzustellen, auf der der Rest der Entwicklung eines Anwendungssystems aufbauen kann

3.1.3

konzeptuelles Niveau

(en: conceptual level)

konzeptuelles Datenmodell bezogen auf Datenmodellierung

3.1.4

Datenbank

(en: data base)

Datensammlung

Anmerkung 1 zum Begriff: Oft im übertragenen Sinne als physische Implementierung eines Datenmodells verwendet.

3.1.5

Datendomain

(en: data domain)

Datenstruktur, welche auf sich gegenseitig bedingende Daten baut und die Tatsache berücksichtigt, dass es einen funktionellen Bereich oder Funktionsgruppen gibt, die diese Datenmenge als Ganzes verwenden

3.1.6

Datenmodell

(en: data model)

Beschreibung einer realen Domain bezogen auf Daten und deren Beziehungen

3.1.7

Entität

(en: entity)

(Daten)Objekt, das seine eigene Existenz hat (im Gegensatz zu einem Attribut)

3.1.8

Fahrgeldmanagement

(en: fare management)

alle Aktivitäten bezüglich Geldeinsammlung von Fahrgästen

3.1.9

Funktion

(en: function)

Aktivität

3.1.10

funktionaler Bereich

(en: functional area)

zufällig festgelegte Menge von Aktivitäten, die zur Festlegung der Grundsätze und der Grenzen des Datenmodells verwendet werden

3.1.11

Interoperabilität

(en: interoperability)

Fähigkeit, eines (Sub)Systems, mit anderen (Sub)Systemen nach einer Menge vordefinierter Regeln (Schnittstellen) zu interagieren

3.1.12

logisches Datenmodell

(en: logical data model)

Datendesign, welches den Typ der verwendeten Datenbank berücksichtigt, aber keine Wege zur Nutzung von Raum oder Zugriff aufzeigt

3.1.13

logisches Niveau

(en: logical level)

logisches Datenmodell bezogen auf Datenmodellierung

3.1.14

objektorientiertes Datenmodell

(en: object-oriented data model)

Datenstruktur, die nach den Prinzipien ausgedrückt ist, die eine direkte Implementierung als eine objektorientierte Datenbank ermöglichen, in der Information in Form von Objekten ausgedrückt wird, d. h. die Darstellung nach den Prinzipien der Verkapselung, im Speziellen, dass auf alle Daten durch zugehörige Operationen (Methoden) zugegriffen wird oder diese modifiziert werden

3.2 Domainspezifische Begriffe

3.2.1

Zugriffsmodus

(en: access mode)

Charakterisierung der Fortbewegung eines Reisenden (z. B. gehen, Radfahren usw.), die dem Reisenden ermöglicht, öffentliche Verkehrsmittel zu erreichen oder eine vollständige Reise durchzuführen

3.2.2

alternativer Modus

(en: alternative mode)

beliebiger öffentlich angebotener Betriebsmodus, der vom konventionellen Betriebsmodus verschieden ist, speziell Fahrzeugteilung, Fahrzeugvermietung und Fahrzeugzusammenführung

3.2.3

Carpooling

(en: car pooling)

Fahrzeugpooling bezogen auf Autos, bestehend aus dem Teilen eines sich im Privatbesitz befindlichen Autos für eine Fahrt durch einen Fahrer, der bereits in die Fahrt involviert ist, mit mindestens einem weiteren Reisenden

3.2.4

Autovermietung

(en: car rental)

Fahrzeugvermietung bezogen auf Autos, bestehend aus der Bereitstellung von Autos in bestimmten Büros mit der Einschränkung, dass diese zu einem bestimmten Büro zurückgebracht werden müssen

3.2.5

Carsharing

(en: car sharing)

Teilen von Fahrzeugen bezogen auf Autos, bestehend aus der kurzzeitigen Nutzung eines Fahrzeugs für eine bestimmte Reise oder Zeit, während der das Auto von einem Ort genommen und an einem anderen Ort im städtischen Bereich wieder geparkt werden kann

3.2.6

konventioneller Modus

(en: conventual mode)

bestehender Betriebsmodus, welcher als ein geplantes und/oder flexibles öffentlich beworbenes Transportangebot zur Verfügung gestellt wird, welches auf eine Menge von Eigenschaften vertraut:

- Fahrer sind Angestellte;
- der Fuhrpark gehört einem Betreiber oder einer Behörde;
- die Topologie des Straßennetzes wurde gut im Voraus festgelegt und basiert auf Linien und Reisevorlagen

Anmerkung 1 zum Begriff: Die Unterscheidung zwischen alternativen und konventionellen Betriebsmodus vertraut auf den Fakt, dass eine oder mehrere Bedingung(en) von oben vielleicht nicht erfüllt sind. Außerdem besteht der Unterschied eher im Betriebsmodus als der Art, wie Reisende bedient werden.

3.2.7

Fahrradvermietung

(en: cycle rental)

Fahrzeugvermietung bezogen auf Fahrräder, bestehend aus der Bereitstellung eines Fahrrads (von Fahrrädern) in bestimmten Büros mit der Einschränkung, dass diese zu einem bestimmten Büro zurückgebracht werden müssen

3.2.8

Fahrradverleih

(en: cycle sharing)

Teilen von Fahrzeugen bezogen auf Fahrräder, bestehend aus einer kurzzeitigen Miete eines Fahrrads, wobei das Fahrrad von einem Ort genommen und an einem anderen Ort im städtischen Bereich wieder abgestellt werden kann

3.2.9

flexibler Transportmodus

(en: flexible transport mode)

Transportbetrieb von Fahrgästen verbunden mit einem festen Straßennetz/Zeitplan, aber mit flexiblem Angebot, um beispielsweise den Dienst zu optimieren oder die Fahrgastnachfrage zu erfüllen

3.2.10

betrieblicher Dienst

(en: operational service)

Aktivitäten, die von Akteuren ausgeführt werden, die für den Betrieb des Dienstes zuständig sind

3.2.11

Park & Ride

Aktivität, die es Reisenden ermöglicht, zwischen persönlichen/alternativen Modus und dem konventionellen Modus zu wechseln

3.2.12

Park & Ride-Einrichtungen

(en: park and ride facilities)

zweckbestimmter Ort für Reisende, der einen modalen Wechsel erlaubt, speziell um eigene Fahrzeuge vor/nach einer Fahrt mit dem öffentlichen Verkehr abzustellen/abzuholen

3.2.13

persönlicher Modus

(en: personal mode)

privater Betriebsmodus, der die Nutzung von jedweden öffentlichen Angebot ausschließt

3.2.14

öffentlicher Verkehr

(en: public transport)

Verkehrsmittel, das für die Nutzung durch die allgemeine Öffentlichkeit beworben wird und zur Verfügung steht

3.2.15

planmäßiger Modus

(en: scheduled mode)

Fahrgasttransportbetrieb, der einem festen Zeitplan und einer festen Route folgt

3.2.16**Taxi**

(en: taxi)

Art des Fahrzeug-Pooling-Betriebs, wobei das Fahrzeug von einem Fahrer gefahren wird, der Dienste für Reisende für kommerzielle Zwecke anbietet

3.2.17**Informationsversorgung für Reisende**

(en: traveller information provision)

Aktivität, bestehend aus der Versorgung mit Informationen zu den Regeln/Bedingungen bezogen auf einen Reisedienst und die verfügbaren Verkehrsmittel betreffend

3.2.18**Dienst für Reisende**

(en: traveller service)

Aktivität (im Allgemeinen vom Nutzer initiiert) zur Durchführung/Ermöglichung einer Reise

3.2.19**Gehmodus**

(en: walking mode)

Gehen betrachtet als Zugangsmodus, sodass der Reisende zu einem Haltepunkt geht, um eine Transportmöglichkeit zu erhalten

3.2.20**Fahrzeugpooling**

(en: vehicle pooling)

bestimmter Betriebsmodus eines im Privatbesitz befindlichen Fahrzeugs, bestehend aus dem Teilen eines sich im Privatbesitz befindlichen Fahrzeugs für eine Fahrt durch einen Fahrer, der bereits in die Fahrt involviert ist, mit mindestens einem weiteren Reisenden

3.2.21**Fahrzeugvermietung**

(en: vehicle rental)

bestimmter Betriebsmodus einer Fahrzeugflotte (im Allgemeinen im Privatbesitz), bestehend aus der Bereitstellung in bestimmten Büros mit der Einschränkung, dass diese zu einem bestimmten Büro zurückgebracht werden müssen

3.2.22**Teilen von Fahrzeugen**

(en: vehicle sharing)

kurzzeitige Fahrzeugvermietung, während der das Fahrzeug von einem Ort genommen und an einem anderen Ort im städtischen Bereich wieder geparkt werden kann, meistens ohne Einschränkung, dass das Fahrzeug zu einem bestimmten Ort zurückgebracht werden muss

3.2.23**Fahrzeug mit Fahrer**

(en: vehicle with driver)

Fahrzeug, welches auf Anfrage betrieben wird, wie ein Taxi, Fahrzeug mit Chauffeur oder beförderndes Mini-Taxi

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English Version

Intelligent transport systems - Urban ITS - Models and definitions for new modes

Systèmes de transport intelligents - ITS urbains -
Modèles et définitions des nouveaux modes de
transport

Intelligente Verkehrssysteme - Städtische IVS - Modelle
und Festlegungen für neue Modi

This Technical Specification (CEN/TS) was approved by CEN on 27 October 2019 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (CEN/TS 17413:2020) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Services already present in the urban environment such as multimodal information and traffic management and control are already well understood. Standard reference data models and data exchange formats for the use of these services, in particular data sets describing the public transport offer, are already standardized and available. However, a previous study has identified that there is a need for reference data models to accommodate emerging modes of transport to allow seamless transitions for the traveller between all available modes. Examples of these new modes are car and cycle sharing, car-pooling, and intelligent parking (Park & Ride).

