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Public transport - Reference data model - Part 8: Management information & statistics

Einführendes Element — Haupt-Element — Ergänzendes Element

Élément introductif — Élément central — Élément complémentaire

CCMC will prepare and attach the official title page.

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European foreword

This document (prEN 12896-8:2025) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This document is currently submitted to the Committee Internal Balloting process.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by XXXX, and conflicting national standards shall be withdrawn at the latest by XXXX.

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 supersedes EN 12896-8:2016 .

This document is part of the European standard EN 12896, known as “Transmodel”. The standard is a series of documents that comprises of the following ones:

— Public transport - Reference data model - Part 1: Common concepts

— Public transport - Reference data model - Part 2: Public transport network

— Public transport - Reference data model - Part 3: Timing information and vehicle scheduling

— Public transport - Reference data model - Part 4: Operations monitoring and control

— Public transport - Reference data model - Part 5: Fare management

— Public transport - Reference data model - Part 6: Passenger information

— Public transport - Reference data model - Part 7: Driver management

— Public transport - Reference data model - Part 8: Management information and statistics

— Public transport - Reference data model - Part 10: Alternative Modes

Together these documents create Transmodel version 6.2 of the European Standard EN 12896, known as “Transmodel” and thus replace Transmodel V6.0.

In addition to the nine normative Parts of this European Standard, a Technical Report (Public Transport – Reference Data Model – Informative Documentation) was published in 2016 under the reference TR 12896-9. It provides additional information to help those implementing projects involving the use of Transmodel. It is intended that this Technical Report will be extended and republished as soon as all the normative parts are revised.

EN 12896-8:2025 includes the following significant technical changes with respect to EN 12896-8:2016:

— Integration into Part 1 of the already published common concepts,

— Updates and extensions of the model related to the described Use Cases.

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

Introduction

Rationale for the Transmodel Standard

Public transport services rely increasingly on information systems to ensure reliable, efficient operation and widely accessible, accurate passenger information. These systems are used for a range of specific purposes: setting schedules and timetables, managing vehicle fleets, issuing tickets and receipts, providing real time information on service running, and so on.

This standard will improve a number of features of public transport information and service management: in particular, the standard will facilitate interoperability between information processing systems of the transport operators and agencies by using similar definitions, structures and meanings for their data for the systems being part of one solution. This applies both to connecting different applications within an organisation, and also to connecting applications between interworking organisations (for instance, a public authority and a transport operator).

The Transmodel standard presented in this European Standard provides a framework for defining and agreeing data models and covers the whole area of public transport operations. By making use of this European Standard, and of data models derived from it, it will be possible for operators, authorities and software suppliers to work together much more easily towards integrated systems. Moreover, the breadth of the standard will help to ensure that future systems' developments can be accommodated with the minimum of difficulty.

Use of the Transmodel standard

This European Standard presents version 6.2 of the European Standard EN 12896, known as "Transmodel". Transmodel V6.2 is a reference standard which provides a conceptual data model for use by organisations with an interest in information systems for the public transport industry.

As a reference standard, it is not necessary for individual systems or specifications to implement Transmodel as a whole.

It needs to be possible to describe (for those elements of systems, interfaces and specifications which fall within the scope of Transmodel):

— the aspects of Transmodel that they have adopted;

— the aspects of Transmodel that they have chosen not to adopt.

Transmodel may prove of value to:

— organisations within the public transport industry that specify, acquire and operate information systems;

— organisations that design, develop and supply information systems for the public transport industry.

In both cases Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the organisation and/or for the product suite.

For the public transport organisations, Transmodel will enable to specify the database structures and/or system interfaces in such a way that separate modules can be openly tendered but will still integrate easily. The organisation also has a greater likelihood that information exchange interfaces with external organisations will be more easily achieved.

For an organisation wishing to design, develop and supply information systems for the public transport industry, Transmodel will enable the organisation to develop its products in such a way that separate modules will integrate easily, but also so that they may be sold separately to clients seeking Transmodel-compliant systems.

Transmodel is a large and intricate model, which allows for great flexibility. Consequently, it takes some skills and resource to apply it effectively in order to develop the physical data model and its implementations for a particular aspect, e.g., one particular functional domain, such as vehicle scheduling or fare management or for a particular interface, as between a ticket machine and a fare management system, or a particular organisational boundary, as between two connecting transport operators.

For such situations, Transmodel provides a wider setting and a starting point. The specific elements of Transmodel must be refined, attributes and data formats will have to be completed, for a specific sub-model of the Transmodel data model. The resulting specification, although specific, will facilitate the built of a coherent overall systems framework, since it will coexist more readily with other Transmodel-based specifications.

For all these potential users, the adoption of Transmodel as a basis for development means that a common language is being used. Thus, users will understand and assess the claims of suppliers better, and specification developers will be more likely to be working in alignment with each other.

Applicability of the Transmodel standard

General

Transmodel may be applied to any framework for information systems within the public transport industry, but there are three circumstances to which it is particularly suited:

— specification of an organisation’s ‘information architecture;

— specification of a database;

— specification of a data exchange interface.

Specification of information architecture

An ‘information architecture’ refers to the overall structure of information used by an information system, which is used to determine:

— the structure of data held in system databases;

— the structure of data exchanged across interfaces between systems.

It may be used as a strategic guide to system planning and evolution, and as the basis for the specification and acquisition of individual systems.

It is easier to maintain an information architecture made up of independent modules with well-defined interfaces. A malfunctioning module can be taken out of service or completely replaced without disrupting the rest of the system. This is particularly beneficial for online or safety critical systems. The modules can also be more easily reconfigured on to hardware located elsewhere on the network to fit in with changes in organisational arrangements for managing the business and data administration processes.

The information architecture itself should be evaluated from time to time to make sure that it is still meeting the needs of the organisation. Technological changes in communications and computing are continuously bringing forward new opportunities for evolving the systems supporting the business.

Specification of a database

At a more technical level, an organisation's systems will have a collection of data in one or more databases, which may be associated with individual applications or may be common to many applications.

In either case, Transmodel can serve as a starting point for the definition of a database schema, which will be used for the physical implementation of databases. Whether applications access a common database built to this schema or have their own databases and exchange data built to consistent schemas, the use of an overall reference data model assists integration.

Technical constraints (such as memory capacity restrictions of smart cards) may affect the detail and complexity of the data models that can be used in particular data storage devices. Transmodel does not itself specify a level of detail to adopt.

Specification of an interface

Public transport organisations may require different applications to exchange data with each other. Also, public transport organisations may exchange data with other organisations. In either case, the reference data model can be used to help design the interfaces.

Again, technical constraints (such as bandwidth limitations of radio communications links) may affect the detail and complexity of the data models that can be used for particular interfaces. Transmodel does not itself specify a level of detail to adopt.

Conformance statement

A specification which cites Transmodel needs to include comparisons of the specification against the Transmodel reference data model in at least two conformance levels:

— level 1 (the global level) identifies which data domains within the specification are drawn from the Transmodel domains, and which ones are not;

— level 2 (the detailed level) compares the data model within the specification against the Transmodel entities.

The level 1 conformance statement should be presented as a table based on one of the following:

— the Transmodel functional domains:

— public transport network topology;

— timing information ;

— vehicle scheduling;

— operations monitoring and control;

— fare management;

— passenger information;

— personnel management;

— management information & statistics;

— alternative modes;

— alternatively, the corresponding UML diagrams as presented in the data model.

The level 2 conformance statement consists in a detailed comparison of data elements of a source specification to Transmodel (target specification) and shall be presented as a table (mapping table[1]) in which the data elements used in the source specification are qualified as:

— Exact correspondence of a source concept to a Transmodel class;

— Exact correspondence of a source attribute to a Transmodel attribute;

— Source-specific concept without contradiction to any of the Transmodel elements;

— Source-specific attribute without contradiction to any of the Transmodel elements;

— Source element belonging to a group of source elements corresponding to a Transmodel class;

— Source element derived from several Transmodel attributes.

Transmodel origins and development milestones

Transmodel development started in early 90's within the Drive I European programme. It was first published as ENV 12896 V4 in 1994.

Subsequent versions have been elaborated within a range of European projects and led to the publication of V5.1 in 2006 and of V6.0 in 2016.

Further details in the development of Transmodel can be found in Annex C of Part 1 (cf. EN 12896-1, Public transport – Reference data model – Part 1: Common concepts).

Reference to the previous version and other projects and documents

General

Transmodel V5.1 published under the number EN 12896 served as the basis for the development of the SIRI, IFOPT and NeTEx standards and specifications.

The updated version first published in 2016 (Transmodel V6.0) broke the specification down into several separate documents (Parts 1 to 3). It was followed in 2018 by Parts 4 to 8, including a significantly extended Fare model as Part 5 and an informative document TR 12986-9.

In 2021, an additional Part 10 was added, extending v6.0 to cover alternative modes such a rental, bike sharing, car-pooling, etc. This included revisions to the core models for organisations and for vehicle types.

With the addition of each new part to Transmodel, minor enhancements to the core framework were added as annexes to each respective part.

This new version 6.2 consolidates changes to the core framework and reusable components back into Part1, so that they are described in a single place. In addition, several new functional areas are added to the common components, in particular for seating plans and deck plans.

IMPORTANT: Transmodel parts 2 to 10 rely on Transmodel - Part 1: Common concepts (EN 12896-1, Public transport – Reference data model – Part 1: Common concepts).

[1] https://data4pt-project.eu/wp-content/uploads/2021/03/Data4PT-Methodology-for-comparing-data-standards.pdf

In order to fully understand this part (Transmodel part 8) the reader will need to refer to EN 12896-1, Public transport – Reference data model – Part 1: Common concepts.

Another aspect of the development of V6.2 is an active link of the Transmodel group with the Transmodel-based implementation specifications: SIRI, NeTEx, OJP and OpRa in particular. For this reason, the term of "Transmodel ecosystem" is used in this context. These aspects are briefly described below.

SIRI (Service interface for real-time information)

The project SIRI has used EN 12896:2006 as an input to develop standard interfaces as regards exchanges of real-time data for passenger information. The present document does not formally establish the link between SIRI data model and the evolution of EN 12896, as at the time updates of Transmodel are under way, SIRI is proceeding to updates as well. However, possible extension requests formulated by the SIRI group are intended to be considered in the relevant parts of Transmodel V6.2.

IFOPT (Identification of Fixed Objects in Public Transport)

The project IFOPT used EN 12896:2006 as an input to develop a logical data model for the fixed objects, relevant for public transport, in particular for physical stops and points of interest. IFOPT was established an implicit link to EN 12896:2006 (Transmodel v5.1) and was published as EN 28701. As Transmodel V6.0 has integrated IFOPT in EN 12896-2, CEN has withdrawn IFOPT (EN 28701) from its list of standards.

NeTEx (Network Timetable Exchange)

Between 2009-2013, the NeTEx project developed standard transport data interfaces as XML schema. These are intended for the exchanges of network topology and timetable data based on the models EN 12896:2006 and EN 28701. NeTEx unified the (Transmodel V5.1 and IFOPT) and extended the fares model. The result was a single conceptual model covering the domains network topology, timing information and information on fares. The NeTEx model was modularised into packages so that implementors only need to implement the elements relevant to their application. NeTEx was subsequently updated in 2018.

The 2016 update to Transmodel included a systematic modularisation of the packages and the addition of functional extensions from NeTEx.

This new version of Transmodel includes some further features that have been added to NeTEx during its use.

OJP (Open API for Distributed Journey Planning)

The specification originally called Open API for Distributed Journey Planning (OJP) was partly elaborated using Transmodel V5.1 and has been published in 2017. The present document takes into account the harmonisation work between Transmodel and OJP as far as it has been possible to achieve it without breaking compatibility with previous versions of Transmodel and OJP.

OpRa (Operating raw data and statistics exchange)

OpRa focuses mainly on observed/measured and registered information, i.e. information which cannot be changed anymore in the future. This information is mainly an output of the domain "operations monitoring & control" as defined by Transmodel.

Based on the actual service, including delays and cancelled vehicle journeys, etc. OpRa takes into account the recorded reality of operation, either through individual observed and registered data at a given sampling interval (raw data) or in an aggregate way (indicators) and provides the data exchange format.

As for NeTEx and SIRI, OpRa is based on Transmodel, in particular on Transmodel Part 8.

Some basic conventions

General

A comprehensive presentation of the specific conventions as regards the use of UML is presented in EN 12896-1, Public transport – Reference data model – Part 1: Common concepts). The paragraphs below present an extract of it, in particular, the explanation related to the use of specific characters or abbreviations and the meaning of colours.

Typographic conventions

This Standard makes use of specific typographic conventions that have been adopted for previous and related Standards and Technical Specifications. Unless the context dictates otherwise:

— Terms wholly in CAPITAL LETTERs refer to a concept which is defined in the Data dictionary in the relevant part or in a part with a lower number, i.e. capitalised concepts in Part 1 are defined in the Data dictionary of Part 1, capitalised concepts in Part 2 are defined either in the Data dictionary of Part 2 or of Part 1, etc. Note that pluralisation of such an entity is indicated by the addition of a lower case “s”. It is planned that a comprehensive Data dictionary will be issued as a separate document, updated as additional Parts of this Standard are published;

— Terms wholly in CAPITAL LETTERs and in italic characters appearing mainly in the diagrams concern abstract classes, i.e. classes which cannot be instantiated directly. They represent common characteristics of all their sub-classes (specialisations);

— Terms wholly in lower case letters refer to the use of those words in their normal everyday context;

— Terms in italic characters are used for explanatory text, particularly related to the context in which a defined entity may be found;

— Terms in UpperCamelCase are class attributes, such as PersonCapacity, AtCentre, IsExternal, etc.;

— The use of colours helps the reader to link the different classes with similar semantical meaning to a particular package;

— The word “model” is written either “model”, or “Model”, or “MODEL”. The diagram notes marked MODEL refer to the corresponding conceptual diagrams of the Transmodel documentation.

Use of model prefix abbreviations

Transmodel is structured in modules which intend to describe specific data domains (related to a functional domain). A prefix in front of each package name indicates the part in the standard where this package has been introduced and described first, Sub-packages in each main package have a prefix as well as indicated below.

Table 1 – List of model prefix abbreviations

Part number	Part abbreviation	Part name	Sub-part abbreviation	Sub-part name
1	CC	Common concepts		
2	NT	Public transport network topology	FO	Fixed objects
			ND	Network description
			TP	Tactical planning components
3	TI	Timing information and vehicle scheduling	DJ	Dated Journey
			JA	Vehicle Journey Assignment
			JT	Journey Times
			VS	Block & Vehicle Service
4	OM	Operations monitoring & control	CA	Control action
			DM	Detecting & Monitoring
			DP	Dated production components
			EI	Operational event & incident
			MA	Facility monitoring & availability
			MS	Messaging
			OC	Dated Call
			OY	Occupancy
			PP	Production plan
			SI	Situation
5	FM	Fare management	AR	Access rights description
			FC	Validation and control
			FP	Pricing
			FR	Fare role
			FS	Fare structure

				description
			ST	Customer & sales transaction
6	PI	Passenger information	TD	Trip description
7	DM	Driver management	DC	Driver control action
			DS	Driver scheduling
			PD	Personnel disposition
			RO	Rostering
8	MI	Management information & statistics	GS	Generic Information anf Statistics
			RS	Recorded Use of Services
			SP	Service Jouney Performance
			US	Use of Services
			QM	Query
10	AM (NM)	Alternative modes (New modes)	SJ	Single journey

Colouring of classes in a class diagram

UML does not formally use colour to denote semantic meaning. As an additional stylistic convention, Transmodel uses colour to help make diagrams easier to comprehend. Colours are assigned to functional areas and classes are then consistently coloured according to the functional area to which they belong throughout Transmodel (and NeTEx). This makes it easier to distinguish the "home" and external classes (cf. EN 12896-1, Public transport – Reference data model – Part 1: Common concepts) of a given model, and to recognize commonly used components when they appear on various diagrams.