The Commission Delegated Regulation (EU) 2017/1926 requires that Member States facilitate the easy exchange and reuse of data for the provision of comprehensive travel information services. Transport authorities, transport operators, infrastructure managers or transport on demand service providers as appropriate should make the static data, corresponding metadata and information on the quality of the data accessible to users through a national or common access point.

This document defines a reference data model, in order to allow integration of these modes into urban multimodal services (e.g. trip planning systems).

This document considers in first place static data, but some aspects of real-time (dynamic) information are taken into account in order to enable efficient traveller information and includes: cycle sharing; car sharing; carpooling and cars with a driver (taxi).

To form this document, information has been gathered from outreach to stakeholders, Transmodel (EN 12896 series), and documents in the Bibliography.

CEN/TS 17413 is a project under the European Standardization body CEN/TC 278 - Intelligent Transport Systems Working Group 17 (Urban ITS). Its title is Models and definitions for new modes. The project team members have worked within Intelligent Transport Systems for many years as developers, implementers and standardizers.

1 Scope

This document defines new modes in a reference data model, in order to allow integration of these modes into urban multimodal travel services (e.g. trip planning systems).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12896-1:2016, *Public transport – Reference data model – Part 1: Common concepts*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 General terms and definitions:

3.1.1

attribute

property of an entity

3.1.2

conceptual data model

description of a real-world domain in terms of entities, relationships and attributes in an implementation independent manner in order to provide a structure on which the rest of the development of an application system can be based

3.1.3

conceptual level

conceptual data model, in the context of data modelling

3.1.4

database

collection of data

Note 1 to entry: Often used in the sense of the physical implementation of a data model.

3.1.5

data domain

data structure made up of data related to each other, through the fact that there is a functional area or group of functions using this data set as a whole

3.1.6

data model

description of a real-world domain in terms of data and relationships

3.1.7

entity

object (data) that has its own existence (as opposed to an attribute)

3.1.8

fare management

activities related to the collection of money from passengers

3.1.9

function

activity

3.1.10

functional area

arbitrarily defined set of activities used to define the objectives and limits of the data model

3.1.11

interoperability

ability of (sub)systems to interact with other (sub)systems according to a set of predefined rules (interface)

3.1.12

logical data model

data design that takes into account the type of database to be used but which does not consider means of utilization of space or access

3.1.13

logical level

logical data model, in the context of data modelling

3.1.14

object-oriented data model

data structure expressed according to principles that allow for a direct implementation as an object-oriented database, where information is represented in form of objects, i.e. respecting the principle of encapsulation meaning in particular that each data is accessed or modified through operations (methods) belonging to it

3.2 Domain specific terms and definitions:

3.2.1

access mode

characterization of the traveller movement (e.g. walking, cycling, etc.) enabling the traveller to reach public transport or to carry out a whole trip

3.2.2

alternative mode

publicly advertised mode of operation different from the conventional mode of operation, in particular vehicle sharing, vehicle rental and vehicle pooling

3.2.3

car pooling

vehicle pooling applied to cars, consisting in sharing a privately owned car for a trip between a defined driver who is already engaged in the trip and at least another traveller

3.2.4

car rental

vehicle rental applied to cars, consisting in making car(s) available at specified agencies with the constraint to bring them back at specified agencies

3.2.5

car sharing

vehicle sharing applied to cars, consisting of the short-term use of a vehicle for a specific journey or time where the car might be taken from and parked at different places in an urban area

3.2.6

conventional mode

legacy mode of operation which is provided as a scheduled and/or flexible publicly advertised transport offer relying on a set of features:

- drivers are employees;
- the fleet is owned by an operator or an authority;
- the network topology is defined well in advance and is based on lines and journey patterns

Note 1 to entry: The distinction between alternative and conventional mode of operation relies on the fact that one or more of the conditions as above may not be fulfilled. Moreover, the difference is in the mode of operation rather than the way the traveller is served.

3.2.7

cycle rental

vehicle rental applied to cycles, consisting in making cycle(s) available at specified agencies with the constraint to bring them back at specified agencies

3.2.8

cycle sharing

vehicle sharing applied to cycles consisting of short-term cycle rental where the cycle can be taken from and parked at different places in the urban area

3.2.9

flexible transport mode

passenger transport operation linked to a fixed network/schedule but offering flexibility, in order for instance, to optimize the service or to satisfy passenger demand

3.2.10

operational service

activities performed by actors in charge of operation of a service

3.2.11

park and ride

activity allowing travellers to transfer between personal/alternative mode and conventional mode

3.2.12

park and ride facility

location dedicated to travellers allowing them a modal transfer, in particular to leave/pick up their personal vehicles before/after a trip on public transport

3.2.13

personal mode

private mode of operation excluding any publicly advertised use

3.2.14

public transport

means of transport advertised and available for use by the general public

3.2.15

scheduled mode

passenger transport operation following a fixed schedule and fixed routes

3.2.16

taxi

type of vehicle pooling operation where the vehicle is driven by a driver providing services to travellers for commercial reasons

3.2.17

traveller information provision

activity consisting in the provision of information on the rules/conditions related to a traveller service and concerning the available transportation means

3.2.18

traveller service

activity (in general, initiated by users) in view of facilitating/enabling a trip

3.2.19

walking mode

walking as considered as an access mode so the traveller walks to a stop to get to the transport option

3.2.20

vehicle pooling

particular mode of operation of a privately-owned vehicle consisting in sharing the vehicle for a trip between a defined driver who is already engaged in the trip and at least another traveller

3.2.21

vehicle rental

particular mode of operation of a vehicle fleet (in general privately owned) consisting in making it available at specified agencies with the constraint to bring them back at specified agencies

3.2.22

vehicle sharing

short term vehicle rental where the vehicle can be taken from and parked at different places in the urban area, often without the constraint of bringing the vehicle back to a dedicated specific location

3.2.23

vehicle with driver

vehicle operating on demand such as a taxi, chauffeured car or dispatched mini-cab

4 Symbols and abbreviations

CCAM	Cooperative, Connected and Automated Mobility
EU	European Union
GDF	Geographic Data Files
GNSS	Global Navigation Satellite System
INSPIRE	Infrastructure For Spatial Information In Europe
ITS	Intelligent Transport Systems
MaaS	Mobility as a Service
U-ITS	Urban ITS

5 Functional description of the alternative modes

5.1 Introduction

This document describes an extension of the Public Transport Reference Data Model, known as Transmodel (EN 12896 series), which provides definitions and a conceptual data model for the “conventional transport” domain. This clause provides a clarification as regards the “conventional transport mode” vs. “alternative transport mode” (mentioned as 'new modes' in the title of this specification).

5.2 Categorization of modes of transport

5.2.1 General

'mode' as any means of transport used or available. It is split into 'vehicle mode' and 'access mode' (see Figure 1).

'Vehicle mode' is a characterization of the public transport operation according to the means of transport, e.g. bus, tram, metro, train, ferry, ship, or bicycle.

'Access mode' (e.g. walking, cycling, private car driving, etc.) is a characterization of the traveller movement (e.g. walk, bicycle, etc.) enabling them to reach the 'vehicle mode' or to carry out a whole trip.

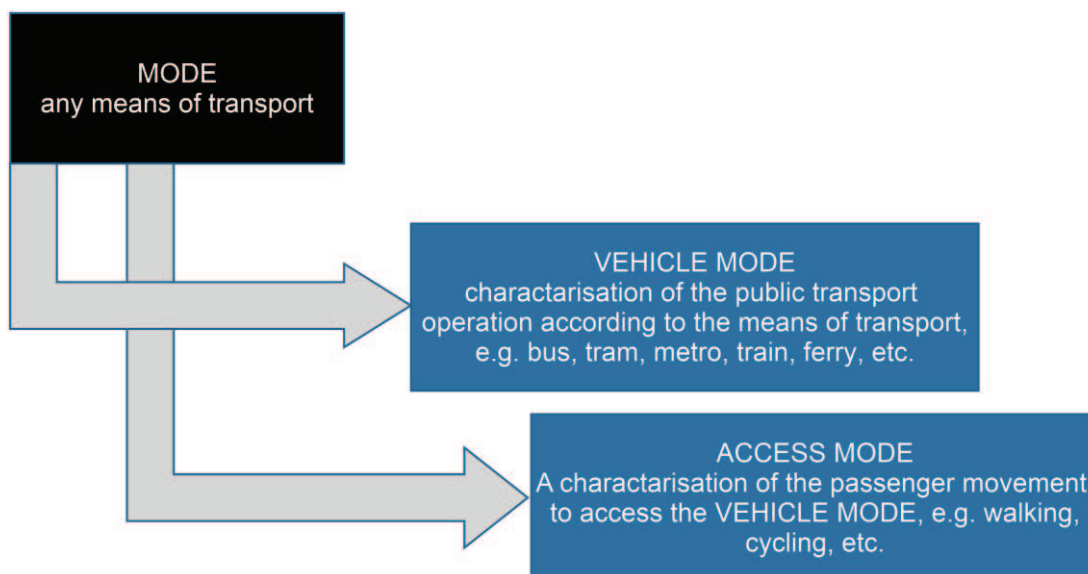


Figure 1 — Categorization of transport modes

A distinction is made between 'vehicle mode' and 'vehicle type'. Each 'vehicle mode' may correspond to a range of 'vehicle types' (e.g. to the 'vehicle mode' 'bus' may correspond 'standard', 'articulated, minibus', 'double-deck' buses).