NOTE: I if one suffers from colour blindness some of the distinctions between functional areas may not be apparent. They will not impact one's comprehension of Transmodel and its UML model.

Colouring of connectors in a class diagram

As an additional stylistic convention, Transmodel uses colour to distinguish changes to the model since the last release:

— classes added since the last release have a red triangle.

connectors added or changed since the last version are coloured red.

1 Scope

1.1 General scope of the standard

1.1.1 Functional domains

Transmodel V6.2, as already in the previous version, is structured into 10 parts (of which part 9 consists in informative information). In terms of functional coverage, Transmodel provides data structures required by most of the functions of the following domains of Public Transport:

— public transport network definition: routes, lines, journey patterns, timing patterns, service patterns, scheduled stop points and stop places, but also parking (Part 2);

— timing information and vehicle scheduling: runtimes, vehicle journeys, day type-related vehicle schedules (Part 3);

— operations monitoring and control: operating day-related data, vehicle follow-up, control actions (Part 4);

— fare management: fare structure and access rights definition, sales, validation, control (Part 5);

— passenger information (planned and real-time) (Part 6);

— driver management (Part 7) split into:

— driver scheduling (day-type related driver schedules);

— rostering (ordering of driver duties into sequences according to some chosen methods);

— driving personnel disposition (assignment of logical drivers to physical drivers and recording of driver performance);

— management information and statistics (including data dedicated to service performance indicators) (Part 8);

— management of the alternative modes of operation: vehicle pooling, vehicle sharing, vehicle rental, taxi (Part 10).

The data modules dedicated to cover most functions of the above domains are specified.

Several concepts are shared by the different functional domains. This data domain is called 'Common Concepts' (cf. EN 12896-1, Public transport – Reference data model – Part 1: Common concepts).

The different parts are related to the implementations NeTEx, SIRI, OpRa, OJP, OpRa as shown in the figure below.

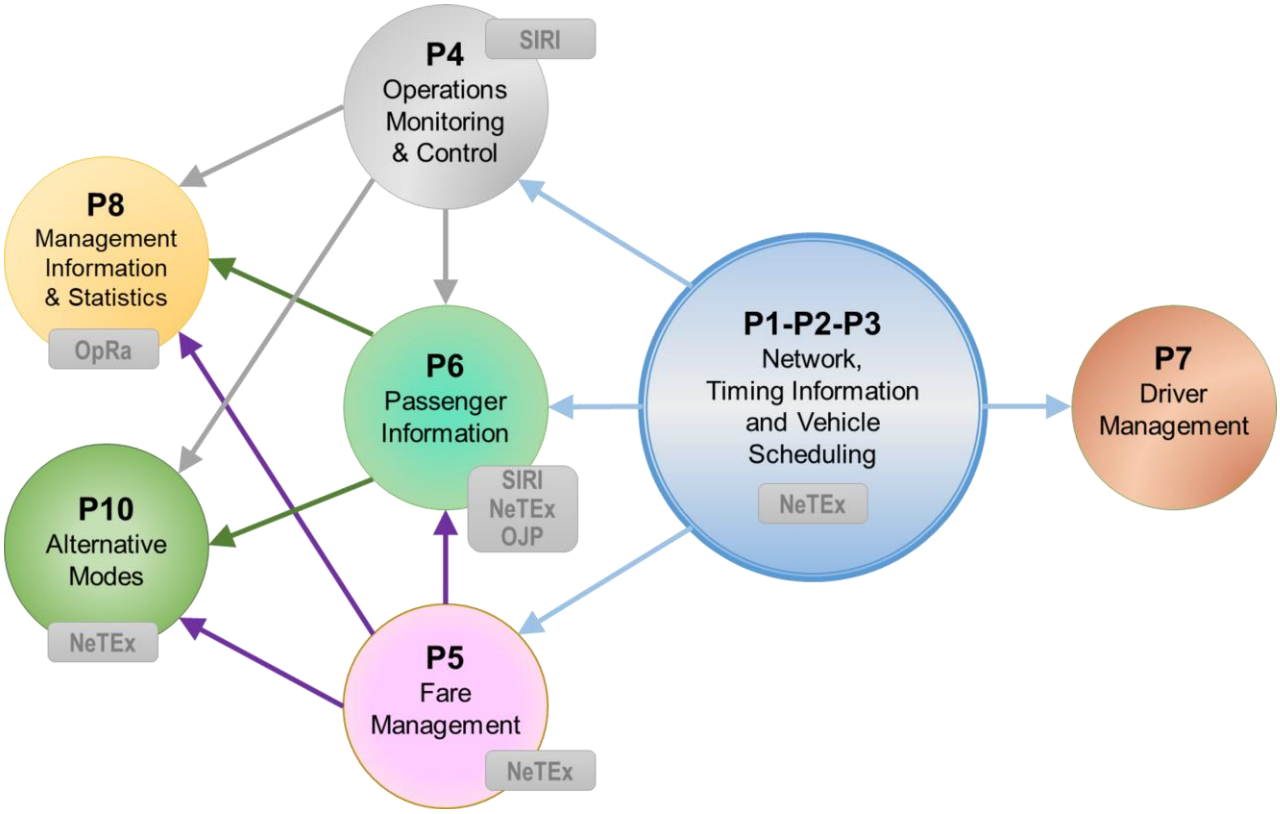

Figure 1 — Link Transmodel parts and Transmodel implementation standards

1.1.2 Modes of operation

The main objective of this European Standard is to be the Public Transport Reference Data Model.

'Public transport' must be understood as services advertised and available for use by the general public carried out by any means of transport.

The 'transport means' operations themselves may be characterised in terms of types of operation (methods/modes of operation), i.e., ways they are operated. Transmodel coverage is described in terms of 'modes of operation' rather than in terms of 'transport means'.

EN 12896 V6.2 distinguishes the following types of 'mode of operation':

— conventional mode of operation: the legacy method of operation which is provided as a scheduled and/or flexible publicly advertised flexible transport offer. This method 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 optimise 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.

Transmodel V6.2 is primarily dedicated to the conventional and the alternative mode of operation. The figure below represents what Transmodel covers and how public transport is to be understood for this standard.

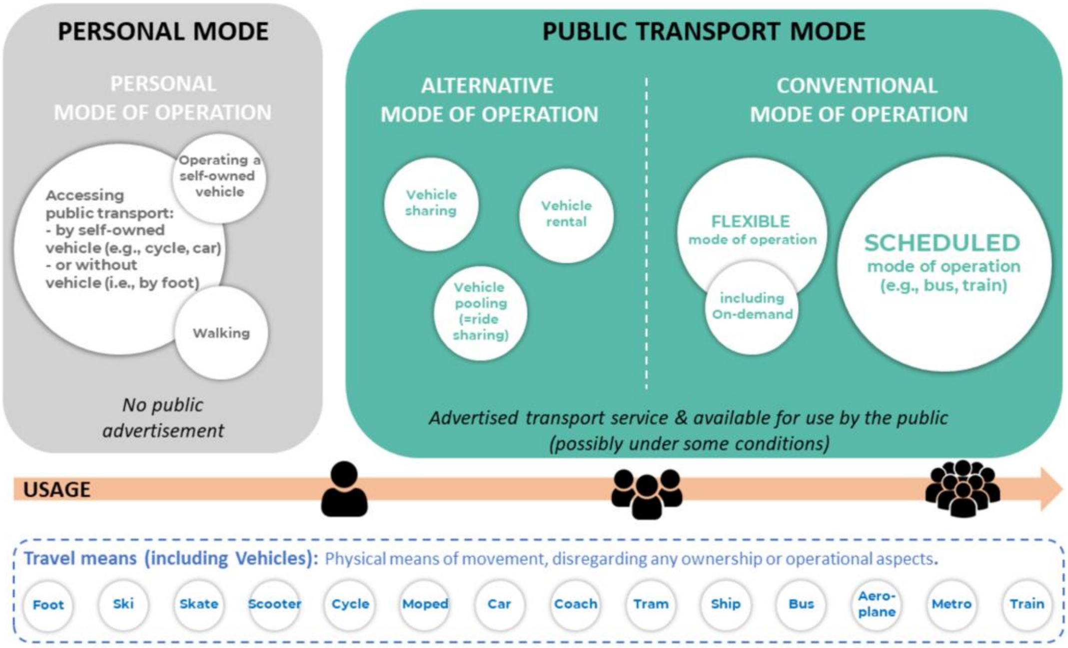

Figure 2 —Public transport modes covered by Transmodel

NOTE: The figure does not represent the market share of each mode of operation nor vehicle. For example, it is obvious that' walking' (referred to as 'without vehicle') is the most use mode of transport whereas its bubble can be seen as small.

1.2 Functional domain description

1.2.1 Public transport network and stop description

The reference data model includes entity definitions for different types of points and links as the building elements of the topological network. Stop points, timing points and route points, for instance, reflect the different roles one point may have in the network definition:

— used for the definition of (topological or geographical) routes,

— as a point served by vehicles when operating on a line, or

— as a location against which timing information like departure, passing, or wait times are stored to construct the timetables.

The line network is the fundamental infrastructure for the service offer, to be provided in the form of vehicle journeys which passengers may use for their trips. The main entities describing the line network in the reference data model are the line, the route, and the journey pattern. They refer to the concepts of an identified service offer to the public. The possible variants of itineraries vehicles would follow when serving the line, and the (possibly different) successions of stop points served by the vehicles when operating on the route.

The functional views of the network are described as layers. A projection is a mechanism enabling the description of the correspondence between the different layers. This mapping between the layers is particularly useful when spatial data from different environments (sources, functional domains) must be combined. An example of such a situation is the mapping of the public transport network on the road network.

1.2.2 Timing information and vehicle scheduling

The work of the vehicles necessary to provide the service offer advertised to the public consists of service journeys and dead runs (unproductive journeys that are necessary to transfer vehicles where they are needed, mainly from the depot into service and vice versa). Vehicle journeys are defined for day types rather than individual operating days. A day type is a classification of all operating days for which the same service offer has been planned. The whole tactical planning process is seen on the level of day types in the reference data model, with all entities necessary to develop schedules. These include a series of entities describing different types of run times and wait times, scheduled interchanges, turnaround times etc.

Chaining vehicle journeys into blocks of vehicle operations, and cutting driver duties from the vehicle blocks, are parts of the main functions of vehicle scheduling and driver scheduling, respectively. The corresponding entities and relationships included in the reference data model allow a comprehensive description of the data needs associated with this functionality, independently of the specific methods and algorithms applied by the different software systems.

1.2.3 Operations monitoring and control

The domain of operations monitoring and control concerns all activities related to the actual transportation process. It is also known as real-time control, or operations management.

The supply basis for each operating day is known as a production plan, composed of the planned work of each available resource (e.g., vehicles and drivers). It includes for instance all dated journeys planned on the considered day, including occasional services.

The transportation control process supposes a frequent detection of the operating resources (in particular, vehicle identification and location tracking). Such collected information is compared to the planned data (e.g., work plan for a vehicle or a driver, target passing times), thus providing a monitoring of these resources (e.g. **actual observed passing times** at scheduled stop points).

The monitored data are used for:

— controlling the various resource assignments (e.g., vehicle assignment to a dated block);

— assisting drivers and controllers to respect the plan (e.g., schedule adherence, interchange control);

— alerting on possible disturbances (e.g., delays and cancellations);

— helping the design of corrective control actions according to the service objectives and overall control strategy; the model describes a range of such control actions (e.g., departure lag);

— activation of various associated processes (e.g., traffic light priority, track switching);

— passenger information on the actual service (e.g., automatic display of the expected waiting time at stop points);

— follow-up and quality statistics.

Other aspects, such as communication between actors, are taken into account.

1.2.4 Fare management

The fare management data model aims at a most generic description of the data objects and elements needed to support functions like definition of the fare structure and its parameters, operating sales, validating the consumption and charging customers. These functions and their underlying data structures are handled differently between European countries, and even between the public transport operators within one country.

This situation leads to a considerable complexity of the concepts to be considered in the attempt to define one single fare management data model, which aims at covering as many existing solutions and practices as possible. In order to cope with this complexity, the fare management data model concentrates on the abstract, generic concepts that form the core of any fare system, independently of how these abstract concepts are implemented by a set of concrete fare products (e.g., tickets or passes) offered to the public.

The starting point for the description of these fundamental concepts is the definition of theoretical access rights. These can be combined to immaterial fare products, which are linked to travel documents to form sales packages to be sold to passengers. Controls may be applied to these travel documents to validate the use of the public transport system. Price components are linked to the access rights, fare products and sales packages; they are used to calculate the price to be paid by a customer for a specific consumption (e.g., sale on a vending machine, debiting a value card, post-payment).

1.2.5 Passenger information

In its passenger information model part, the reference data model does not only describe the data which are needed for applications providing passengers with the relevant information on the planned as well as on the actual service, but also the data resulting from the planning and control processes which may result in service modifications possibly to be made known to the public. Consequently, the passenger information data model includes data descriptions which go far beyond the planned timetable, which is the main source for the classic timetable information, but does not take into account any dynamic issues.

These additional concepts refer to:

— passenger information facilities and their use for passenger queries;

— detailed description of all conceptual components of a passenger trip, as possibly needed by an interactive passenger information system when answering a passenger query;

— basic definitions of run times and wait times needed to calculate the trip duration;

— planned, predicted, and actual passing times of journeys at individual stops;

— service modifications decided by the schedulers or the control staff, resulting in changes of the vehicle journeys and blocks, compared to the original plan.

An important component of the Passenger Information model is the Trip Model which shows the Transmodel elements relevant for the trip planning requests. Transmodel v6.2 provides an updated version of the Trip Model allowing for the representation of trips composed of legs served by both conventional public transport and alternative public transport modes.

Basically, all types of passenger information generally use many elements of the topological network definition, the lines and journeys which form the service offer, the definition of run and wait times, and other fundamental definitions. Geographical information may possibly be provided in some cases, if matching application systems are available.

Specific types of passenger queries are also represented: some are related to passenger trips, some are related to fares, where the relevant information elements are included in the fare management sub-model of the reference data model.

Thus, the information basis for passenger information systems is widely spread over the whole reference data model, and the genuine passenger information data model covers only those elements which cannot be derived from, and are not explicitly included in, other parts of the model.

1.2.6 Personnel management: driver scheduling, rostering, personnel disposition

This part of the reference data model describes all the information that is necessary to schedule (logical) drivers to work the blocks and duties necessary to provide the defined service offer to the passengers.

The process of ordering driver duties into sequences to obtain a balanced work share among the driving personnel over the planning period, and to keep the resulting work time in harmonisation with legal regulations and internal agreements between drivers and the company management, is known as rostering. The reference data model offers a model part covering the information needs associated with some classical rostering methods, widely used in European countries. There may, however, be other (particularly more advanced, dynamic) methods applied in some cases, which would probably need additional or other entities than described in the rostering part of the reference data model.

The personnel disposition domain of the reference data model covers the data needs of the relevant driver management functions with respect to the two major tasks of:

— assigning physical drivers to the logical drivers identified in the scheduled duty plan;

— recording the performance of drivers on the actual day of operation.

The assignment of drivers for the actual operating day to the duty plan set up for the whole planning period is usually done in a staged procedure. The assignment will mostly start from default assignments for the whole period in consideration, which can be continuously overridden by changes and adjustments due to regular absences of drivers from work, changes initiated by drivers according to their preferences or by the control staff according to operational needs. Short-term adjustments may become necessary to balance unplanned absences and other circumstances principally not known in advance.

Records to document the actual driver activities are usually taken to control the driver performance and compare it with the original plan, and to prepare these data in a suitable way for wage accounting. This mainly refers to the specification of the time worked by each driver on the individual day for each type of activity, and some additional classifications, which may result in appropriate modifications of the amount to be paid for the recorded activity in question.

1.2.7 Management information

The data model part supporting management information and statistics provides some additional data descriptions which may be needed apart from the information elements already included in the scheduling, operations management and control, passenger information and fare management sub-models. Statistical information may of course be provided for any object of interest that is included in the organisation's specific data model and for which information is recorded in a database, whether for the organisation management or for other organisational units.

However, some additional information needs and sources are necessary, which cannot be derived from the model parts mentioned above and are specifically related to the evaluation of the operational process, especially to the evaluation of the current timetable and the comparison between the scheduled performance and actual performance. These include:

— events and recordings describing the actual course of vehicle journeys and the resulting service performance;

— service journey performance: the actual status of the planned and advertised interchanges and the resulting service quality;

— recorded use of services: recordings of the actual use of the service offer, i.e., passenger counting at stops, on vehicles, at ticket validators.; and

— predicted use of services: expected service demand (i.e. expected passenger count) rather than observed usage to support forecasting and planning.

1.2.8 Multi-modal operation aspects

All mass public transport modes are considered by this standard, including train, bus, coach, metro, tramway, ferry, and their sub-modes. It is possible to describe airports and air journeys, but there is no specific consideration of any additional requirements that apply specifically to air transport.

Such modes may be operated, conventionally according to a fixed timetable or in some cases to planned headway (metro), or flexibly as demand responsive services.

Additionally, Transmodel v6.2 considers the alternative modes of operation such as vehicle hire, taxis, car-pooling, ride sharing. They have both network (i.e. places where services may be accessed), service (i.e. the available services and how to book them), and fare aspects (i.e. the costs of different services).

1.2.9 Multiple operation environment aspects

The standard considers the situation where several operators are present in one geographical area. The model addresses problems related to the management of the different responsibilities for resources and services between authorities and operators (and their organisational units). Problems related to the provision of information to passengers when the timetable data comes from different sources are also solved (merged timetables). The problem of interchanges in this situation is also described.

As regards to the fare management aspects, the reference data model for fare management is developed in a way to allow the aggregation of product and other data from different operators, using various transport modes or even providing other services. It is therefore designed where necessary to meet requirements of an integrated fare management system.

1.2.9.1 Fleets and equipment

Different types of vehicles may be used to provide transport services. Passenger information as to the vehicle types, deck plans carriage layouts and seating arrangements, and the availability of onboard facilities and equipment can be described in the model for both conventional and alternative modes. The composition of trains and the alignment of carriages with boarding positions on the platform can also be described.

1.3 What is new in Part 8 of Transmodel V6.2

The following main extensions/enhancements have been totally integrated into Transmodel v6.2:

Clarifications regarding the design pattern dedicated to the representation of registered raw data and related indicators (Generic Loggable Object Model, cf EN 12896-1, Public transport – Reference data model – Part 1: Common concepts)

Data structures underpinning some use cases as described and discussed in the implementation standard OpRa (in particular for service demand and service efficiency) showing, by example, the usage of the Generic Loggable Objects Model.

Several model structure updates resulting from these extensions must be noted.

1.4 Scope of this document

The present European Standard entitled "Public transport - Reference data model – Part 8: Management information and statistics" describes how to structure data referring to the planning stages (e.g. timetables, run times, driver rosters, etc.) and/or to the daily actual production, and which is registered for different purposes, to build service performance indicators. It presents: the already discussed Generic Loggable Object Model: a generic design pattern modelling information related to log entries (see EN 12896-1, Public transport - Reference data model - Part 1: Common concepts) and applications of the Loggable Object Model to several examples, in particular:

— Service demand:
  - Expected number of passengers
  - Measured number of passengers
    - Passenger counting
    - Expected number of passengers

— Service efficiency:
  - Number of cancelled journeys
  - Number of late services.

This document itself is composed of the following parts:

— main document representing the data model for the concepts shared by the different domains covered by Transmodel (normative);

— Annex A containing the data dictionary and attribute tables, i.e., the list of all the concepts presented in the main document together with their definitions (normative);

Annex B presenting the model evolution (informative).

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, *Public transport - Reference data model - Part 1: Common concepts*

EN 12896-2, *Public transport - Reference data model - Part 2: Public transport network*

EN 12896-3, *Public transport - Reference data model - Part 3: Timing Information and Vehicle Scheduling*

EN 12896-4, *Public transport - Reference data model - Part 4: Operations monitoring and control*

EN 12896-5, *Public transport - Reference data model - Part 5: Fare management*

EN 12896-6, *Public transport - Reference data model - Part 6: Passenger information*

EN 12896-10, *Public transport - Reference data model - Part 10: Alternative modes*

ISO 4217:2015, Codes for the representation of currencies

ISO 80000 1:2009, Quantities and units – Part 1: General

CEN/TS 17370 OpRa (under development)

3 Terms and definitions

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

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General Terms and Definitions

For this particular document, the general terms defined in EN 12896-1, Public transport - Reference data model - Part 1: Common concepts apply.

3.2 Domain Specific Terms and Definitions:

NOTE The following terms specific to the Management Information and Statistics domain are used. Terms which are also data entity names are defined in the data dictionary in Annex A and are mostly not repeated here.

3.2.1
aggregation frame
data structure within which the data values are grouped and used for a formula to provide an indicator

3.2.2
indicator
set of data (calculated or measured) which may be either qualitative or quantitative that is used to provide information on the status (may be a measure, a functional state, etc.) or the quality of a service or a function

3.2.3
indicator type
category of a given indicator, e.g. time, length, passenger count, price, vehicle, etc.

3.2.4
indicator unit
measurement unit (e.g. metres, seconds, passengers, etc.) in which a specific indicator is measured

3.2.5
formula
method to calculate indicators that are based on other indicators or on a set of raw data

3.2.6
granularity
input for calculation processes representing the smallest unit(s) to generate output indicator(s)

3.2.7
O/D matrix
tabular structure describing data by origin/destination parameters (e.g. daily traffic volume between zones)

3.2.8
indicator parameter type
category of a given indicator parameter, e.g. time, length, passenger count, price, vehicle, etc.

3.2.9
indicator parameter unit
measurement unit (e.g. meters, seconds, passengers, etc.) in which a specific indicator parameter is measured

4 Symbols and Abbreviations

API	Application Programming Interface
AVM	Automatic Vehicle Monitoring
GIS	Geographical Information System
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
IFOPT	Identification of Fixed Objects in Public Transport
ISO	International Standards Organisation
IT	Information Technology
NeTEx	Network and Timetable Exchange
O/D	Origin / Destination
OJP	Open API for Distributed Journey Planning
OpRa	Operating Raw Data and statistics exchange
PT	Public Transport
PTO	Public Transport Operator
SI	International System of Units (abbreviated from the French Système international)
SIRI	Service Interface for Real-time Information
TM	Transmodel
UML	Unified Modelling Language

5 Management Information and Statistics Domain

5.1 Introduction

5.1.1 Information Needs

Management information deals with functions analysing production data to evaluate the service quality or to take corrective measures in planning and managing operations. In public transport, for instance, the study of operational data (e.g. observed passing times, passenger load, delays and cancellations) collected during service operations is an input for strategic planning (e.g. how and when to amend the schedules), tactical planning (e.g. when to undertake a certain control action), quality follow-up, etc.

Management information uses therefore three main types of data:

— data resulting from the planning stages, i.e. theoretical data on the production orders (e.g. timetables, target passing times, driver rosters, etc.);

— data describing the daily actual production (e.g. observed passing times, actual number of passengers, number of of late or cancelled journeys, etc.);

— data aggregations and calculated statistics (late journey duration intervals, number and percentage of late and cancelled journey occurrences)

Advances in technology, as regards to data storage, allow the provision of the necessary data in production databases, against which the desired requests can be made by public transport managers. Consistent data structures make the design of such requests easier, and offer the flexibility required to meet a large variety of needs.

5.1.2 Calculation of indicators

The number of different ways of processing PT data to issue relevant and synthetic information reports for managers is almost infinite. The criteria for doing so will depend on local conditions, on the level of management, on the time scale of the analysis, etc. The objective of the reference model is not to describe the processing methods, but to offer data structures able to fulfil their manifold requirements.

The result of raw data processing provides different types of indicators, each specialized for reporting information on a specific aspect of public transport (Service Demand, Commercial Speed, etc.).

An *indicator* relates to a set of data (planned, measured, or a combination of both) and may be either qualitative or quantitative. Indicators of lower-level objects may be overridden by higher level objects (e.g. an indicator related to the ROUTE can override the aggregation - summary, average, etc. - of indicators related to ROUTE LINK).

Indicators may be of several *indicator types*, for example, they may describe the time, length, passenger count, price, vehicle, etc.

An *indicator unit* is used to describe the measurement unit of quantitative indicators. Unit names shall follow standards ISO 4217:2015 for currency codes, and ISO 80000:2009 for SI units.

A set of parameters may be associated with any indicator to represent the scope of that indicator (for example, a TIME BAND and a DAY TYPE for a passenger count indicator).

Indicator parameter type describes categories of the indicator parameter: time, length, passenger count, price, vehicle, etc.

Indicator parameter unit describes the measurement unit of quantitative indicator parameters. Unit names shall follow standards ISO 4217:2015 for currency codes, and ISO 80000:2009 for SI units.

A *formula* describes the method to calculate indicators that are based on other indicators and/or on a set of raw data.

An *aggregation frame* describes a data structure within which the data values are grouped and used for a formula to provide an indicator.

A *granularity* entity determines the smallest unit(s) in a calculation process which generates indicator(s).

A calculation process that generates the indicators is characterized by indicator parameters, formula, aggregation frame and granularity unit.

The main elements used to calculate indicators are presented in the figure below.

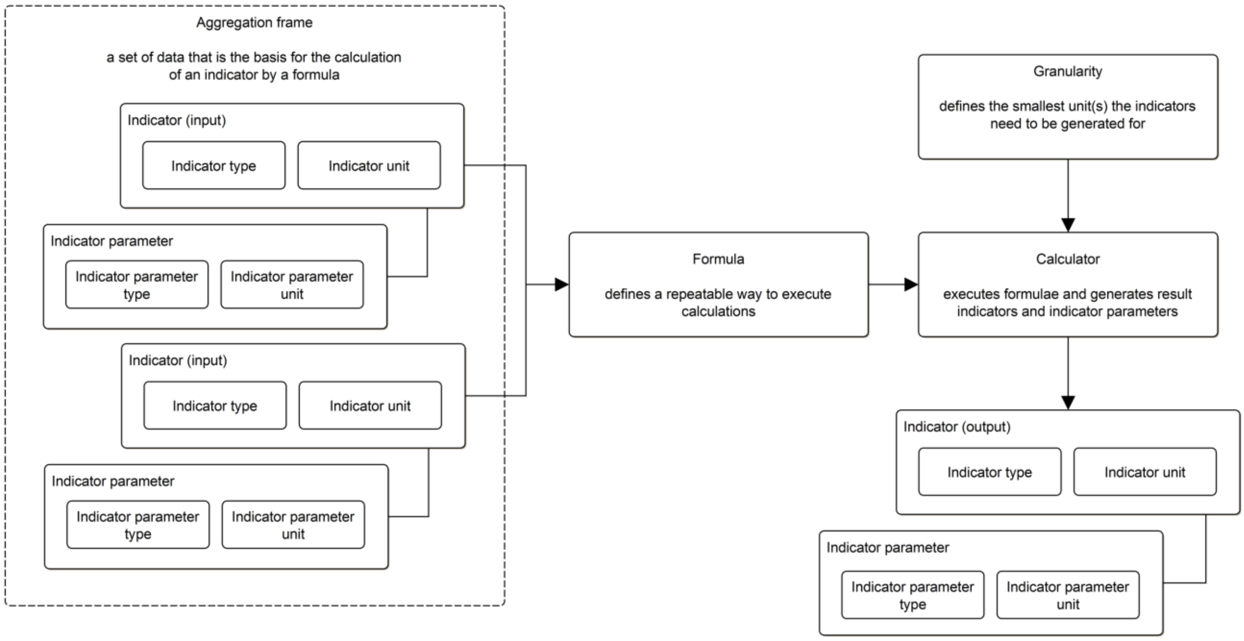

Figure 3 — Calculation of indicators

This figure also indicates that indicators might be generated by a previous (nested) calculation and might be used in another calculation process.

For example, the calculation of the length of a tram network for each infrastructure operator (assuming there are more than one) may be modelled as follows:

— indicator (input): length of the projection of ROUTE LINKs on the infrastructure, parameterized by infrastructure operator;

— aggregation frame: defines a set of ROUTE LINKs that make up the network;

— granularity: defines that the indicators shall be grouped by infrastructure operator;

— formula: calculates the sums of the length of each item in the aggregation frame;

— calculator: executes the formula for each infrastructure operator;

— indicator (output): total length of the network, parameterized by infrastructure operator.

A typical use of indicators is when the actual service must be compared to the planned service. To ensure the same indicator parameters are used in the comparison, a common granularity definition might be needed to govern the calculation processes and provide the same level of detail for both actual (measured) and planned service indicators. This is illustrated by the figure below.

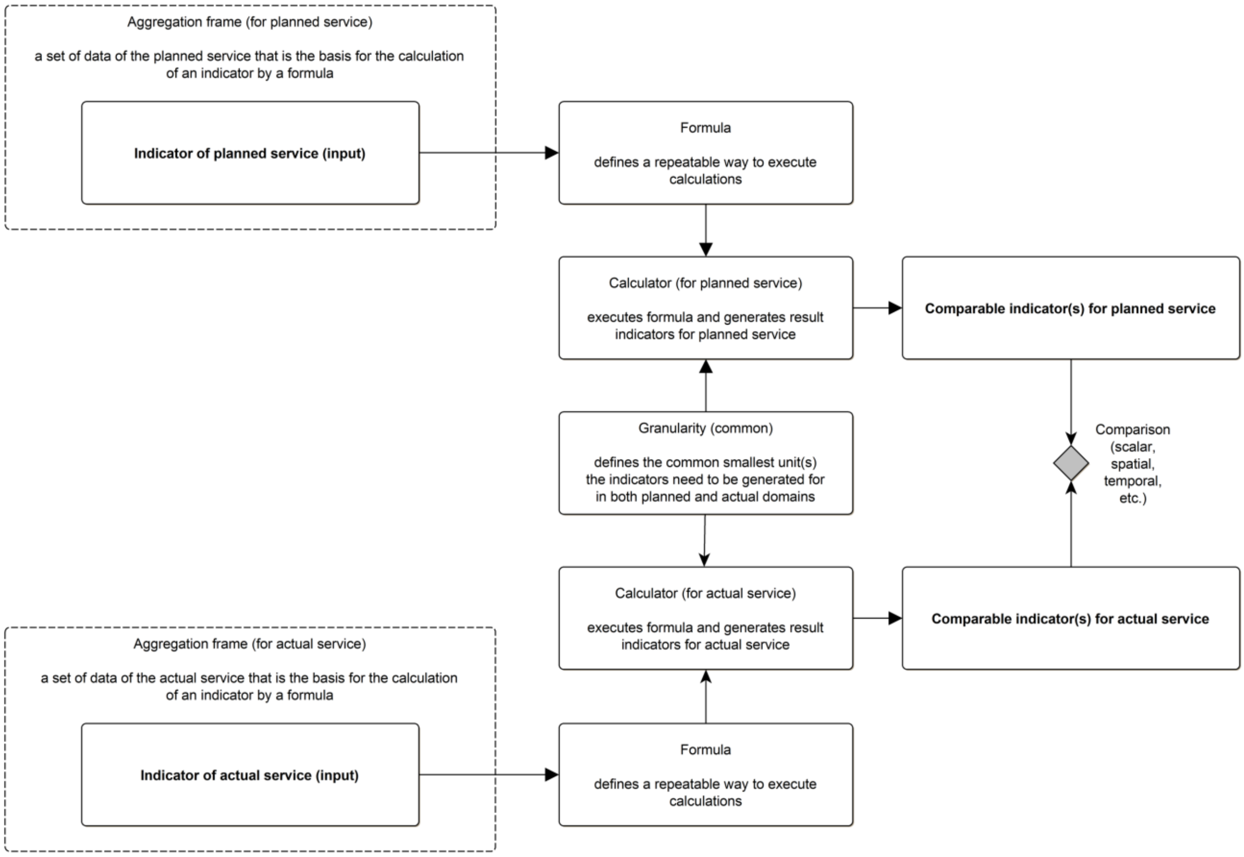

Figure 4 — Comparison of planned and actual service indicators

5.1.3 Functions Covered

The following functions as defined in the TR "Operating Raw data and statistics exchange" (2019) and TS "Operating raw data and statistics exchange" (2025) are covered by Transmodel v6.2:

a) PT service dimensions: this function consolidates all structural elements of the planned and actual offer, including lines, journeys, vehicle types, offered seats, stops, and route length, to quantify and compare the size of the service across networks, lines, journey patterns, and periods.