A further, finer categorization of transport modes is provided by the concept of 'submode', which is a variant of a 'mode'. For example, for the mode 'rail', possible submodes are 'international rail' or 'domestic rail'; for the mode 'bus', the example of submode is 'regional bus', for the mode 'car', examples of submodes are 'electric car', 'conventional car', 'self-driven car'.

This document takes over these normative definitions and provides a further clarification as regards the term 'public transport'.

For this document 'public transport' has to be understood as any means of transport, advertised and available for use by the general public.

5.2.2 New modes as an alternative mode of operation

5.2.2.1 Overview

Modes and submodes being defined as 'transport means' may be characterized in terms of types of operation, i.e. ways they are operated.

This document distinguishes the following types of 'mode of operation' (see Figure 2):

- conventional mode of operation: the legacy mode of operation which is provided as a scheduled and/or flexible *publicly advertised* flexible transport offer. This mode of operation is either following a fixed schedule and fixed routes or linked to a fixed network/schedule but offering flexibility, in order for instance, to optimize the service or to satisfy passenger demand;
- alternative mode of operation: any *publicly advertised mode of operation different from the conventional mode of operation*, in particular vehicle sharing, vehicle rental and vehicle pooling; and
- personal mode of operation: a private mode of transport *excluding any publicly advertised use*.

The scope of Transmodel is the conventional mode of operation, including both scheduled and flexible mode of operation. The distinction between alternative and conventional mode of operation relies on the fact that a conventional mode relies on a set of features: drivers are employees and the fleet is owned by an operator or an authority and the network topology is defined well in advance and is based on lines and journey patterns; whereas the alternative modes may not fulfil one or more of these features.

This document (referring to 'new modes') concerns the alternative mode of operation.

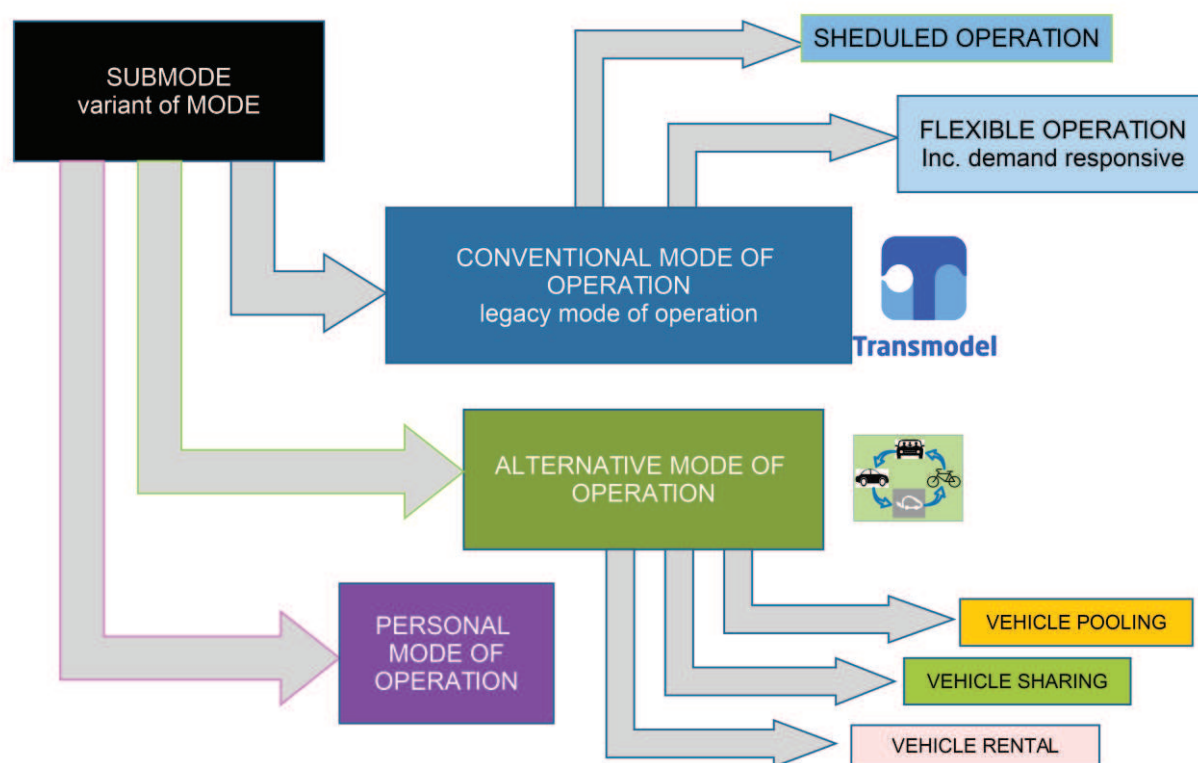


Figure 2 — Operation types for transportation mode

5.2.2.2 Wording convention

In this document, alternative mode of operation, alternative mode and new mode are used as synonyms (with a preference to alternative mode).

Conventional mode of operation is used as synonym of conventional mode, flexible mode of operation is synonymous to flexible mode, scheduled mode of operation as synonymous to scheduled mode.

5.2.2.3 Transport modes in Commission Delegated Regulation (EU) 2017/1926

The Commission Delegated Regulation (EU) 2017/1926 (see [9]) partitions the transport modes into Scheduled, Demand Responsive, and Personal. Rather than a definition, examples for these concepts are provided.

Scheduled modes: Air, rail including high speed rail, conventional rail, light rail, long-distance coach, maritime including ferry, metro, tram, bus, trolley-bus.

Demand-responsive modes: Shuttle bus, shuttle ferry, taxi, car-sharing, car-pooling, car-hire, bike-sharing, bike-hire.

Personal modes: Car, motorcycle, cycle.

Table 1 below provides the correspondence of the different concepts and terms in use with the concepts of this document.

Table 1 — Concepts and terms

Mode of operation	Type of mode of operation	Specification covering data requirements	Type of mode according to the Commission Delegated Regulation (EU) 2017/1926	The Commission Delegated Regulation (EU) 2017/1926: examples
Conventional mode of operation				
	Scheduled mode of operation	Transmodel	<i>Scheduled mode</i>	Air, rail including high speed rail, conventional rail, light rail, long-distance coach, maritime including ferry, metro, tram, bus, trolley-bus.
	Flexible mode of operation	Transmodel	<i>Demand-responsive mode</i>	Shuttle bus, shuttle ferry
Alternative mode of operation				
	Vehicle sharing (car sharing, cycle sharing)	This document	<i>Demand-responsive mode</i>	car-sharing, bike-sharing
	Vehicle pooling (carpooling)	This document	<i>Demand-responsive mode</i>	car-pooling, taxi
	Vehicle rental (Car rental, cycle rental)	This document (partly)	<i>Demand-responsive mode</i>	car-hire, bike-hire.
Personal mode of operation			<i>Personal mode</i>	Car, motorcycle, cycle.

5.2.3 Limits of the specification

This document concentrates on data domains of use for the alternative modes of operation: vehicle sharing, vehicle pooling.

Vehicle rental and taxi are only partly considered.

The correspondence with the Commission Delegated Regulation (EU) 2017/1926 is provided in the table above.

This document does not cover Flexible Transport, as it is already covered by EN 12896 series.

Two following types of usage as regards cycle sharing car sharing and car-pooling have been identified: the mobility of persons; and the transportation of goods. This document considers mobility of persons only.

Types of vehicles considered are referred to in Subclauses 5.5.1 and 5.6.1

The data model focuses at the functional domain (Traveller) Information Provision mainly, in order to satisfy the requirements of the Delegated Regulation (EU) 2017/1926 mentioned above and covers partly data requirements of the functional domain Traveller Services (see Figure 3).

Operational Services are not in scope of this document.

5.3 Links to Mobility as a service

5.3.1 Mobility as a service (MaaS)

Since the advent of the personal computer, the internet and more latterly, the smartphone, consumer experiences have become increasingly integrated, and there has become an expectation of greater integration.

As well as an expectation of an integrated experience, there is also a trend towards purchasing services. For example: whereas a meal has been traditionally prepared in the home, it is increasingly common to now buy a meal as a delivered service, ordered from a restaurant online and delivered to one's door by a delivery company as an integrated service, the whole service often provided by an online service provider.

In transportation, however, systems, and until recently user expectations, have been monothetic (based around one theme). "I am going to visit my brother.": "How will you get there?" "I am going by train" or "I will take a bus" or "I will drive over" etc.; in the event however, users are likely to also employ a car to get to the station, or use a combination of bus and a train, etc.; but these have not provided the joined up integrated service experience now expected in other aspects of life.

Increasingly, and especially in the urban setting, multiple modes of transport are used; and with the advent of car sharing, carpooling, cycle sharing, the number of modes, and mode combinations, have multiplied.