b) PT service commercial speed: this function computes planned and actual commercial speed (distance over in-motion time) by route or line and time band to assess timetable realism and operational performance.

c) PT service spatial coverage: this function characterises the geographic extent of the service, including served areas, stop places, and lines, and highlights changes such as rescheduling or replacements that affect which zones are covered.

d) PT service temporal coverage: this function describes the temporal availability of the service, including operating days, time bands, frequency or headway windows, and how updates such as timetable changes alter time-of-day or day-type coverage.

e) PT service interchange nodes: this function identifies and evaluates interchange nodes (stops or places where passengers change) and their usage to understand connectivity and transfer opportunities within the network.

f) Origin/Destination zones connections: this function assesses actual and planned connectivity between origin and destination zones (which zone pairs are served and how) to reveal coverage gaps, detours and changes caused by rescheduling.

g) Origin/Destination matrix: this function aggregates expected and measured passenger flows between origins and destinations by period and line to support demand modeling, capacity planning and contract reporting.

h) Origin/Destination zones moving cause: this function classifies expected and actual reasons for travel such as school, work or other by day or time and line to enrich demand analysis and planning scenarios.

i) PT fleet dimensions: this function evaluates the characteristics and efficiency of the public transport fleet including vehicle count, age distribution, mileage per vehicle and maintenance indicators such as Mean Time Between Failures to monitor technical capacity and optimize resource utilization.

j) Transport demand dimensions: this function quantifies demand with expected and measured indicators such as total passengers, passengers per distance or vehicle and combined passenger-distance measures segmented by line, day type and period.

k) PT service load factor: this function calculates the ratio of offered seating capacity to operated distance, both planned and actual, providing a key indicator of vehicle utilisation efficiency and supporting comparisons across time periods, lines, and service types..

l) PT service safety: this function consolidates safety-related operational data vehicle and driver incidents, alarms and network situations and enables benchmarking per distance, time and fleet usage to monitor safety performance over a defined period.

m) PT service pollution emission: this function quantifies the service's environmental footprint by attributing pollutant emissions to operated kilometres (e.g., by vehicle type and pollutant) over a reporting period for contractual and regulatory assessment.

n) PT service incoming funds: this function aggregates all revenue streams fare product sales (incl. season cards and luggage), public and non-public subsidies, and other inflows and derives KPIs such as revenue per km, per vehicle and revenue-to-cost ratio at network/line/period levels.

o) PT service costs: this function aggregates operating expenses (e.g., fuel/energy, vehicle amortization, maintenance, labour, insurance, stops/parking) and produces cost KPIs (per km, per vehicle, per passenger km) to evaluate efficiency against contract targets.

p) PT operator dimensions: this function profiles the operator's capacity and organization workforce structure (employee categories, drivers' share, age bands), peak driver needs, and fleet-related indicators to characterize available resources.

q) PT service delays and inefficiencies: this function detects and classifies unreliability mean delays by route/stop, late services versus thresholds, causes (infrastructure, external, operational, strikes), cancellations, and full/empty vehicles to quantify punctuality and operational efficiency.

r) PT service performed distance: this function measures the actual distance operated by the public transport fleet during a reference period, broken down by network, line, journey pattern, area, and vehicle type, and distinguishes service, dead-run, and replacement kilometres for performance monitoring and contractual compliance..

The above functions have been categorised as Use Cases in OpRa, as:

— Service offer

— Service demand

— Service externality

— Service economy

— Service efficiency.

Service offer covers all indicators that describe the supply side of public transport, both planned and actual. It includes the structure and size of the service such as lines, journeys, stops, route lengths, offered seats, and vehicle types, as well as performance characteristics like commercial speed, spatial and temporal coverage, and interchange nodes. This category enables authorities and operators to monitor how the planned offer compares with actual delivery, supporting contractual compliance, quality of service evaluation, and network planning.

Service demand focuses on the measurement and estimation of passenger usage and travel behaviour. It includes expected and actual passenger volumes like number of boarding and alighting passengers at stop points, number of ticket validations, load factors, origin–destination matrices, reasons for travel, and modal choices, as well as indicators that link demand to supply such as passengers per distance or per vehicle. These metrics support demand forecasting, capacity planning, and assessment of how well the service meets user needs.

Service externality refers to the set of indicators that measure the impacts of public transport operations on external parties who did not choose to incur those effects. This category includes safety aspects such as the number and type of vehicle and driver incidents, alarms, and network events, as well as environmental aspects such as total pollutant emissions. The goal is to monitor and report how the service influences safety and environmental conditions beyond the immediate transport offer, enabling authorities and operators to assess compliance with contractual obligations, evaluate risks, and support sustainability objectives.

Service economy addresses the financial dimension of public transport operations. It includes all cost components such as fuel, maintenance, labour, and infrastructure, as well as revenue streams from fare products, public subsidies, and other sources. This category supports the calculation of key financial ratios like cost per kilometer, revenue per vehicle, and revenue-to-cost ratios, enabling economic performance monitoring and informing funding and pricing strategies

Service efficiency evaluates how effectively resources are used to deliver the service. It includes indicators related to fleet utilization, vehicle age and mileage, workforce structure and productivity, and operational reliability such as delays, cancellations, and occupancy extremes. These measures help identify inefficiencies, optimize resource allocation, and improve overall service quality and sustainability. This process includes the analysis of service journey performance, the study of observed passing or run times and target passing times at stop points, the detection of sections where vehicles are slowed down by the traffic, the analysis of regular disturbances and modifications to the service, the study of missed interchanges, etc.

5.1.4 Limitations of the Model

The reference model describes only elementary data (e.g. number of passengers boarding a particular vehicle at a defined stop points). The various possible aggregations of such data, which depend primarily on the manager own requirements, are not described.

There are numerous other areas of interest with respect to management information, for instance the analysis of driver work, the mechanical behaviour of vehicles, and revenue patterns. However, these areas are not covered by the current version of the reference model.

5.2 Management Information and Statistics Data Model

5.2.1 Loggable Object Model

The Generic Loggable Object MODEL described in EN 12896-1 (Public transport - Reference data model - Part 1: Common concepts) presents the basic pattern on which is based the data structure for registered data. The LOGGABLE OBJECT represents an ENTITY being monitored for significant events and changes of state; successive states and events affecting the entity are recorded as a set of LOG ENTRies, making up a temporal trace that can be analysed for management purposes or examined for audit purposes. Loggable Object MODEL is a design pattern used widely in Transmodel.

Note that this design pattern is sometimes explicitly used (for example in VEHICLE MONITORING in Part 4, EN 12896-4) but is available for being used on any object whenever there is a use case for it. This is especially true for Management Information and Statistics: this pattern can be applied to any Transmodel object being of use for Management and Statistics.

A LOG ENTRY is the single record of an event and may contain measurements as well as a record of the current state of some or all the attributes of a LOGGABLE OBJECT, supplied by a DATA SOURCE. LOG ENTRies occur in temporal sequence, together making up a LOG.

LOGs will typically be archived or purged once their data are no longer of interest.

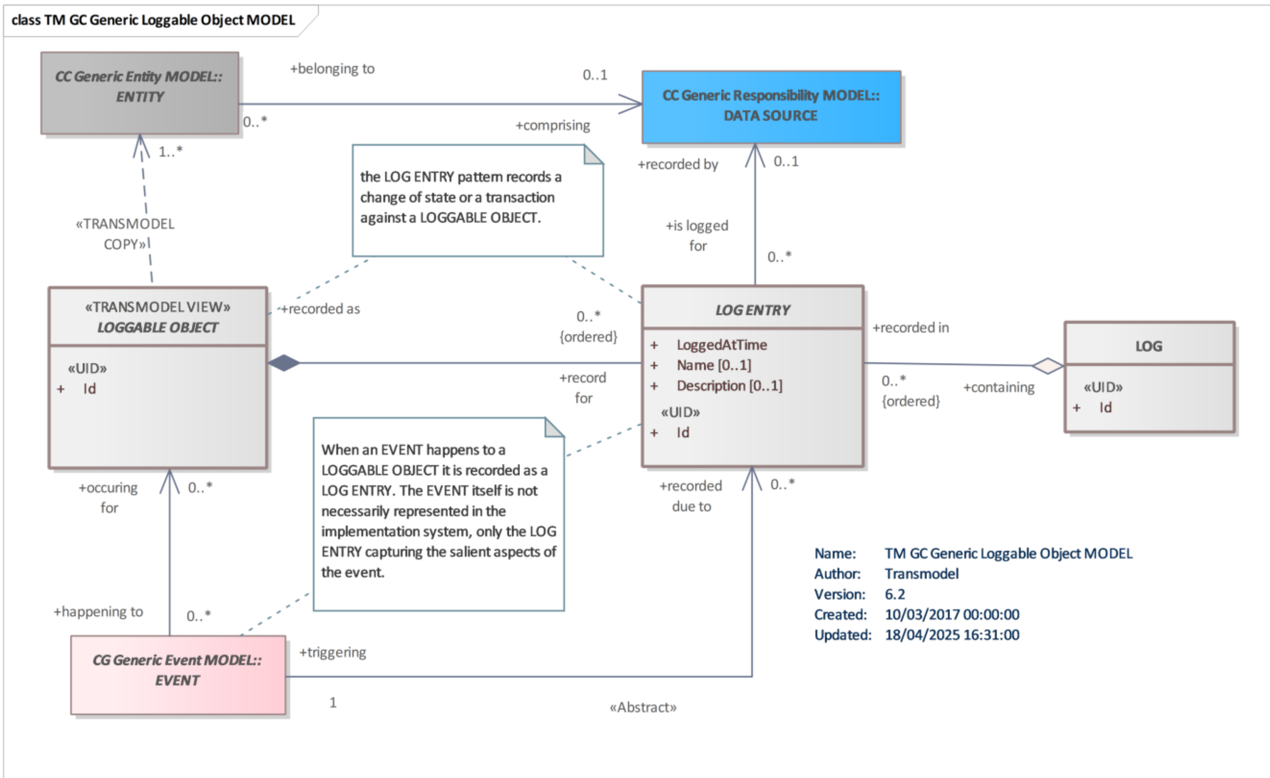

Figure 5 — Loggable object MODEL (source Public transport - Reference data model - Part 1: Common concepts)

An EVENT can be described as something happening to a LOGGABLE OBJECT, i.e. a change of the attributes or the status of a LOGGABLE OBJECT. The EVENT itself is not necessarily represented in the implementation system. The LOG ENTRY is the class in the model designated to represent the EVENT, recording only its salient aspects.

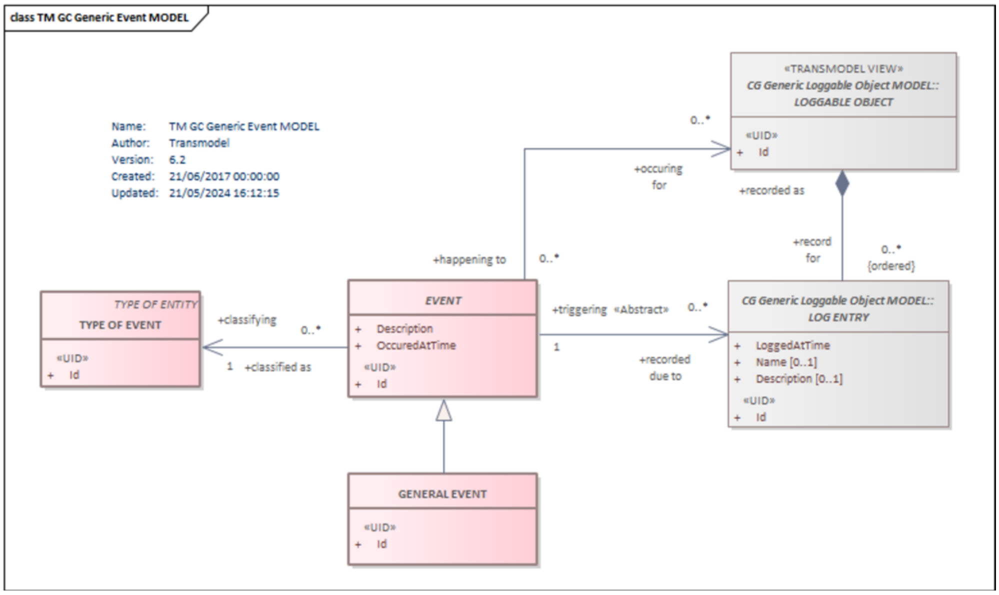

Figure 6 Generic event MODEL (source Public transport - Reference data model - Part 1: Common concepts)

5.2.2 Logging Time and Place

An EVENT can signify changes occurring to an ENTITY in both temporal and spatial dimensions. When an EVENT has spatial attributes, it becomes a LOCATED EVENT and has geographical attributes that can refer to:

— the ZONE in which the LOCATED EVENT is located.

— the POINT where the LOCATED EVENT occurs.

— the LINK on which the LOCATED EVENT is located.

A ZONE can be represented by its functional centroid, an instance of POINT; a LINK can be referenced by its start POINT and end POINT. A LOG ENTRY may also reference the actual ZONEs, POINTs or LINKs if this is relevant for analysis.

The temporal dimension of a LOCATED EVENT should always conform to ISO 8601:2004. In addition to the timestamp of the EVENT, it also provides the date and time at which the event has been received.

The LOG ENTRY will record, among other attributes, the identifier of the LOGGABLE OBJECT, the timestamp and the spatial attributes.

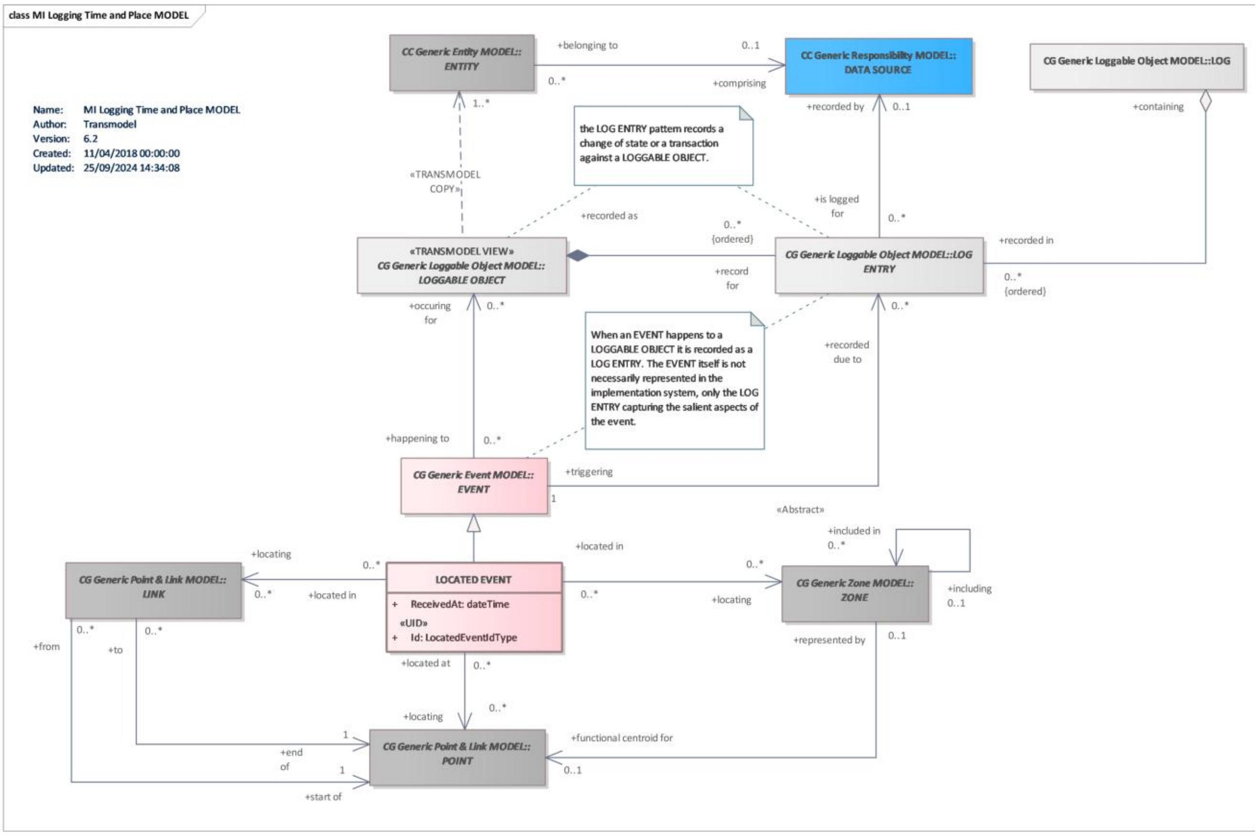

Figure 7 — Logging time and place MODEL

5.1 Explicit Frames

The diagram of the Explicit Frame Hierarchy models the hierarchical structure of frame-based data containers used in OpRa to organize and exchange public transport information. At its core is the COMPOSITE FRAME (from *RC Composite Frame MODEL*), which aggregates multiple specialized frames to provide a unified context for data exchange. These include the RAW DATA FRAME (from *RF Raw Data Frame MODEL*), PLANNED SERVICE FRAME (from *PF Planned Service Frame MODEL*), ACTUAL SERVICE FRAME (from *AF Actual Service Frame MODEL*), and KPI FRAME (from *KF Kpi Frame MODEL*), each carrying domain-specific content such as planned timetables, real-time operational data, and performance indicators. Supporting this structure are generic components like VERSION FRAME (from *CC Generic Version Frame MODEL*) for version control and VALIDITY CONDITION (from *CC Generic Validity MODEL*) to define temporal applicability. This layered design ensures interoperability and consistency across planning, monitoring, and reporting processes in public transport systems.

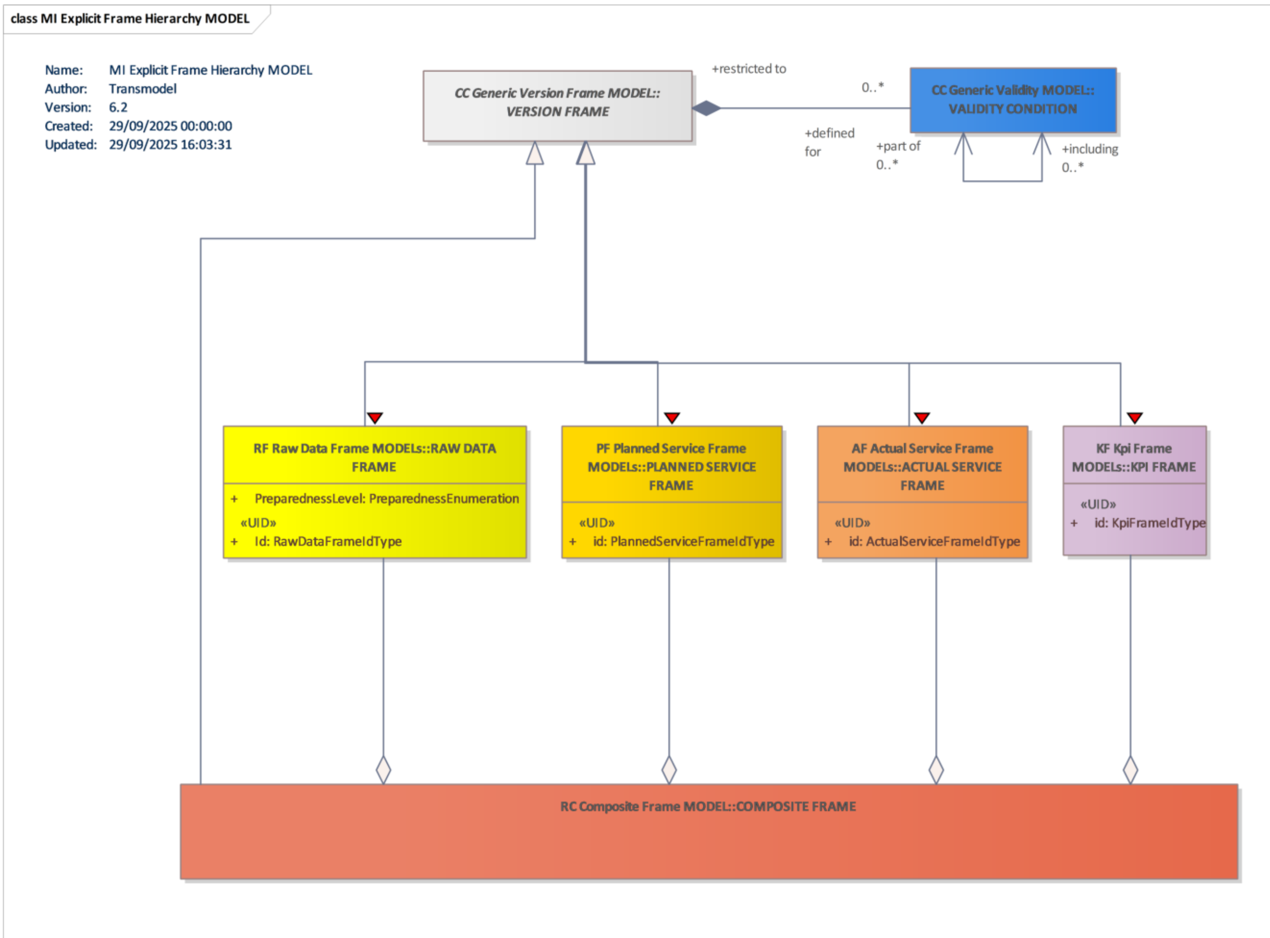

Figure 8 Explicit Frame Hierarchy MODEL

5.2 Temporal and PT Context

The model defines a set of generic, reusable classes that provide temporal and contextual structures for other models, such as those handling late journeys, cancellations, and expected passenger counts. At its core is **CALENDAR AWARE PT SCOPE**, which anchors statistical or operational indicators to a defined time frame and service context. This scope is enriched by classes from the **RC Service Calendar MODEL**, including **SERVICE CALENDAR**, **OPERATING PERIOD**, **OPERATING DAY**, **DAY TYPE**, and **TIME BAND**, which together describe when services are planned or active. These elements allow models to express KPIs or aggregations in relation to specific dates, periods, or recurring patterns (e.g., weekdays, peak hours). The model also references **PT SCOPE** from the publication scope model, ensuring that aggregated or reported data can be filtered by organizational or geographic boundaries. By centralizing these temporal and scope definitions, this model enables consistent interpretation of time-based indicators across all related models, supporting interoperability and accurate performance analysis.

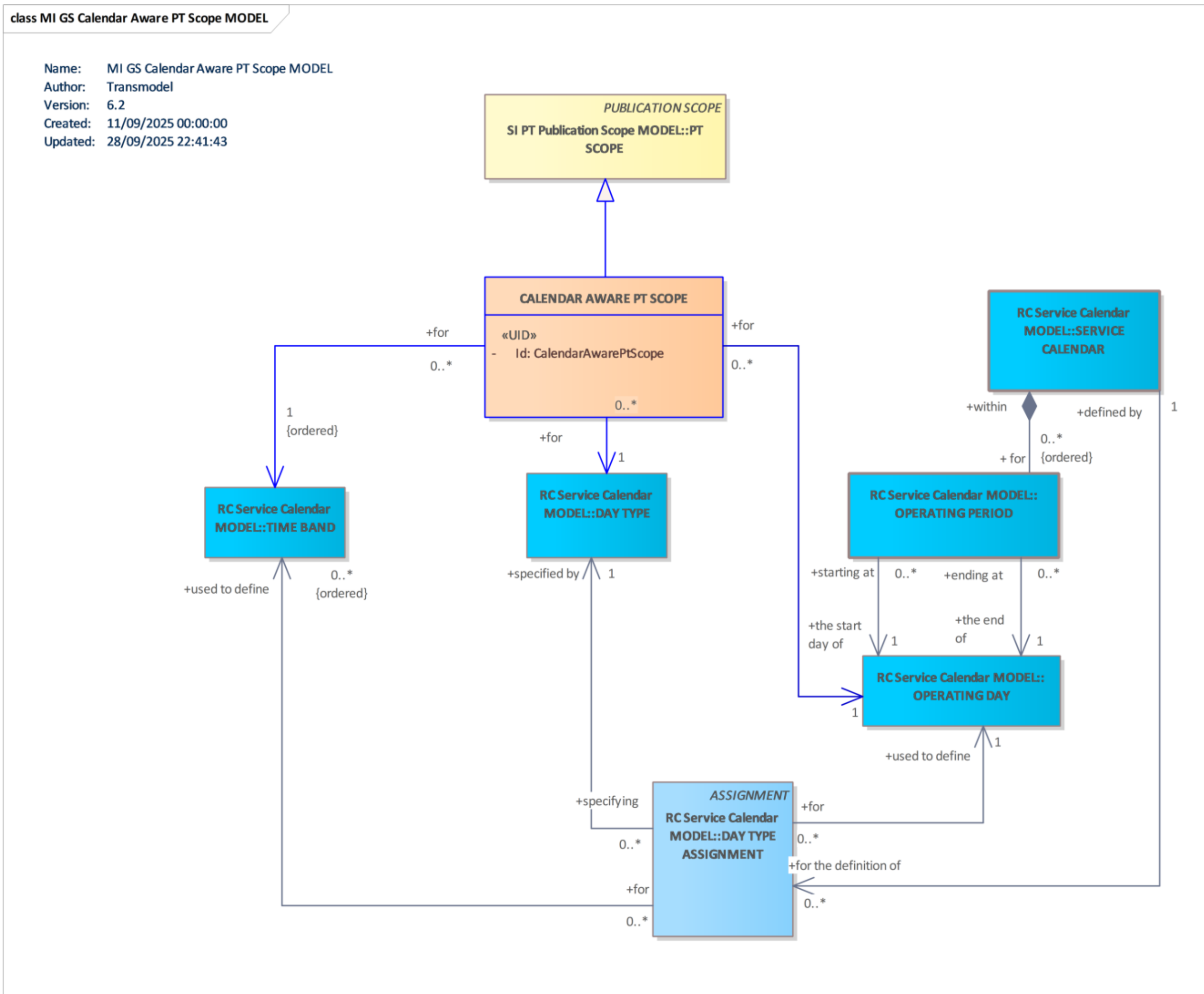

Figure 9 Calendar Aware PT Scope MODEL

5.2.1 Recorded Objects

5.2.1.1 Recording Service and Vehicle Performance Events

The record of events related to the performance of vehicle journeys, in particular service journeys, on each day of their operation is an important source of information for management information. The main information to record is the following:

— actual passing times at points along the route;

— the number of passengers boarding and alighting and the time taken to do so;

— the occurrence of impeded time;

— interchange realisation;

— the occurrence of disturbances.

The diagram below shows such recorded information that exist in Transmodel. Several use cases use the data from the diagram.

The Recorded Object MODEL for vehicle monitoring demonstrates how Transmodel supports the capture, storage, and association of operational data related to VEHICLE MONITORING. Key functionality of the model:

— Vehicle monitoring events**:** the model can record monitored vehicle journeys, including their operational context (e.g., operating day, service journey, and vehicle journey references). Each monitored journey can be broken down into monitored legs and monitored trips, which are linked to trip patterns and stops.

— Temporal and spatial data**:** the model can handle observed passing times, recorded stops, and interchange statuses, ensuring accurate timestamps and location references (e.g., places, zones).

— Logging and traceability**:** all monitored activities can be logged through vehicle monitoring log entries and trip monitoring log entries, providing traceability for auditing and performance analysis.

— Granularity and composition**:** the model allows hierarchical decomposition of journeys into legs and trips, supporting detailed monitoring at different levels of granularity.

— Integration with service data**:** recorded objects should reference planned data such as service journeys, vehicle journeys, and stop points, enabling comparison between planned and actual operations.

— Flexibility for operational adjustments**:** the model should accommodate real-time updates, such as boarding and alighting events, and interchange adjustments, to reflect actual passenger and vehicle behavior.

However, according to user needs many other operating raw data may be recorded.