By applying the same 'integrated service' logic to the transport sector, because of technology change and the opening up and sharing of transport data sets, considerable 'value' can be added to the travellers experience by the provision of "mobility as a service" (MaaS), i.e. using a digital interface to source and manage the provision of transport related service(s) to meet the mobility requirements of a customer. A MaaS Provider offers its customer the travel experience using any, and probably multiple, types of transport service, public or private, in order to optimize the travel experience. This is all enabled by technological advancement, combined with the rise of new business models to provide Mobility as a Service (MaaS). Innovation is expected to lead to new MaaS offerings for the consumer; market conditions will shape which are made available.

Tailored travel options can be provided using the fastest route, the lowest cost route, most direct route, most environmentally friendly, or most accessible service for persons with reduced mobility, or those travelling with children.

Travellers will no longer need to collect and keep timetables to work out the most optimal connections between transport modes. Personalized smartphone apps designed to serve travellers delivering information in real-time to assist in avoiding congestion and delays and enable the customer to choose a travel option according to the specific travel requirement.

One MaaS possibility is the scenario where MaaS Providers offer consumers a service focussed on vehicle transport e.g. taxi, car sharing and carpooling services. The other possibility is a scenario where consumers are offered a fully intermodal service, i.e. combining different modes of transport.

In the future, this trend is likely to continue due to growth of urban populations and changing preferences of younger generations that care less about ownership and more about experiences. This trend will be especially evident as the car industry also enables an environment where customers prefer not to buy cars but instead acquire an access to a vehicle and service on demand – this represents a clear shift from an ownership model, to a service model.

The MaaS Provider uses data from multiple travel service providers to create a value proposition that comprises a 'bundle' of different mobility services to meet a travel requirement. .

5.3.2 Cooperative, connected and automated mobility (CCAM)

The potential for MaaS is enhanced by changes in mobility consumption, the adoption of new mobility models (and this may lead to a move away from car ownership).

Modern vehicles are already connected devices, but the advent of Cooperative Intelligent Transport Systems (C-ITS), will allow road users and traffic managers to share information and use it to coordinate their actions.

Automated vehicles, and their full integration in the overall transport system (automated mobility), significantly advance the capabilities of, and desirability to the user, of MaaS, by assisting the MaaS provider to be able to offer options that are seen by the traveller to be better than their previous options.

The European Commission supports such initiatives towards cooperative, connected and automated mobility. See [10].

5.3.3 MaaS, CCAM and Urban ITS — Models and definitions for new modes

In order to achieve MaaS, and utilize the associated capabilities of CCAM for MaaS, it is necessary to exchange and have access to relevant data. The Commission Delegated Regulation (EU) 2017/1926 requires that Member States facilitate the easy exchange and reuse of data for the provision of comprehensive travel information services. Transport authorities, transport operators, infrastructure managers or transport on demand service providers as appropriate need access to static data, corresponding metadata and information on the quality of the data accessible to users through a national or common access point.

This document provides links to existing reference data models and data exchange formats for the use of established services, and provides data models to accommodate emerging modes of transport to allow seamless transitions for the traveller between all available modes. This document defines a reference data model, in order to allow integration of these modes into urban multimodal services (e.g. trip planning systems).

5.4 Functions and aspects related to the alternative modes

5.4.1 Introduction

As a result of an alternative mode of operation, new services are operated and proposed to travellers. This section describes new services through particular aspects and functions characterizing these services.

The following 3 aspects are mostly relevant:

- types of vehicles: cycles, cars, cycle types, car types, etc., in particular characterized by their equipment,
- modes of operation: pooling, sharing, rental, personal,
- types of transportation: persons, goods.

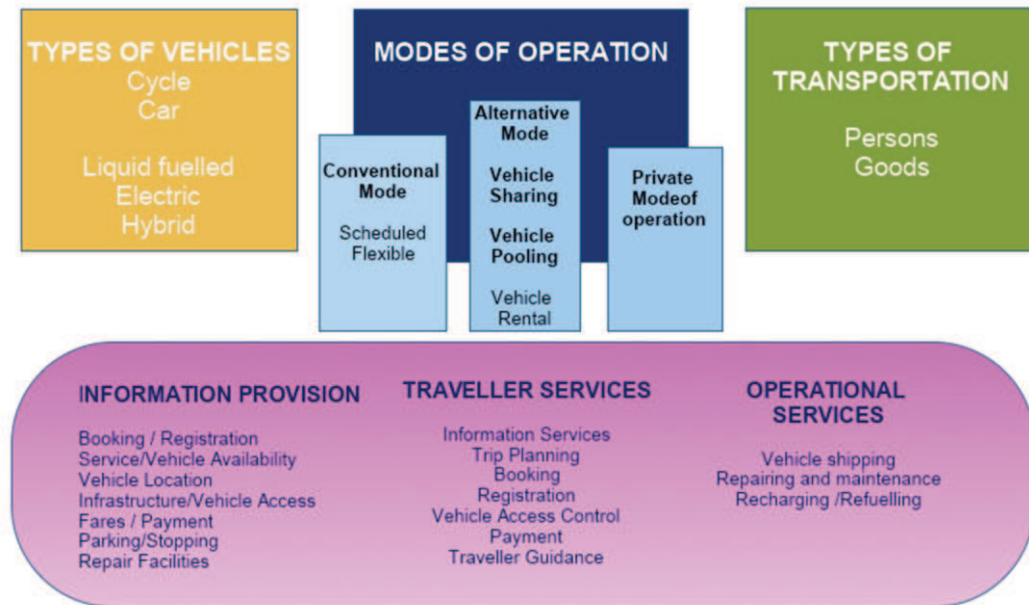


Figure 3 — Aspects and functions of related to alternative modes

The functional domains by which alternative modes are mostly concerned are grouped into the following categories;

- (traveller) information provision: activities consisting in the provision of information to the traveller on the rules/conditions related to a traveller service,
- traveller services: activities (in general initiated by users) in view of facilitating/enabling a trip,
- operational services: activities performed by actors in charge of operation of a service.

The following sections describe the functional domains by functions (activities) in more detail, providing a short definition of each function. As mentioned above in 5.2.2 the primary goal of the following sections is to illustrate the scope of the developed conceptual data model mainly focusing at information provision.

Specifics of each particular mode of operation is described in the corresponding sections (cycle rental, cycle sharing, private cycling, car sharing, car rental, carpooling) in Subclauses 5.5, 5.6 and 5.7.

5.4.2 Information provision functions

5.4.2.1 Introduction

The following functions are dedicated to the provision of information to travellers. Some of the functions are applicable to the private modes of operation. In most of the cases, information provision may be general (referring to a whole area), or specific, related to a particular user query with specific parameters.

5.4.2.2 Booking information

This activity consists in the provision of information on booking rules and additional data allowing the user to take the decision to book a service. The following information is considered as relevant:

- booking methods: description how to book (by internet, through an agency, etc.);

- booking conditions: information on how long in advance booking may take place, whether a guarantee is necessary, etc.;
- contact information: URL, address, etc. of the booking contact;
- available number/type of vehicles per station; and,
- usage rules: this relates to the service that is going to be booked: time-related conditions, location of check in/out stations, penalties, user profile, etc. used in the booking operation.

There are two circumstances concerning booking access to a vehicle. Firstly, there is the occasion when the vehicle is required immediately due to unforeseen circumstances or the failure of other transport modes; in this case there might not be a vehicle available in an optimum location or indeed a vehicle available at all. Secondly, it should be possible to notify the service provider of the requirement for a car share; in this case a vehicle should be available of the required type and at the optimum location; however, it is likely that a different set of charges will apply.

5.4.2.3 Service availability information

This activity consists in the provision of information on the availability of a particular mode of operation, e.g. opening hours of agencies for vehicle rental, opening hours of off-street vehicle parking locations, etc.. The information may be either static or dynamic.

5.4.2.4 Alternative mode vehicle availability information

This activity consists in the provision of either static or dynamic information on availability of vehicles at areas dedicated to the alternative modes. The static information corresponds to the capacity of areas (planned vehicle availability) dedicated to alternative modes.

The dynamic availability (actual presence of an available vehicle) may be derived from the information provided by vehicle location information (see 5.4.2.6) and the planned vehicle availability (capacity of a given area).

5.4.2.5 Infrastructure access information

This activity consists of the provision of information describing where to find and how to access a dedicated location for an alternative mode, for example, vehicle sharing or rental, and the dedicated location where the vehicle can be released after use. The information is static.

5.4.2.6 Vehicle location information

This activity consists of the provision of dynamic information describing where to find a vehicle or where a vehicle has been dropped off. This information is also relevant to the Personal mode.

5.4.2.7 Vehicle access information

This activity consists in the provision of information describing how to unlock vehicle prior to use and secure it after use, in particular for vehicle sharing and rental. The information may be either static or dynamic.

5.4.2.8 Fares information

This activity consists in the provision of information on fare rules, pricing rules (hourly/weekly/monthly fee), discounts etc. The information is in general static.

5.4.2.9 Payment information

This activity consists in the provision of information on payment means and methods, payment locations. The information is in general static.

This information involves:

- payment methods: cash, credit card, mobile payment, etc.;
- payment guarantees: credit card guarantee, banking, ID registration.

5.4.2.10 Alternative mode area equipment information

This activity consists in the provision of information on equipment present at locations dedicated to alternative modes, in particular secure storage facilities and battery recharging equipment, but also ticketing equipment, information desks, etc. The information may be static (planned presence of the equipment) or dynamic (status of the equipment).

5.4.2.11 Alternative modes parking area information

This activity consists in the provision of information about the alternative modes areas where a vehicle may be parked and left unattended (dropped off) and on the number of available parking slots for dropping-off alternative modes vehicles. This information is dynamic.

5.4.2.12 Registration information

This activity consists in the provision of information on the registration process to be accepted and recognized as a user.

The following information is of interest for the registration process:

- ID information: name, surname, date of birth, place of birth, address of residence
- Contact information: e-mail address of the alternative mode service, mobile number of the user, e-mail addresses of the user;
- Additional information, such as payment information: credit card, bank account (this is mainly for payment guarantee).

5.4.2.13 Repair facility information

This activity consists in providing information about locations where repair and/or maintenance of vehicle is possible. A description of the possible type of repair may be provided, e.g. mending punctures, replacing chains and fixing lights. This information may be static or dynamic (availability status of such facilities).

5.4.3 Traveller Services

5.4.3.1 Introduction

The following sections provide examples of Traveller Services and this list is not exhaustive, and provides examples of functions typically encountered in the context of new modes; e.g. trip planning and traveller guidance functions are not described here as they are extensively described in standards related to conventional modes.

5.4.3.2 Booking

Booking is a traveller service which may be electronic and non-electronic dedicated to the reservation of a vehicle or a trip for users in specific dates and time as part of the urban mobility.

5.4.3.3 Registration

Registration is a traveller service considered as the virtual or physical first identification of users to access a traveller or transportation service. The registration process can be undertaken remotely using internet platform via PC or mobile access, or physically at specific locations.

5.4.3.4 Vehicle access control

Vehicle access control is a traveller service consisting in verifications and mechanisms to unlock and relock either an alternative vehicle mode.

5.4.3.5 Stopping place access control

Stopping place access control is an activity consisting in controlling and granting/denying access to a particular stopping place to vehicles operating as alternative or personal modes.

5.4.3.6 Payment

Payment is a traveller service of payment of a transport service. In the context of alternative modes, the process is mostly carried out using electronic payment procedures.

5.4.3.7 Trip planning

Modern computer-aided travel tools assist potential travellers in preparing their trips, particularly in answering specific TRIP REQUESTs. Such a trip planning function identifies the origin and destination places of an intended trip and proposes one or several trip solutions. The proposition takes into account the user's constraints or preferences, such as minimal trip duration, minimal number of interchanges, cheapest fare, etc., and involves an optimization process using such parameters.

After specification of the trip origin and destination, the system proposes a "trip pattern", composed of access or connection walks/transfers to a number of public transport modes including alternative modes. Given a trip pattern proposal, it is possible to compute a precise duration of the trip (taking into account, for instance, the latest arrival time requested by the traveller) or a mean duration. It is also possible to calculate the corresponding costs, the suitability for a person of reduced mobility, etc.

The trip pattern components are explicitly linked to accessibility features; if such features are known they are populated ensuring that the trip pattern is suitable for the traveller according to specific needs.

If the request is made for a trip taking place on the same day, it is possible to take into account the monitored situation to refine the proposal. The trip pattern proposal will be influenced by service modifications due to control actions (e.g. service cancelled or shortened because of a protest) and the timing proposal will be based on actual (monitored) passing times.

5.4.4 Operational services

5.4.4.1 Vehicle shipping

Vehicle shipping is an activity consisting in cross-city vehicle shipping for any purpose, though particularly to ensure that vehicle sharing stations have sufficient vehicles for sharing and that the stations have sufficient spaces for vehicles to be released.

5.4.4.2 Repairing and maintenance

Repairing and maintenance is the provision of facilities for the repairing of all types of vehicles in dedicated areas with access to tools and spare parts.

5.4.4.3 Recharging and refuelling

Recharging and refuelling is the process of charging (possibly at a sharing station) of electric vehicles and the refuelling of liquid powered vehicles when required.

5.5 Cycling

5.5.1 Introduction

This subclause describes specific additional aspects of cycling.

Cycling is the operation of a cycle by a user to carry out a trip. Different modes of operation are described as: cycle rental; cycle-sharing; and private cycling.

The modelling of the information related to cycling can be used to provide traveller services; for instance, existing route planning algorithms may use cycling data to compute multi-modal trip plans including cycle rental and cycle sharing.

Cycle sharing, and cycle rental are both based on a commercial relationship between a user and an organization making cycles available, which is not the case for private cycling.

The following types of cycles are considered in this document:

- Classical cycle: vehicle composed of wheels attached to a frame. It is powered by human muscles; and;
- Cycle with electric propulsion: vehicle with a low powered electric motor; falling in this category are: electric bikes; but also balancing scooter, hoverboard, motorized unicycles, etc.

5.5.2 Cycle rental

Cycle rental is applicable to any type of cycle. It provides a service which makes it possible to temporary (typically few hours or could be days) use a cycle for a time-based fee. In the context of multi-modal transportation systems cycle rental is a mode of operation enabling an alternative way of travelling across urban areas, in comparison to the conventional transport mode.

5.5.3 Cycle sharing

5.5.3.1 General

Cycle sharing is a mode of operation dedicated to (in general) short-term cycle rental in which the cycle can be taken and parked in different places anywhere in urban areas. One of the main differences between cycle sharing and cycle rental is the scheme in which they operate. Cycle sharing has a set of subscribed users who share the service, in general for short time or short distance rides for a fixed monthly or yearly fee. The fare depends on a range of parameters, for instance “frequent traveller profile” (see Figure 38 concerning USAGE PARAMETERS). To be noted that the fares rely on a contract which may be implicit and anonymous (but in many cases the contract is personal) and this contract expresses the “membership” in a community of users of specific services (see 6.2.7.12, Alternative Modes Fare Contract Information).

5.5.3.2 Booking

Cycle sharing services offer a short-term booking in such a way that the users can check the closest available station, book a cycle and check-in within a short time. However, there is mostly no booking in advance; the user picks up one of the available cycles in the closest station.

5.5.3.3 Fares and payment

In cycle sharing operation, in most cases users pay for the service only once at the subscription and every time they have used the cycle longer than the free rental time.

5.5.3.4 Cycle network

Information about the cycling network is particularly important for trip planning. Parts of the cycling network may be shared (with other vehicle types) or dedicated to cycles. Dedicated lanes can be located on a part of the carriage way or sidewalks. Separation is provided using lane markings or permanent road equipment. The description of different characteristics of the cycling network, in particular of the sections dedicated for cycling, the slope, the type of surface, etc. is standardized by ISO TC 204 (GDF standard) and only partly by INSPIRE.

5.5.3.5 Cycling maps

Map of cycling infrastructure, comprising a map for the cycle network, cycle parking, cycle lockers locations, publicly available lockers or private lockers, etc. represents a complement to the delivery of information concerning cycling-related infrastructure. According to the Delegated Regulation EU 2017/1926, INSPIRE data model has to be used to publish the cycle-lanes related information. However, there is a standardization gap, as the INSPIRE data model is not complete in this domain.

5.5.3.6 Availability scenarios

The following scenarios are possible depending on the type of cycle sharing scheme:

- A specified predetermined location such as a cycle docking station where the station communicates the availability of a cycle and records when it has been taken and returned and by whom. The docking station will have systems to release a cycle to the potential traveller.
- For cycles in a dockless bike sharing system which feature authorized locks, typically integrated into their frame, does not require a station, but the cycle can be left at any safe location within the scheme zone.

5.5.4 Private cycling

Private cycling is a mode of operation consisting in using private cycles without any public advertisement. Travellers require access the entire infrastructure, in particular to cycle lanes, cycle parking areas and associated equipment (racks and lockers).

Data considered of interest for private cycling is:

- cycle network information: maps of urban infrastructure entirely or partly dedicated to cycling (dedicated or shared sections of the road network, dedicated lanes);
- parking availability information: availability of parking spots and lockers;
- pricing rules information (this is for parking or more general the use of the cycle infrastructure only).

This document does not focus on private cycling but most of the information modelled is useful for the above information provision.

5.6 Car sharing

5.6.1 Introduction

Car sharing is the use of a vehicle belonging to a commercial car sharing provider or a car sharing club for a specified pre-agreed time; it is similar to conventional vehicle renting but the time periods are shorter and there is less manual intervention at the beginning and end of the sharing period, and that the organizations involved are generally smaller than the large rental companies.

Car sharing is different to trip-sharing or carpooling in that it is the vehicle that is shared rather than a number of travellers using the same vehicle at the same time to complete a trip.

There are four types of cars sharing:

- provision of vehicles by an organization (commercial cars sharing);
- peer to peer (car club) provision;
- conventional car rental.

The following types of cars are considered in this document for the different modes of operation:

- conventional cars: cars of different sizes, equipment, and gearbox type using conventional liquid fuel (gasoline or diesel); although hybrid cars which do not rely on being charged can also fall into this category;
- cars with electric propulsion: cars that need to be recharged after journeys or at the end of a sharing period;
- larger vehicles: vans that could carry up to 16 persons or goods.

5.6.2 Commercial car sharing

5.6.2.1 General description

Two different types of commercial car sharing are identified:

Business to Business - where an organization makes available vehicles to another business (B to B) for the purpose of car sharing. The vehicles are only available to the staff of the business for the purpose of carrying out tasks for that business. Essentially, it is the contracting business that organizes who, when and where an employee can use the vehicle. The car sharing organization looks after all the charges and the provision and maintenance of the vehicle and possibly provides the systems for the logistical control of the vehicle.