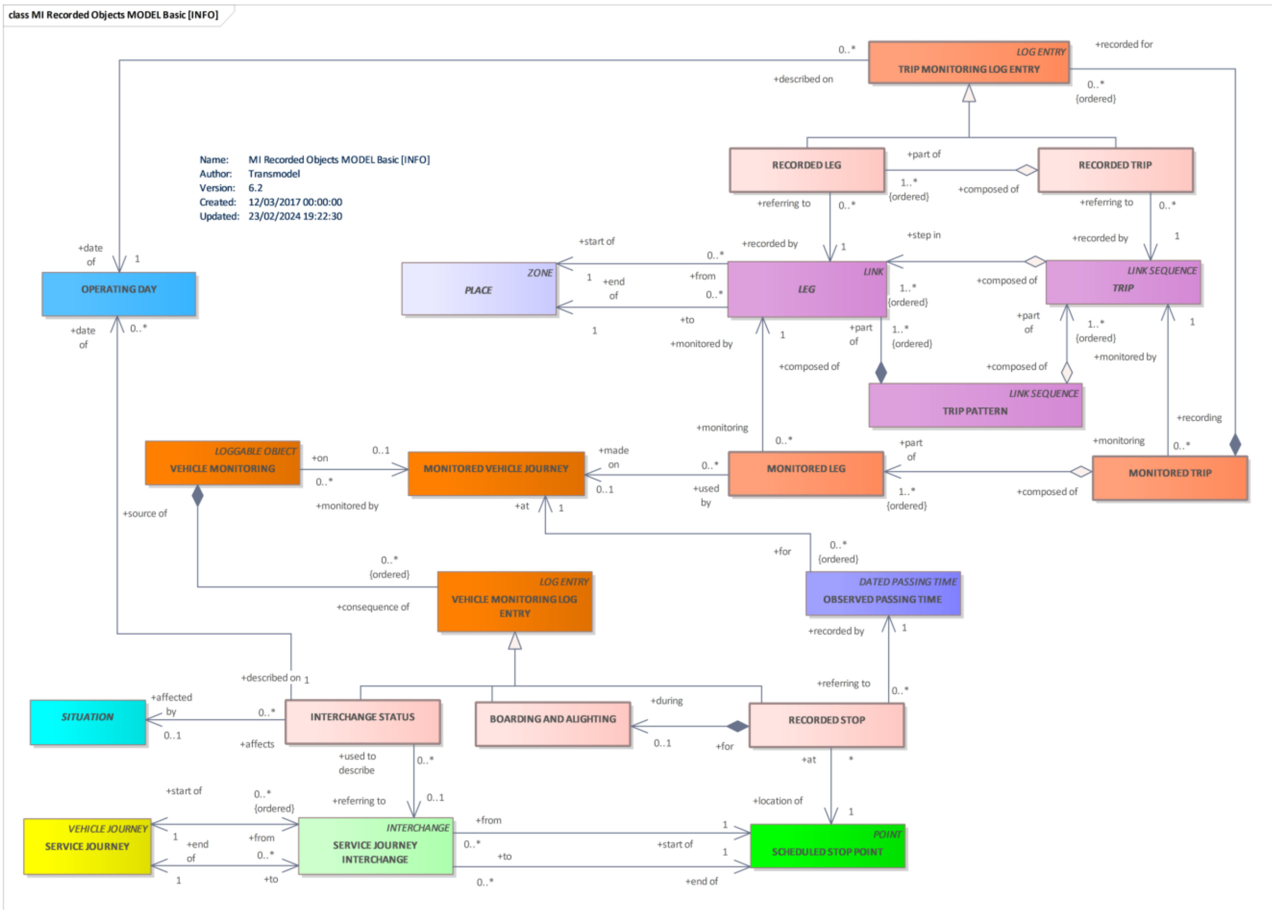

Figure 10 Recorded Objects MODEL

5.2.1.2 Journeys

The data for the subsequent evaluation of service journeys is collected during operations through recording MONITORED VEHICLE JOURNEYs (as described in EN 12896-4). Such journeys are observed actual journeys, as recognized by a monitoring system, operated on the OPERATING DAY on which the data are collected. The term “monitoring” should be understood in a wide sense that embraces both automated and manual survey means.

However, it is of a great importance for management information to be able to relate, as far as possible, any such monitored journeys to the plan assigned to them, to compare the actual production performance against the original plan. Therefore, a MONITORED VEHICLE JOURNEY will relate, in most cases, to a DATED VEHICLE JOURNEY. The latter represents the latest valid plan assigned to the considered vehicle.

Most DATED VEHICLE JOURNEYs will be NORMAL DATED VEHICLE JOURNEYs, which means that they are copied from a schedule designed for a DAY TYPE to be applied on the OPERATING DAY. Others are extra DATED VEHICLE JOURNEYs, created by a CONTROL ACTION to meet a specific set of circumstances.

Any DATED VEHICLE JOURNEY may have been amended by CONTROL ACTIONs (e.g. by shortening of the ROUTE, an added departure lag, etc.).

5.2.1.3 Recorded Passing Times

The passing time of a vehicle is recorded as an OBSERVED PASSING TIME. It refers to a given MONITORED VEHICLE JOURNEY and is recorded at a particular POINT. An OBSERVED PASSING TIME is a specialization of DATED PASSING TIME.

The POINT in question may be a SCHEDULED STOP POINT, a TIMING POINT or any other type of POINT defined for a measurement purpose. For instance, to evaluate the influence of the traffic on a bus line, passing times may be recorded at the entry point then at the exit point of a complex road junction. OBSERVED PASSING TIMEs may be recorded at TIMING POINTs to check whether standard run times are appropriate, or at a SCHEDULED STOP POINTs to check the service punctuality as a quality indicator.

If the vehicle stops at a POINT, an OBSERVED PASSING TIME may record an arrival time or a departure time, or both; alternatively, it may record simply a passing time. If the vehicle stops, the waiting time (i.e. the period during which the vehicle is not moving) may also be recorded.

5.2.1.4 Recorded Stops

It is of interest to record when a vehicle stops at a SCHEDULED STOP POINT and opens the doors to allow passengers to board or alight. This information is useful on networks where vehicles only stop when a passenger (onboard or waiting at the stop point) requests it to do so. The duration of the period during which the doors are open is also of interest, as it can be used to refine the schedules or to consolidate demand data. This duration of the period that the doors are open is often different from that of the time the vehicle is halted at the stop.

The entity RECORDED STOP is used to describe the above information. It is referencing an OBSERVED PASSING TIME, extending the information captured. RECORDED STOPs may only be created for a SCHEDULED STOP POINT. Note that, when the vehicle has several doors, the DoorsOpenedTime is the time of opening of the first door and the DoorsClosedTime is the time when the last door is closed. A RECORDED STOP follows the LOGGABLE OBJECT design pattern (and therefore inherits from LOGGABLE OBJECT).

5.2.1.5 Boarding and Alighting

During a RECORDED STOP, i.e. when a vehicle stops at a SCHEDULED STOP POINT on a service journey, passenger movements may take place. A passenger movement can be either boarding a vehicle or alighting from a vehicle.

The most usual practice is to record the number of alighting and boarding passengers at a defined SCHEDULED STOP POINT. Such information may be obtained thanks to manual surveys or specific sensors (e.g. infrared sensors, NFC scanners, or counting steps). In spite of a certain lack of accuracy, such sensors enable the collection of data for online control (degree of occupancy of a vehicle) or for statistical investigations as to actual demand. The accuracy is sometimes improved by sensors measuring the current load (occupancy) of a vehicle between two stop points, or by data provided by fare collection devices. Often, only a subset of the possible information can be recorded regularly.

The observed number of boarding and alighting passengers at a SCHEDULED STOP POINT is stored in the entity BOARDING AND ALIGHTING, which corresponds to a given RECORDED STOP. BOARDING AND ALIGHTING follows the LOGGABLE OBJECT design pattern (and therefore inherits from LOGGABLE OBJECT).

The occupancy of a vehicle on every SERVICE LINK may be derived from the counts of boarding and alighting passengers at both SCHEDULED STOP POINTs bordering it. LINK data are therefore not explicitly represented in the reference model but can be computed from it. Users wanting to use the occupancy data separately should implement the corresponding entity.

The number of passengers possibly left at the stop, because of a too high occupancy level already in the vehicle, is not described by the current version of the model but could be added as an extra attribute.

5.2.3.6 Impeded Time

The evaluation of the running times and the speed of vehicles is an important tactical planning function, for bus lines on which vehicle running is influenced by the general traffic. Statistical investigations on OBSERVED PASSING TIMEs are an important source of information for this function (e.g. measurement of the time taken to cross a frequently congested road junction). It may be completed by a record of situations where the vehicle is not moving, due to congestion for instance.

Such a recording of impeded periods may also be carried out using a monitoring system. This function will typically use three types of thresholds to trigger observations:

— a maximal speed under which the vehicle is considered as impeded (e.g. 5 km/h);

— a minimum duration to trigger an impediment statement (e.g. wait at least a minute before recording that a vehicle is still impeded);

— a minimum speed a vehicle should reach to declare the end of an impediment.

The entity IMPEDED TIME describes the event of such a vehicle impediment during a MONITORED VEHICLE JOURNEY. An IMPEDED TIME occurs on a LINK (e.g. an INFRASTRUCTURE LINK). Attributes of this entity are the ‘start time’ and the ‘end time’, the ‘distance from the link start point’ and the possible ‘distance covered’ under the maximal speed.

5.2.1.6 Status of Planned Interchanges

In networks covering a large area or served by different transport modes, travellers are likely to have to interchange between services to reach their destination. Many networks will organize the operational planning and control to facilitate such interchanges.

Planned interchanges may be optimized by trying to minimize the waiting time for the second service, for instance. There are various levels of complexity in planning such an optimization, as described in EN 12896-3, Public transport - Reference data model - Part 3: Timing Information and Vehicle Scheduling. Many planned interchanges will be advertised, to improve the trip organization by passengers. Some of them will even be guaranteed. Thanks to a monitoring system, information on the actual status of interchanges (e.g. whether an interchange will be missed) may be provided to passengers. Such passenger information regarding interchanges is described in EN 12896-4, Public transport - Reference data model - Part 4: Operations monitoring and control. Whenever interchanges are considered for planning and control of operations, it is of a high importance for service quality management purposes to measure the actual performance of the realization of the planned interchanges. Such a measurement is mainly based on the recording of INTERCHANGE STATUS data. Any time a SERVICE JOURNEY INTERCHANGE is planned, an INTERCHANGE STATUS record will exist. However, many companies will register only the missed interchanges. Such cases may be analysed using the ‘number of passengers’ involved and the ‘reason for missing’, stored as attributes, which supposes in most cases a manual entry.

A SERVICE JOURNEY INTERCHANGE describes a specific interchange of two individual service journeys. Less sophisticated interchange management may be used in the planning of operations. For instance, planning may simply consider the general CONNECTION times for any journey or may organize broad JOURNEY MEETINGs. In such cases, it will in general not be possible to register precise INTERCHANGE STATUS records. The follow-up of the interchange realization may, however, be based on computation of OBSERVED PASSING TIMEs at the interchange SCHEDULED STOP POINTs, which will then be compared to the planned data.

5.2.1.7 Disturbances

The analysis of disturbances affecting the network functioning is of a high interest for operations management. Such disturbances are caused for instance by traffic jams, accidents, road works, demand peaks, passenger illnesses, etc. It is often possible to identify the cause of a disturbance. In other cases, only the effects may be recorded (e.g. an observed delay, without any obvious reason).

Any disturbance affecting operations may be recorded in the entity OPERATIONAL EVENT (described in EN 12896-4, Public transport - Reference data model - Part 4: Operations monitoring and control). The main types of OPERATIONAL EVENTs are ALARMs (these may either be logged manually or recorded automatically when a system detects a threshold is exceeded) and INCIDENTs (often recorded in a logbook). A more detailed classification may be specified by a TYPE OF EVENT (inherited from EVENT, described in Public transport - Reference data model - Part 1: Common concepts, Generic event MODEL).

In addition, a disturbance can be related to a SITUATION (an incident or deviation affecting traffic or travel circumstances, which can be any event e.g. some weather condition, passenger illness, a car accident on the ROUTE used by the bus, etc.), having some PT SITUATION CONSEQUENCE on the network (delays, cancellations, etc.).

The staff in charge of controlling operations may make CONTROL ACTIONs, modifying the latest valid plan (e.g. DATED VEHICLE JOURNEYs). Such a CONTROL ACTION may be associated to one or several OPERATIONAL EVENTs and SITUATIONS, to classify the modifications by their causes. This allows for a historic analysis of the efficacy of different actions on the running of the network.

5.2.2 Recorded Use of Services

5.2.2.1 Introduction

One of the most common planning task in public transport is the data collection task to obtain information on the observed demand, on the origin and destination of passenger trips. Such information is crucial for strategic planning (e.g. network design) and for tactical planning (e.g. choice of vehicle types or planning of interchanges). As the fare system of many networks is not based on the specification of precise origins and destinations, the only way to collect such data was, for some decades, to carry out surveys on passenger behaviour. The progress of fare collection techniques allows some systems to provide, in addition to their basic functions, more precise information on passenger trips.

5.2.2.2 Actual Service Demand

The management information part of the reference model includes concepts describing the actual consumption of the transport services by travellers (i.e. measured number of passengers), regardless of the means used to collect this information. It refers to the generic concepts (developed in EN 12896-6, Public transport - Reference data model - Part 6: Passenger information) of trips (traveller movements between two places), PT TRIPS (parts of trips restricted to the PT network, i.e. between stop points) and LEGs (parts of trips on the same PT vehicle).

A RECORDED TRIP is an actual trip undertaken by a passenger, from a certain origin place to a certain destination place, on a specific OPERATING DAY. In many cases, the origin and destination places will be expressed as a type of PLACE (STOP PLACE, POINT OF INTEREST, ADDRESSABLE PLACE, etc.). However, due to system limitations, they will be sometimes described with less precision, as TARIFF ZONEs or FARE SECTIONs.

A RECORDED TRIP may be composed of one or more RECORDED LEGs. RECORDED LEGs are those parts of the whole trip that are carried out on one single vehicle, without transfers or other interruptions. RECORDED LEGs may be recorded as being made between PLACEs (and subtypes), TARIFF ZONEs or FARE SECTIONs.

The relationship between RECORDED LEG and RECORDED TRIP is optional, as the information necessary to specify which rides a trip may be composed of is not always known, depending on the technical system used. In some cases, only the rides may be registered, while in other cases only the trips are known.

A RECORDED LEG may, when on public transport, be related to a known MONITORED VEHICLE JOURNEY. Such a journey may have been detected and therefore be known already during the registration process, or it may be derived by calculation and stored afterwards. In some cases, it may be not specified at all. The given MONITORED VEHICLE JOURNEY may be recognized by the monitoring system as being the realization of a planned DATED VEHICLE JOURNEY. Such processes may allow the identification of the JOURNEY PATTERN over which a RECORDED LEG was made.

For a RECORDED LEG, the actual times of passenger boarding and alighting may be recorded. If onboard fare collection equipment is available, it enables the registration of the boarding time on the vehicle (derived from the control time). If such equipment is not available, the boarding time can be determined, with less accuracy, from the OBSERVED PASSING TIME at the concerned SCHEDULED STOP POINT on a particular OPERATING DAY. In a similar way, the precise alighting time can be determined from a ticket control when the passenger leaves the vehicle or from an OBSERVED PASSING TIME.

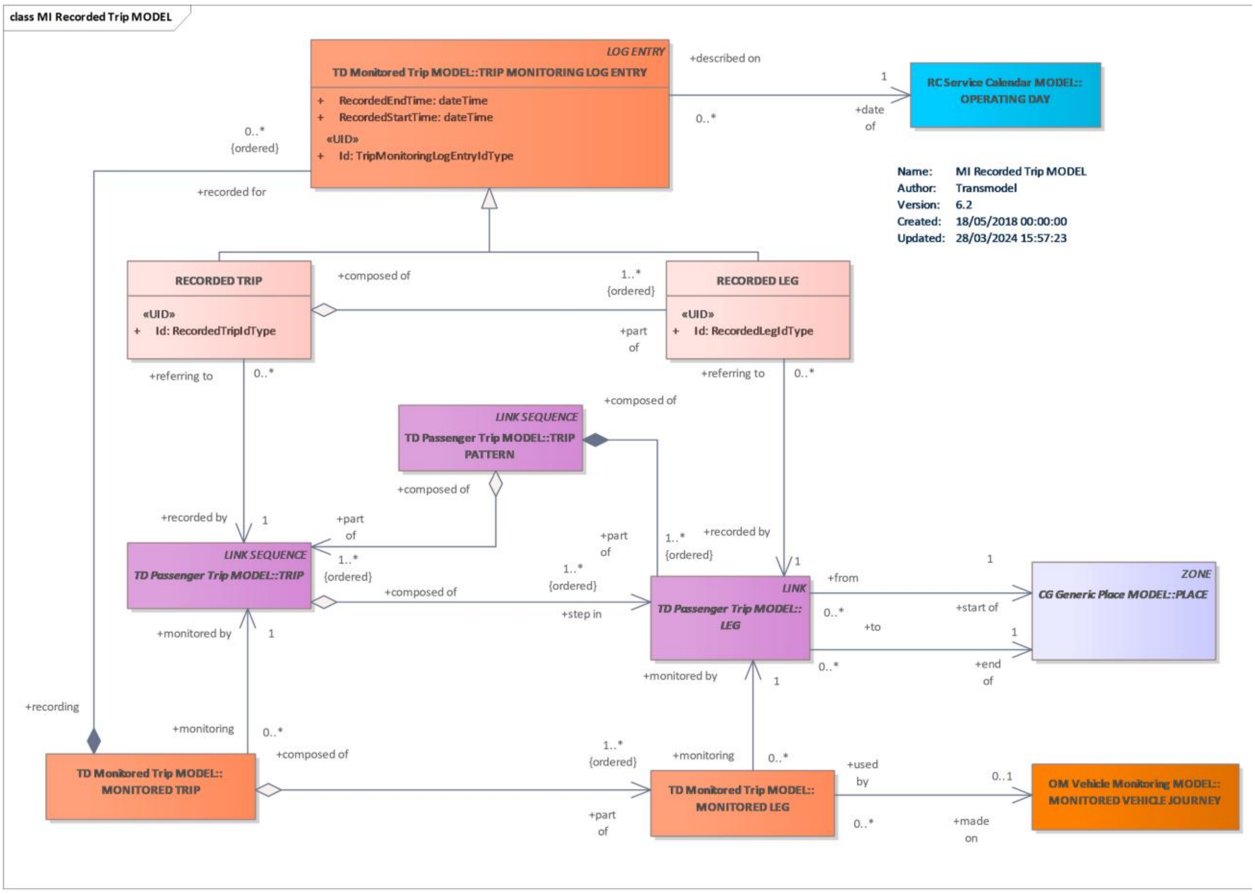

Figure 11 Recorded Trip MODEL

5.2.3 Examples of use of the LOGGABLE OBJECT pattern

5.2.3.1 Introduction

The following sections describe some possible use of the Generic Loggable Object MODEL and Logging Time and Place MODEL. They constitute examples of use of this generic pattern, and real-life situations may differ depending on the operational context.