Business to consumer – this is the conventional car sharing, where an organization has a pool of vehicles that are available on a car sharing basis to registered consumers on an on-demand basis.

5.6.2.2 Registration

For the majority of the commercial services a user shall register with the car sharing company. This registration will set up a payment method, the driver's credentials for use of the service and perhaps a deposit which will supply cover to the service provider in the event of damage or loss of the vehicle. This registration as well as setting up the account will also provide the applications for access and using the services.

5.6.2.3 Availability scenarios

Depending on the type of car sharing the vehicle could either be at a specified predetermined location (a car sharing slot) or where the vehicle was left after its last trip. There are a number of different scenarios around these two location conditions:

- Closed loop - this is where the car is accessed at a prescribed location and dropped off at the same location; this is also known as a station based round trip;
- One way - this is where the car accessed at a prescribed location and dropped off at another prescribed location; this is also known as free floating pool station;

- Free floating - this is where the car is picked up where it was dropped off after its previous use and drop off where the usage ends. The car sharing application will guide the potential user to the nearest or most accessible location of a suitable vehicle; this is also known as free floating operational area; or,
- Special docking facilities (for electric vehicles).

Some types of vehicles will require access locations that are suitable for their fuel type. Electric vehicles will require a parking location with charging facilities where the vehicle can be recharged between uses. Hence the free-floating option will not be applicable.

Car sharing parking lots might be quite large, such as at airports or other transport nodes. It might be necessary to give more detailed guidance to find the allocated vehicle.

It may not be practical to access a vehicle with a conventional key or key fob system so that other methods are used. In most cases it is a telematics system is utilized where the car-share application on a mobile device is used to scan an identification on the vehicle which in turn is automatically unlocks the vehicle and enables its use.

5.6.2.4 Fares and payment

There are a number of models for payment for the service:

- a subscription-based service where for a fee the vehicle can be used on an agreed number of occasions and an agreed distance travelled;
- a per distance service where the number of km travelled are charged on a metered basis;
- a per time basis when the time the vehicle is in used and therefore not available to others is charged; or,
- a combination of time and distance used.

5.6.3 Car sharing clubs (peer to peer)

5.6.3.1 General description

Peer to peer car sharing is publicly advertised service where a vehicle is owned by an individual, or a collective of individuals to make it available to others when it is not being used with a view to realizing the best use of the investment in the vehicle. Peer to peer schemes are similar to commercial car sharing schemes in that an income from the vehicle is expected to offset the cost of the vehicle provision but differs in that it is not the prime purpose of the peer to peer or car club to make it a significant commercial business.

Peer to peer schemes are likely to operate on a semi-formal basis, but it is also likely that a peer to peer operator may join with others to for a car club in order to enjoy the benefits of an operating model, legal advice and insurance discounts. These benefits can be instantiated in a customisable commercially available software that can provide a smartphone app to make the booking and use of a vehicle seamlessly. Car sharing clubs are covered in this document as it is possible that the clubs could be federated into an overall car sharing offer.

5.6.3.2 Registration

Individuals wishing to use a car share vehicle will need to register and present their credentials and payment details before a vehicle is used.

5.6.3.3 Access to the vehicle

At present most peer to peer systems will not use telematics-based access systems and will rely on the manual passing of a key or key-fob; however, this is likely to change as vehicles become more and more connected. As the number of vehicles in a peer to peer or car club scheme are likely to be low and that a closed loop system will be used, there are few logistical issues, save handling faults and damage.

5.6.3.4 Fares and Payment

Payment for the service will generally be by credit or debit card facilities. Payment will generally be handled by a car-club app.

Charges for the services can be based on any of the methods described in 5.6.2.4.

5.6.4 Car rental

Car rental is the provision of a vehicle for a specified time from a car rental company. Conventionally the transactions can be face to face with an agent in an office (adjoining the parking place) or by the car being delivered to, or, collected from an agreed location by the rental company's agent after the car has been booked and financed using web services. Increasingly, services are being introduced where access to the vehicle is undertaken by a telematics system. For instance, many large retail outlets have vans hireable by the hour which are booked and paid for using a terminal in the store or via a smartphone application. Users do have to register for the services, but again this can be done on the application or at the instore terminal. Access to the vehicle is via a code which is keyed into the vehicle which releases the door locks. The keys for the vehicle are left inside along with a fuel charge card. Any damage (before or after the hire period) to the vehicle is reported back to the operator by phone, smartphone application or using the in-vehicle terminal. The vehicle is generally returned back to the parking place it was retrieved from.

The main differences between car sharing and the more automated car rental are:

- with car rental the vehicle is normally booked in advance and for a specified time period rather than on an ad hoc basis;
- with car rental the vehicle has to be returned to an agreed specified location.

5.7 Carpooling

5.7.1 Introduction

Carpooling is sharing personal cars (or possibly other types of vehicles or modes) between travellers for particular journeys or part of journeys (most often drivers and passengers do not share the same origin or destination).

Informal sharing has always taken place, particularly between family members, but also through citizens helping others out, including hitchhiking.

Carpooling in this document is considered to be planned and organized, rather than informal.

Carpooling may not always be arranged for the whole length of a journey. Especially on long journeys, it is common for passengers to only join for parts of the journey, and give a contribution based on the distance that they travel.

In some countries carpooling charges can only cover prescribed costs and a profit cannot be made by the provider of a carpooled journey.

5.7.2 Generic carpooling

Drivers offer a place for specific journeys on a specific date and time through an online service (usually website or app) and passengers browse through these offers and select the one that suits them.

Different offer-request matching algorithms are available. Once the passenger has found a suitable offer (which can be a part of the proposed journey or may require a small change in the journey), a contact is established between the driver and the passenger to agree the detail of the journey.

The final booking (once all the details have been agreed) and payment may vary depending on the carpooling service used.

Most tools also provide a feedback feature to collect opinions and comments about drivers, but also about passengers; both may be banned from the service in case of inappropriate behaviour or conditions.

5.7.3 Dynamic carpooling

Dynamic carpooling is similar to conventional carpooling but allows for ride-matching once a journey has commenced and is mainly suitable in the urban context (as opposed to long distance which is generally inter-urban and pre-arranged).

Dynamic carpooling usually but not necessarily requires:

- a smartphone with a dedicated app (for both driver and passenger);
- a continuous Internet connection;
- GNSS availability, and associated map (road/pedestrian network) information: for users to locate each other, for guidance (walking to join a meeting point, or driving), etc.;
- a ride matching algorithm;
- social networks (usually inside the carpooling app) to establish trust and accountability between drivers and passengers.

Note that the organization of dynamic carpooling is strongly linked to the evolution of technologies and is very different from what it was 10 years ago and is most likely to be very different in 10 years from now.

Data shall be shared taking account of user safety and security.

5.7.4 Carpooling organized by specific companies

Companies, and large organizations like universities can also provide a dedicated carpooling service to their employees, customers, students etc.. Organizational carpooling is mainly dedicated to home-to-work carpooling but can also be used in a broader context (business trips, etc.).

The operating methodology is similar to long distance carpooling but with added features as potential users are already known to the organization operating the service: addresses and destinations (company, university) are already known allowing spontaneous incentive on journeys.

When the fleet of vehicles of the company is used, the service can be a combination of carpooling and car sharing.

More and more carpooling schemes are proposed by public transport organizations to help travellers when there is maintenance work on the network, to provide an alternative in case of cancellation or strike, or to cover last miles when public transport is not.

This type of service is usually based on an “off the shelf” solution from a software company, purchased by the organization willing to set up a carpooling service, and configured for its specific use.

5.7.5 Carpooling functions

5.7.5.1 General

The following clauses describe functions for the carpooling excluding taxi and chauffeured car (see 5.7.7)

5.7.5.2 Pricing

The price the passenger has to pay for his carpooling journey is expected to cover a part of the driver's costs (fuel, car costs, etc.) but is never a way for the driver to make money (as opposed to taxis and chauffeured cars).

The basic principle for the price is to calculate it by dividing the sum of the fuel, possible tolls, calculation of the depreciation of the vehicle purchase and maintenance, insurance and taxes paid by the driver, distributed across travellers in proportion to the distance travelled by the passenger and the number of people that shared the vehicle.

Distance based pricing has also been proposed by some carpooling services (independently from the number of travellers: based on the maximum number of travellers).

Note that pricing nearly always requires an agreement on the distance of the journey before the travel time (and the duration of the journey is not part of the price calculation). The detour of a driver to pick up a passenger should be taken into account as well.

Note that pricing does not always occur: in some cases, it can be an exchange of service, or an agreement to be driver for a future journey.

5.7.5.3 Proof of carpooling

To be paid, or to be able to use some advantages dedicated to carpooling drivers (for example free parking, high occupancy vehicle lanes) the driver may need a proof of carpooling.

This proof of carpooling may also be required for taxes for the driver (income control) or for the traveller (proof of purchase when reimbursement is possible, e.g. for company employees,).

It is not always possible to get proof of carpooling, there is no completely reliable method to get this proof. In practice this proof may be a personal declaration - where the carpooler states he/she did in fact carpool that day. This can be verified, for example by checking the license plates or, on dedicated lanes, by checking the number of travellers inside the vehicle.

5.7.5.4 Registration

Since the carpooling is a person to person activity, services are expected to provide a very high level of trust and security (personal security, in addition to financial security).

Therefore, registration most often involved several levels of identity checking and validation related to:

- E-mail (provided to connect 2 users);
- Phone number (provided to connect 2 users);
- Social network link (so user may check what kind of activity you have on your Facebook account);
- ID/passport number (of course, only the fact that the check has been completed is provided to the other users);
- Driving licence and insurance.

5.7.5.5 Travel matching and booking mechanisms

The travel matching mechanisms can be from very simple (matching of origin/destination and time window) to quite complex, possibly integrating features such as:

- Being based on a real road-based journey planning algorithm (others may just use geographic “corridors” or simple via point or city);
- Possible enlarging of the area around departure and arrival locations;
- Possible integration of multimodal journeys;
- Integration of carpooling areas (and possibly guidance to find them);
- Integrating possible detours;
- Integrating user profile matching;
- Integration possible connections with public transport (offering travellers to start or end their journey on public transport or, in certain case, offering to switch to carpooling in case of disruption in public transport.
- Register request and receive alerts when a matching offer is available (e.g. SMS push alerts, mail, in Apps, and other messaging formats).

5.7.5.6 Payment

Carpooling services integrate a secured payment mechanism, acting as middleman between the driver and the traveller. Most usual payment methods, as credit card, PayPal, bank transfer (for drivers), etc. are usually accepted.

There may be different scenarios and characteristics:

- There is no direct payment from the traveller to the driver;
- The traveller pays using the online service (website or app) at the time of booking the journey;
- The payment usually includes the travel cost plus the service fees plus the possible taxes;
- Once the journey has completed and if no special event has been reported, the driver is paid usually a few days after the trip, so the traveller has sufficient time to report any issues;
- In case of issues or if for some reason the journey was not performed, the traveller may be reimbursed (usually under conditions and not always 100 %, typically service costs aren't usually reimbursed);

5.7.5.7 Accessibility for persons with restricted mobility

Some carpooling services provide a vehicle description, and driver ability to be able to carry disabled travellers with wheelchair, etc.; however, this is not the most common situation and is usually specific to some carpooling services.

5.7.5.8 Infrastructure

In addition to the road network itself, some more specific infrastructure may be used for carpooling.

- Carpooling areas are advertised areas where a driver can pick-up or drop passenger to start or end a carpooling journey. There is no predefined structure for a carpooling area:
 - it can just be an advertised area where the car can access from the road network;
 - it can be a part of a parking area;
 - it can be a dedicated area;
 - it can be a closed or open area;
 - accessing to the area can be free, controlled or regulated;
 - access for passengers can be only by foot, but the area can also offer parking places (under agreed conditions) for passengers to leave their own car, or their bike, and start a carpooling journey; or, an advertised carpooling area may also be used for other purpose (rest area, etc.).

Carpooling areas are not mandatory for carpooling: they mainly aim to facilitate carpooling, promote it and to ensure a safe pick-up and drop-off. In some countries there may be regulations on advertising and management of carpooling areas.

5.7.6 Carpooling users

5.7.6.1 General

Carpooling users' profiles are vital for users to trust the service. There are 2 main types of users' profiles:

- The driver's profile; and
- The traveller's profile.

To be able to provide a sufficient trust level, as much information as possible is expected by users (and therefore by carpooling services) but this raises potential privacy issues that have to be managed by carpooling services.

5.7.6.2 Drivers

There is generally more data collected for the driver than the traveller. The level of detail provided varies depending on the step in the booking process:

- Early stage of the ride matching process (list of available trips): minimum level of information;
- Selection of a trip: a little more detailed information (but driver's name and contact are not provided, the communication with the driver is usually done through the service);
- The driver has accepted the request: full details;

The following information concerning the driver is usually required:

- Name (usually partially hidden in the first steps of the booking process);
- Valid licence and insurance;
- Age;
- The verification level of the driver's account - e-mail address, phone number, ID Card, etc.;

- The driver's account statistics - number of proposed trips, number of persons who have travelled with him, when he first registered, when was the last proposed trip, etc.;
- The driver's driving style - according to users;
- Whether the driver is talkative or quiet;
- Whether the driver is a smoker;
- Whether the driver has an animal that is sometimes in the car, even if not in the car during the specific journey;
- Traveller evaluation - mean ranking, number of evaluations, etc.;
- Traveller comments;
- The type of vehicle - possibly including vehicle details;
- Social network integration - number of friends on Facebook, etc.

Accepted passenger requirements:

- Whether bringing luggage is possible - with dimensions;
- Whether detours are possible (including time and distance);
- Whether taking an animal is possible;
- Facilities for disabled travellers;
- Companions for disabled travellers.

5.7.6.3 Travellers

The traveller's profile is received by the driver who may then accept the request, start discussing with the requesting traveller, or reject the request.

The traveller's profile is usually similar to the driver profile, except for the driver's specific information - type of car, etc.

Drivers can rank travellers as they can be ranked by them (they usually are both notified of any ranking or comment, as on any social network).

5.7.6.4 Priority

The vehicle pooling may be given priority in being able to use public transport lanes or priority at traffic signals with the permission of local traffic authorities. Information on these priorities via signage is necessary as well as a robust means of determining which vehicles are presently using vehicle pooling. Refer to D.1 for more information.

5.7.7 Taxi Services

5.7.7.1 Introduction

Taxi services similar to vehicle pooling services in that the vehicle is operated by a driver and the traveller and the traveller pays for the journey. The main differences between taxi services and carpooling is, firstly that taxi services will be operated on a commercial basis where the operator makes

a profit over and above the costs of providing the service; and secondly that the driver of the vehicle is making the journey solely for the benefit of the traveller. Essentially, they are demand responsive service.

Taxi services can comprise one of three scenarios:

- Taxi services that can be hailed on street and can stop to pick up the traveller at the side of the road and commence charging (by distance and time) from the point of pick up and cease charging on drop off. This sort of taxi service can use taxi stands. In many cities this kind of taxi service is highly regulated and licensed, and the drivers regularly checked for competence and safety. Some taxi services can also be booked and paid for on account.
- Bookable chauffeur driven services (sometimes called minicabs) that need to be booked in advance and cannot be hailed from the roadside. Historically bookable chauffeur driven services were booked by telephone, but more recently services have been introduced where the booking is undertaken by a smartphone application that identifies and hails the nearest vehicle subscribed to that service. This service cannot normally use a taxi rank at the side of the road except where it is combined with a booking office.
- A taxi service which can operate more like a bus service where unrelated travellers can share the costs of part of a trip in a similar way to carpooling. This sort of service is generally operated on a pre-booked basis.

5.7.7.2 Taxi stands

Taxi stands are normally delineated by road signs and/or road markings. The stands can be in an area at the roadside or in a layby area. The purpose of the stand is to provide a place where taxi services can: wait whilst not cruising for business; can provide comfort facilities for the driver; or be a place where potential travellers can find a free taxi. Stands will have a location (address), potentially a telephone number and potentially the number and type of vehicles it can accommodate.

5.7.7.3 Booking

Both taxis and chauffeur driven vehicles can be booked by telephone or online.

5.7.7.4 Fares and payment

For taxis, fares are normally based on a combination of distance and time, which means the fare can increase in heavy traffic. Chauffeur driven cars that are booked can be operated on an agreed cost per journey basis regardless of the time taken to complete the journey.

5.7.7.5 Priority

The taxis may be given priority in being able to use public transport lanes or priority at traffic signals. Information on these priorities via signage is necessary as well as a means of determining that a vehicle is eligible. The awarding of specific priorities will be part of the public authority policy.

6 Data requirements

6.1 General

According to the definition provided above of 'public transport' and because of some similarities between conventional mode and alternative mode of operation, where ever possible, a link is created between data structures of Transmodel and data structures dedicated to the alternative modes. CAPITALIZED letters are used for the name of the classes in the model. The modelling conventions are described in Annex C.

NOTE In addition to these conventions, all new classes defined in this specification are marked with a red triangle.

6.2 Data model

6.2.1 Overview

The data model is composed of the following modules (packages (see Figure 4)):

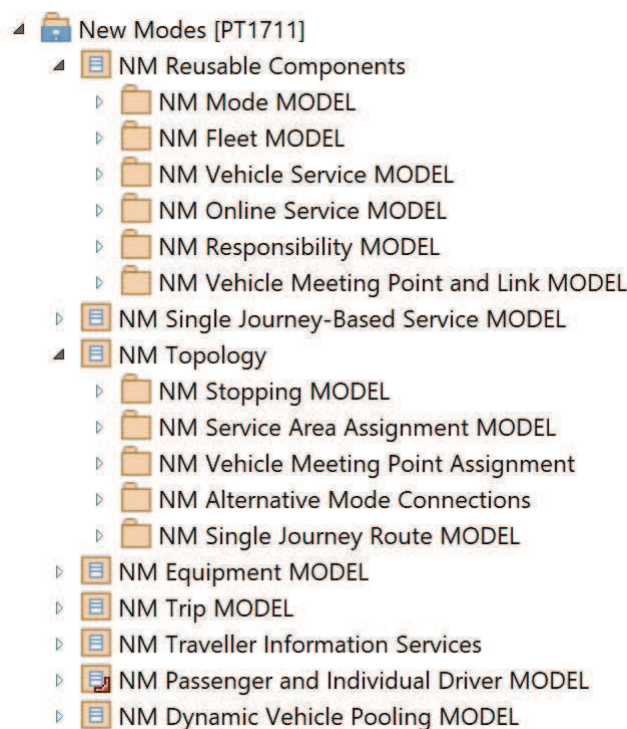


Figure 4 — Model Overview

NM Reusable Components MODEL: models data structures used in other packages;

NM Single Journey-Based Service MODEL: describes the data structure for services such as vehicle pooling;

NM Topology MODEL: provides several models for spatial information linked to alternative modes of operation;

NM Equipment MODEL: describes specific equipment related to the alternative modes;

NM Trip MODEL: provides the model of the trip where particular legs are made using alternative modes;

NM Traveller Information Services MODEL: provides sub-models representing data requirements for the traveller information services enumerated in 5.4.2

NM Passenger and Individual Driver MODEL: describes the different roles of and individual traveller which may be driver and/or passenger, for instance in carpooling services;

NM Dynamic Vehicle Pooling MODEL: provides data structures for dynamic vehicle pooling.