There is a great variety of equipment available in public transport to record operational events, each with its own characteristics. Several generations of onboard or ground measurement devices are installed in PT networks. The most recent are integrated into monitoring (AVM) or payment systems, which cover many other functions than collecting data. In numerous cases, manual surveys are still necessary, as regards to the traveller movements. Each implementation will require some form of data acquisition, utilizing the various forms of equipment available as appropriate for the application.

The following examples are related to OpRa, where several use cases are described and categorised.

To provide concrete examples of the use of the Generic Loggable Object MODEL, the following use cases are presented below. They concern

- Service demand:
  - Expected service demand:
    - Expected number of passengers
  - Actual service demand:
    - Measured number of passengers
- Service efficiency:
  - Number of cancelled journeys
  - **Number of late journeys** .

OpRa considers the data models below and provides the data exchange format for the raw data and related indicators.

5.2.3.2 Actual Service Demand

5.2.3.2.1 Introduction to Actual Service Demand Examples

The following sections illustrate several ways of performing the passenger counting (actual service demand) depending on the available information and means of measure.

Three possible ways of doing passenger counting are proposed here but, of course, other methods may be proposed, and each method can be refined depending on the context and operational needs:

a) Passenger counting based on boarding and alighting counts;

b) Passenger counting based on counting devices;

c) Passenger counting based on ticketing (validations).

Service Demand related raw data resulting from any of the above methods may be used to calculate indicators showing the service demand, for a specific scope, i.e. per LINE, per SERVICE JOURNEY, etc.

All three ways of passenger counting have specific requirements, but they all need the operational context, the monitored entities, and the recorded measurements. The most critical shared classes include OPERATING DAY, SERVICE JOURNEY, and VEHICLE JOURNEY, which define the planned and actual service structure. Additionally, STOP POINT and PLACE are fundamental for spatial referencing, while RECORDED STOP and OBSERVED PASSING TIME capture actual operational events. For monitoring and logging, classes such as VEHICLE MONITORING LOG ENTRY and TRIP MONITORING LOG ENTRY are central to all models, ensuring traceability of events.

5.2.3.2.2 Actual Service Demand based on passenger counts at stops

This first use case proposes to use the RECORDED STOP and BOARDING AND ALIGHTING objects to fill a BOARDING BASED PASSENGER COUNT indicator. The principle is quite simple: at each SCHEDULED STOP POINT the numberOfBoarders is added to and the numberOfAlighters subtracted from the total number of passengers in the VEHICLE operating the DATED VEHICLE JOURNEY. This information is available for each SCHEDULED STOP POINT (the BOARDING AND ALIGHTING BASED PASSENGER COUNT is a LOGGABLE OBJECT and a LOG ENTRY called AGREGATED BOARDING AND ALIGHTING ENTRY is generated at each stop); it is a raw data to be able to calculate the global passenger count for the DATED VEHICLE JOURNEY, which itself is an input to a wider aggregation (per NETWORK, per LINE, etc.).

The following figure also displays relation to the LINE, the OPERATOR, the OPERATING DAY, etc. to illustrate the possibilities of filtering this indicator (i.e. passenger counting per LINE, per OPERATOR, or per OPERATING PERIOD, etc.).

The model supports granularity by distinguishing between observed counts at stops and aggregated data for legs or journeys.

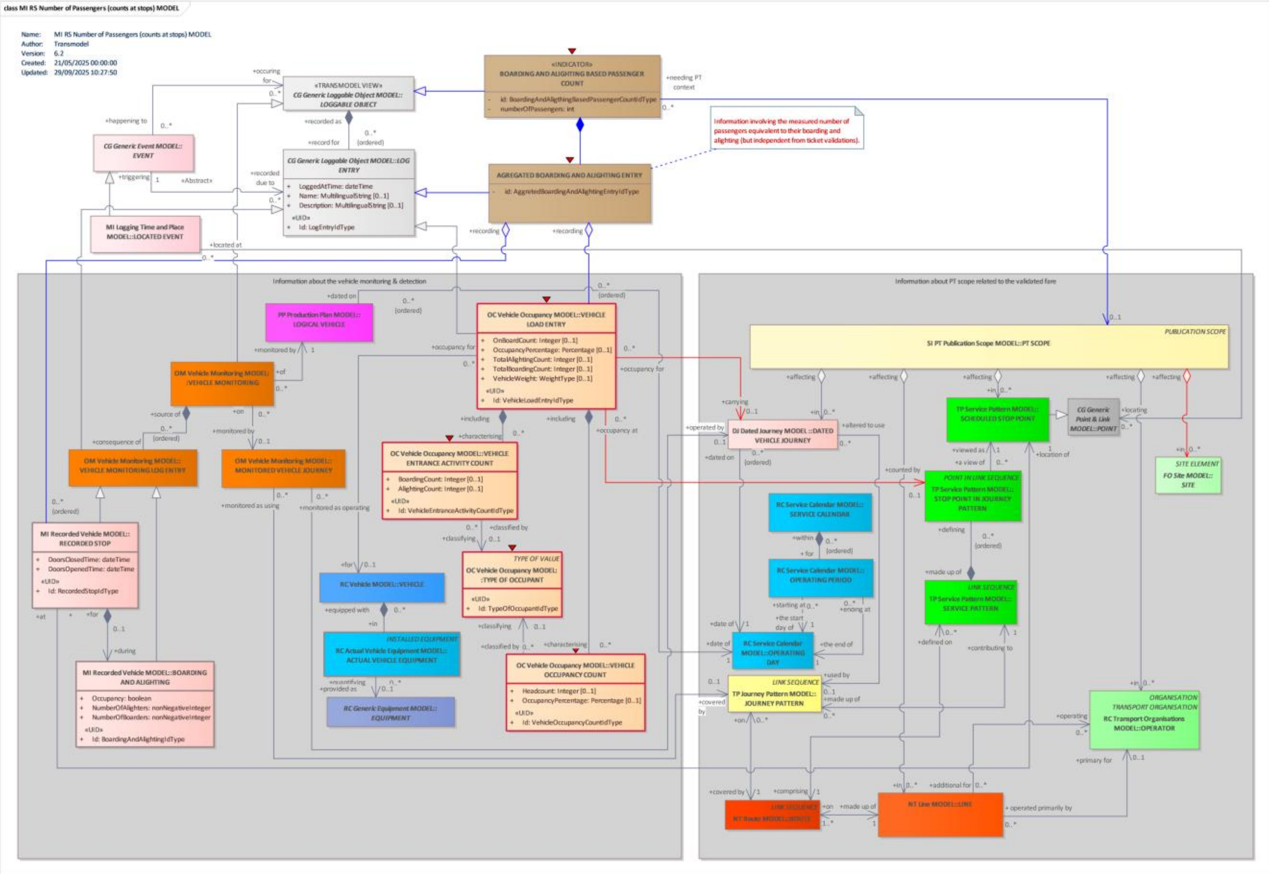

Figure 12 Example UML: Actual service demand based on passenger counts at stops

5.2.3.2.3 Actual Service Demand based on passenger counting device

The process of detection consists of recognizing a vehicle and of assigning some data to it, as collected by the available detection devices available. Onboard measurement devices like infrared sensors and counting steps produce a DETECTED OPERATION that consists of an actual measurement number of alighting and boarding passengers at a defined SCHEDULED STOP POINT as part of VEHICLE DETECTING. The VEHICLE DETECTING is itself a LOGGABLE OBJECT.

The entity VEHICLE DETECTING represents the log entries of all detection events (passenger counting in this example) and refers to a DATED VEHICLE JOURNEY. It is identified by an ID and characterized by an attribute 'timestamp'. This timestamp describes the time, as precisely as possible, at which the data has been collected (there may be a certain delay between the detection time and the data recording in a central system).

The sensors' measures of the current load (occupancy) of a vehicle are recorded in LOG ENTRies with actual weight of load in a particular timestamp at a specific LOCATION.

The ONBOARD DEVICE BASED PASSENGER COUNT is an indicator that specialize the VEHICLE DETECTING (therefore being a LOGGABLE OBJECT) and, using the relations through the DATED VEHICLE JOURNEY and JOURNEY, connect it to the JOURNEY ACCOUNTING. This is done here to illustrate a way of building an indicator providing the number of passengers per kilometre on the NETWORK.

As previously, the relation to the LINE and to the OPERATING DAY is displayed to illustrate the possibility of filtering this indicator per LINE or per OPERATING PERIOD.

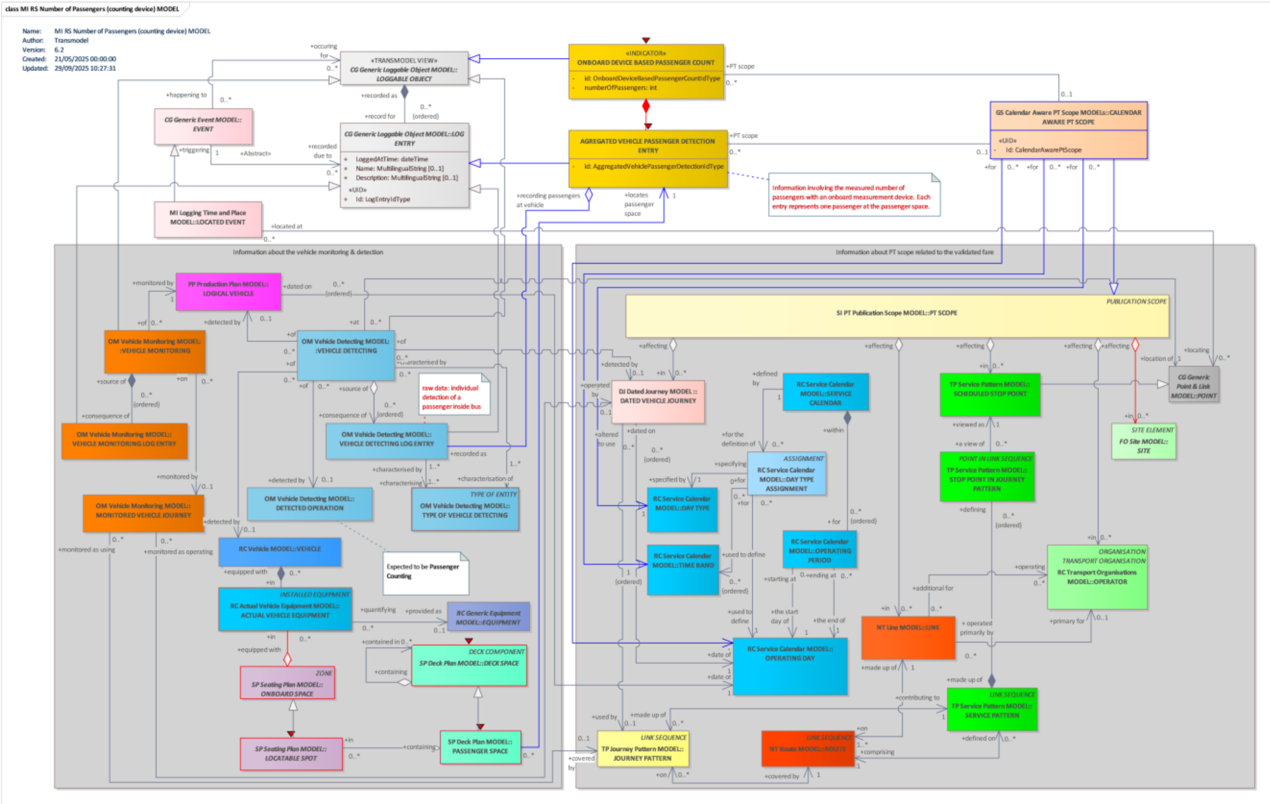

Figure 13 Example UML: Actual service demand based on a passenger counting device

5.2.3.2.4 Actual Service Demand based on fare validations results

In this third example of use of LOGGABLE OBJECT, the passenger counting is based on validation (counting of check-ins and check-outs).

The validation process (described in EN 12896-5, Public transport - Reference data model - Part 5: Fare management) results in VALIDATION ENTRies which are recorded as VALIDATED ACCESSes. Note that a VALIDATION ENTRY can specialize in PASSENGER CHECK IN ENTRY, PASSENGER CHECK OUT ENTRY, FARE TRIP ACTIVATION ENTRY, CONTROL PASSENGER TRIP ENTRY or PASSENGER WAY POINT ENTRY. Based on these specializations (when available) the fare system can infer a passenger count. The result is managed by the TICKETING BASED PASSENGER COUNT, inheriting from LOGGABLE OBJECT, allowing the storage of values in LOG ENTRies.

The relation starting from VALIDABLE ELEMENT on right of the figure will allow different time of filtering: mainly passenger counting per FARE PRODUCT, but this can be extended to passenger counting per USAGE PARAMETER (for example FARE PRODUCT dedicated to a specific age category, or counting of passenger using GROUP TICKET, etc.).