6.2.2 Reusable components

6.2.2.1 Modes and Modes of operation

The diagram below intends to clarify the distinction between, on one hand:

- the concept of MODE, defined as any means of transport, or SUBMODE, defined as a variant of a MODE, linked to VEHICLE TYPE (see EN 12896-1); and the other,
- the concept of MODE OF OPERATION which represents the way the MODE or SUBMODE is operated.
- Three specializations of MODE OF OPERATION are identified:
- CONVENTIONAL MODE OF OPERATION: Legacy mode of operation which is provided as a scheduled and/or flexible publicly advertised transport offer.
- ALTERNATIVE MODE OF OPERATION: Any publicly advertised mode of operation different from the CONVENTIONAL MODE OF OPERATION, for example: VEHICLE SHARING, VEHICLE RENTAL and VEHICLE POOLING.
 - VEHICLE RENTAL: An ALTERNATIVE MODE OF OPERATION of a vehicle, part of a FLEET (in general privately owned), available for use for a certain period of time and fee, with the constraint to bring it back at specified agencies.
 - VEHICLE SHARING: Short term vehicle rental where the vehicle can be taken from and parked at different places in the urban area, possibly without the constraint to bring back the vehicle to a specific location.
 - VEHICLE POOLING: An ALTERNATIVE MODE OF OPERATION of a privately-owned vehicle consisting in sharing the vehicle for a trip between the driver who is at the same time performing a trip and at least another traveller.

NOTE Chauffeured Car and Taxi are special types of VEHICLE POOLING (with a dedicated TYPE OF OPERATION).

- PERSONAL MODE OF OPERATION: Not advertised mode of operation of private persons using their own vehicle.

The diagram “NM Mode MODEL” in Figure 5 shows that any SUBMODE may be assigned one or several MODES OF OPERATION. For instance, a “local bus” may be operated as a CONVENTIONAL MODE, scheduled or flexible. A “mini-bus” may be operated using a CONVENTIONAL MODE OF OPERATION (scheduled or flexible), or as an ALTERNATIVE MODE, for instance, dedicated to VEHICLE SHARING. TYPE OF MODE OF OPERATION characterizes more precisely possible ways of operation, for a given a SUBMODE.

This particular specification concerns ALTERNATIVE MODES OF OPERATION, but many similarities to the CONVENTIONAL MODE exist, in particular, as regards types of data structures and for this reason, many models for the new modes take advantage of Transmodel data structures.

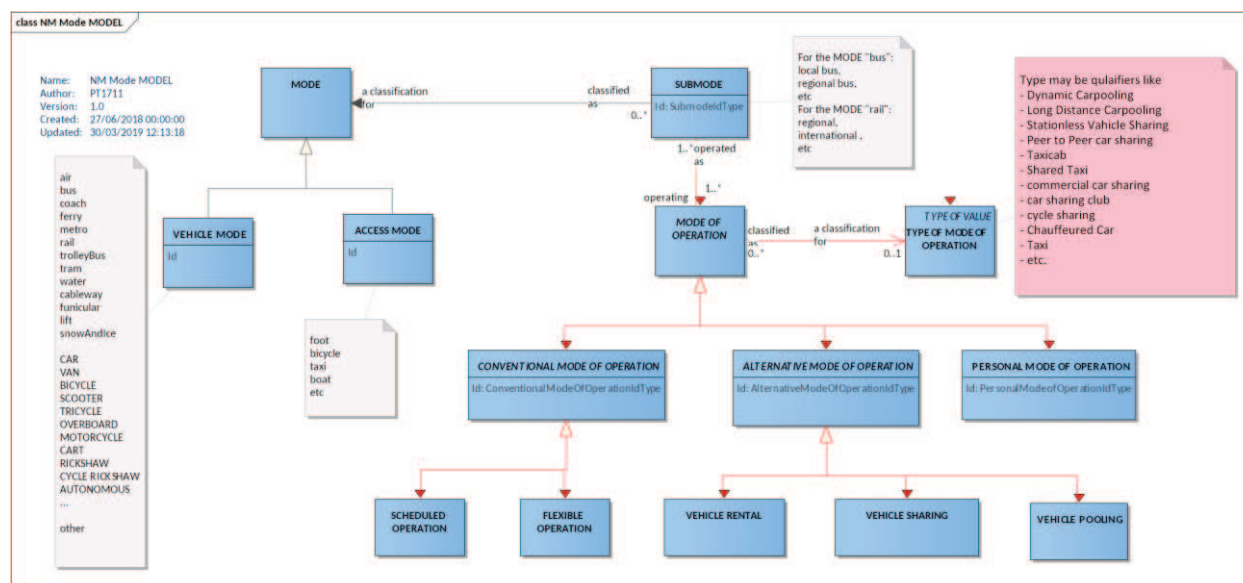


Figure 5 — NM Mode MODEL

6.2.2.2 Fleet

The NM Fleet MODEL in Figure 6 describes the FLEET, defined as a set of vehicles of any type. The concept of a FLEET is general, i.e. not dependent of MODE OF OPERATION, but particularly useful to be considered for the services offered by some of the ALTERNATIVE MODES OF OPERATION (see 6.2.2.3). A FLEET is owned by an ORGANIZATION, a legally incorporated body associated with any aspect of the transport system. The ORGANIZATION can be for example an AUTHORITY, OPERATOR or any OTHER ORGANIZATION. An ORGANIZATION may own many FLEETS.

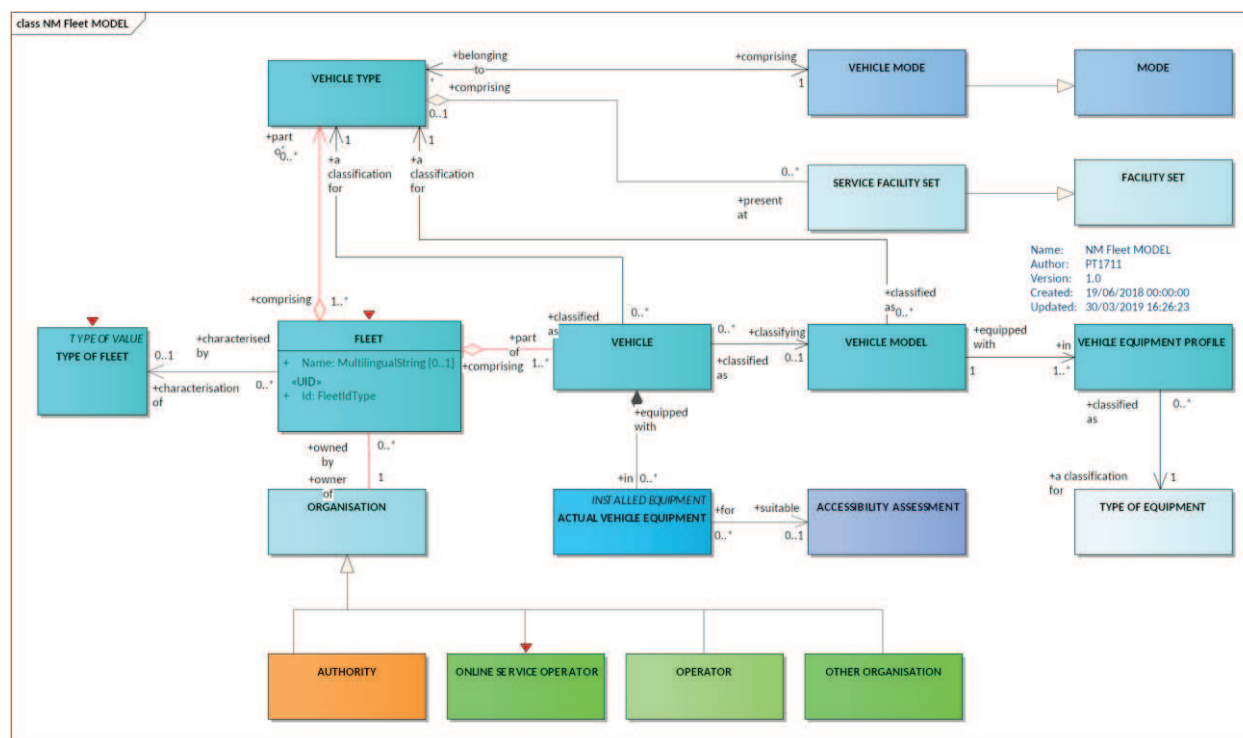


Figure 6 — NM Fleet MODEL