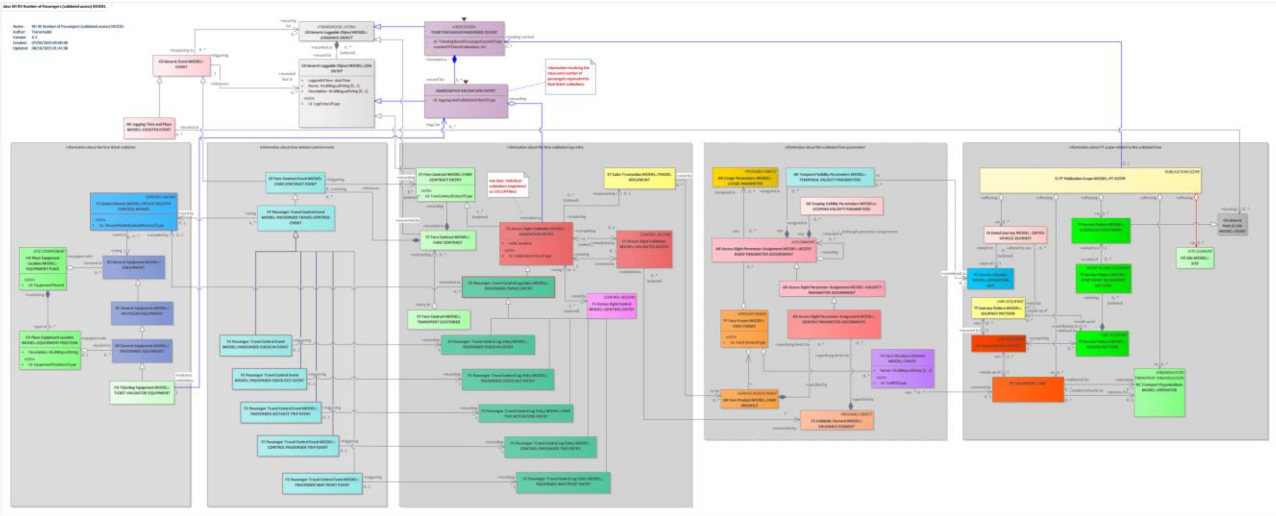

Figure 14 — Example UML: Actual service demand based on fare validation collection results

5.2.3.2.5 Expected Service Demand - Expected number of passengers

This use case reports the expected number of passengers, for a predefined period, typically a year. It is used to evaluate the expected demand for the reference service contract. It focuses on how expected occupancy and passenger count data are structured, exchanged, and associated with operational and planning entities. The use case uses a comprehensive data structure for modelling, predicting, and reporting public transport passenger volumes. It links vehicle types, routes, journey patterns, schedules, organizations, and occupancy data to support planning, analysis, and operational reporting for public transit systems. Relationships clarify how expected passenger numbers are calculated and contextualized within broader transport management and publication frameworks.

The model defines how anticipated passenger demand is represented and structured within the OpRa based framework. At its core, the model introduces the EXPECTED NUMBER OF PASSENGERS indicator, which quantifies forecasted demand for a given service scope and time frame. Supporting this are classes such as EXPECTED PASSENGERS COUNT and EXTERNAL EXPECTED PASSENGER COUNT, which allow differentiation between internally calculated forecasts and externally sourced estimates. These elements are grouped under US Service Demand MODELs, ensuring alignment with broader usage and demand concepts. The model captures essential attributes like expected passenger volumes, temporal applicability (e.g., day, period, or interval), and contextual dimensions such as SERVICE JOURNEY, OPERATOR, or network segment. By structuring expected demand in this way, the model enables integration with planning processes, KPI frameworks, and comparative analysis against actual recorded usage, supporting both operational planning and strategic decision-making.

The following figure shows conceptual classes and attributes for the expected number of passengers model elements:

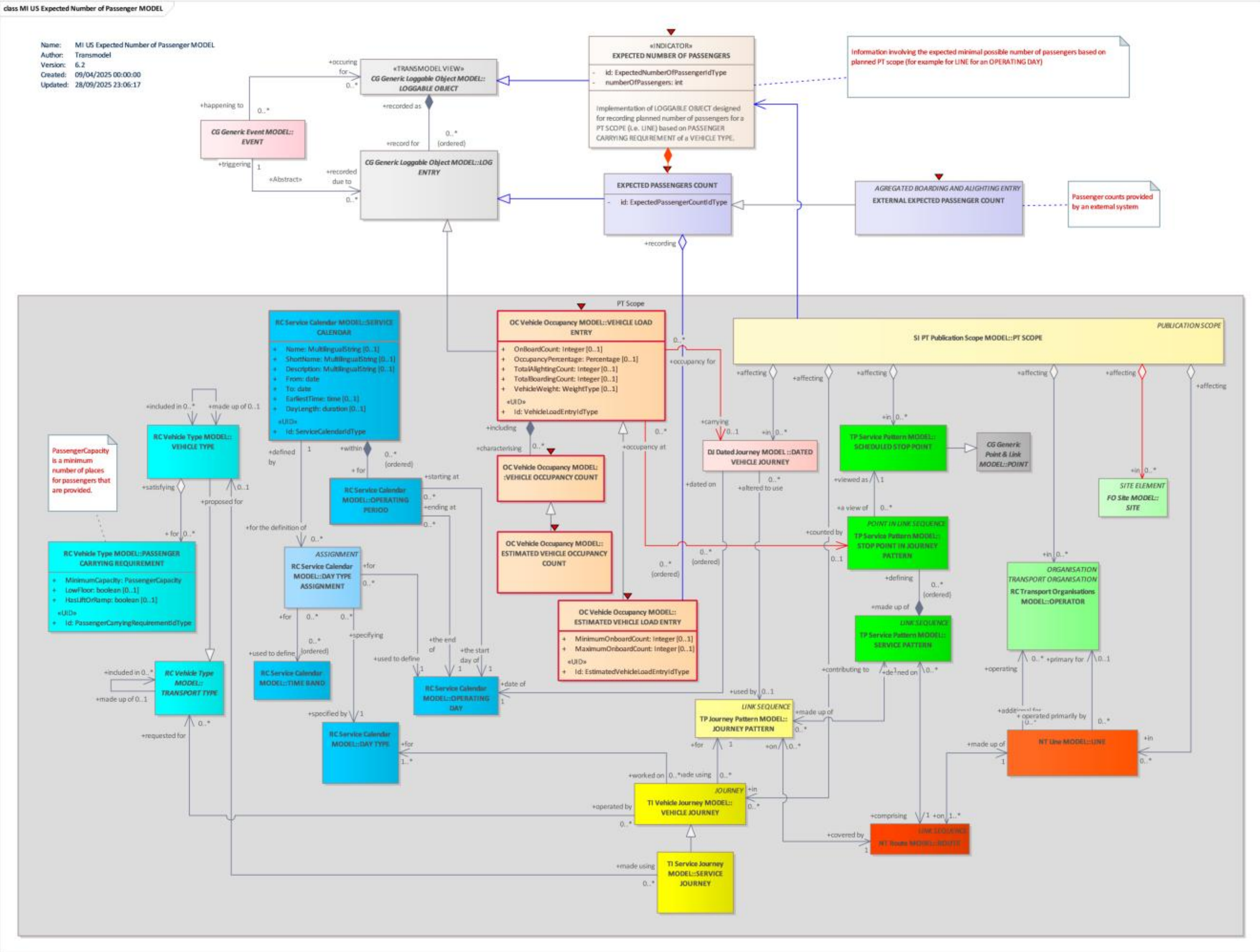

Figure 15 Expected Number of Passenger MODEL

5.2.3.3 Service efficiency

The analysis of service efficiency requires the recording of DATED PASSING TIMEs for a DATED VEHICLE JOURNEY. The DATED JOURNEY INFORMATION RECORDING indicator is a possible implementation of the LOGGABLE OBJECT pattern, and can be used, for example:

— to record DATED VEHICLE JOURNEY information (e.g. final arrival time);

— to record DATED PASSING TIMEs (e.g. passing time at SCHEDULED STOP POINT or TIMING POINT);

— to record PT SITUATIONs (e.g. information on disruptions or events that could explain late passing times).

5.2.3.3.1 Number of Cancelled Journeys

This use case reports the number of cancelled journeys, and associated reasons (number of cancellations per reason type), on a predefined period base. It focuses on how public transport cancellations are recorded, aggregated, and published for planned and dated vehicle journeys. It connects cancellation data to operational events, journey monitoring, service calendars, vehicle types, and operators.

The model defines the conceptual structure for capturing and aggregating journey cancellations At its core is the CANCELLED DATED VEHICLE JOURNEY ENTRY, which records individual cancellations with identifiers and contextual details such as the associated DATED VEHICLE JOURNEY, the reason for cancellation, and its operational scope. These entries are aggregated into CANCELLED DATED VEHICLE JOURNEY COUNT, enabling performance indicators for service reliability. The model links cancellations to PUBLIC TRANSPORT SITUATION, allowing each cancellation to be classified as a situation with a cause and potential operational consequences. It also references SERVICE CALENDAR and OPERATOR, ensuring that cancellations are analyzed within the correct temporal and organizational context. This structure supports both operational monitoring and KPI reporting by providing a standardized way to log, classify, and summarize cancellations across the network.

The following figure shows conceptual attributes for the number of cancelled journeys model elements:

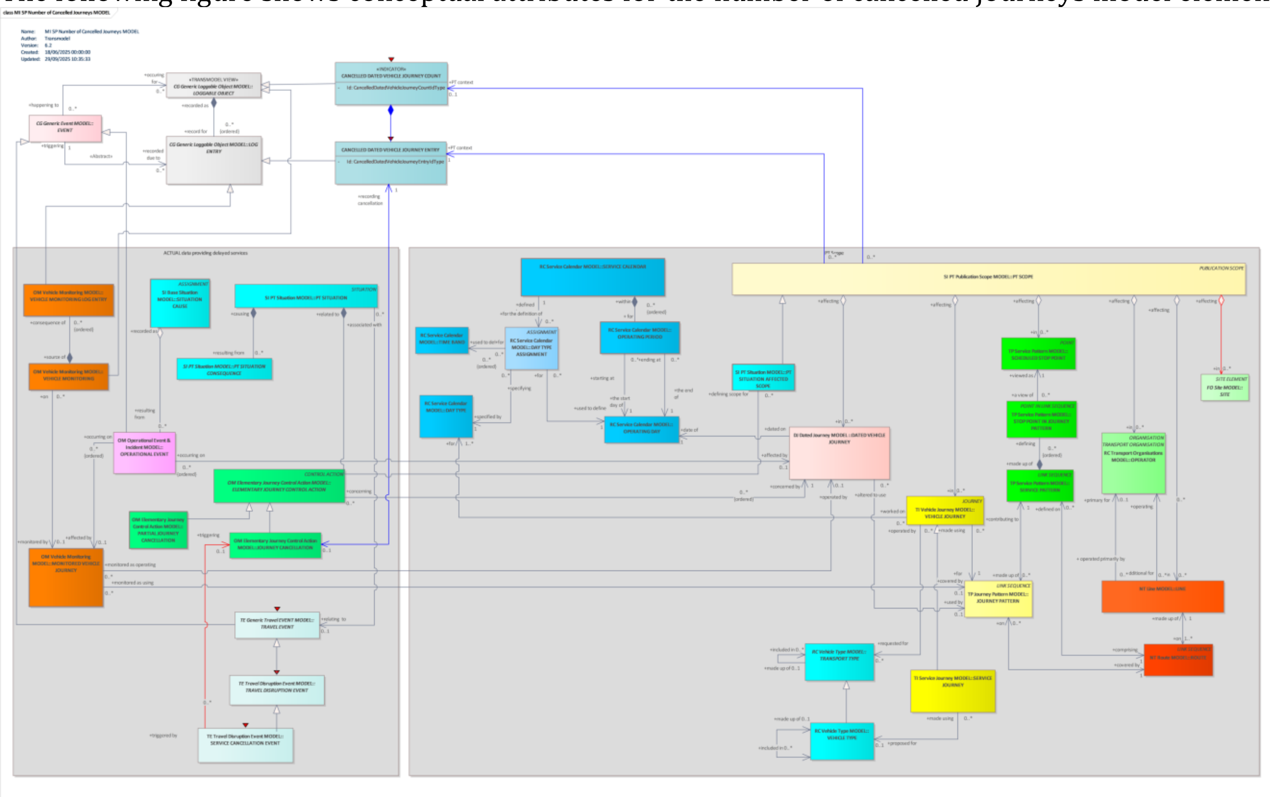

Figure 16 Example UML: Service efficiency – Number of Cancelled Journeys

The Cancelled Journeys Aggregations MODEL extends the Number of Cancelled Journeys MODEL, which records each CANCELLED DATED VEHICLE JOURNEY ENTRY and totals them in CANCELLED DATED VEHICLE JOURNEY COUNT by adding a statistical layer that groups, summarizes, and contextualizes those raw cancellations. Using the generic building blocks from GS GENERIC AGGREGATIONS MODELS, it represents cancellations as OCCURRENCE data points (e.g., with *NumberOfOccurrences* and *PercentageOfOccurrences*) and buckets them into analysis periods via an INTERVAL concept (e.g., *time buckets* such as hour/day/week or other reporting windows). These generic types are specialized for the domain into CANCELLED JOURNEY OCCURRENCE (counts/rates of cancellations for a scope) and, where applicable, a CANCELLED JOURNEY INTERVAL to explicitly define the aggregation window. At the KPI level, an INDICATOR CANCELLED DATED VEHICLE JOURNEY COUNT consolidates the occurrences into publishable metrics, parameterized by PT SCOPE (publication/operational scope) so the same statistics can be sliced by OPERATOR, LINE, SERVICE CALENDAR, or other public transport contexts. In short, the first model captures cancellations; this aggregation model analyzes them—turning raw entries into interval-based counts and percentages that drive reliability KPIs and performance dashboards.

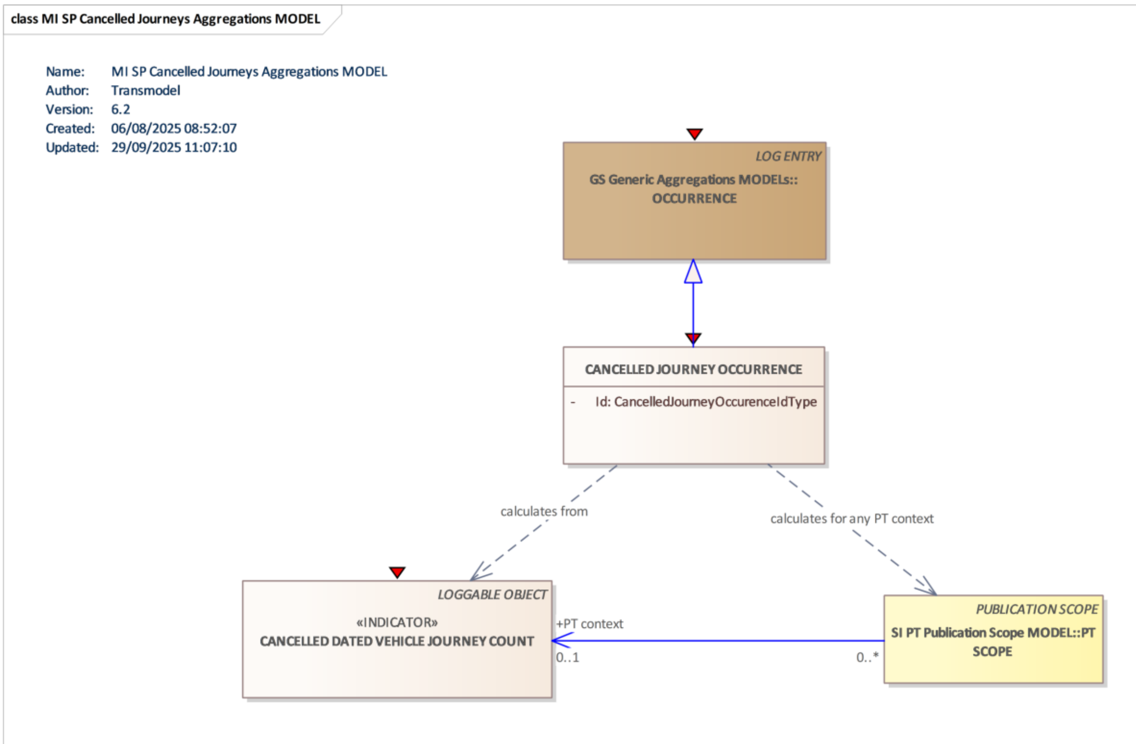

Figure 17 Example UML: Service efficiency – Cancelled Journeys Aggregations

5.2.3.3.2 Number of Late Journeys

The use case addresses the monitoring and analysis of late vehicle journeys within a public transport context. A DATED VEHICLE JOURNEY is observed against its planned schedule by comparing target passing times with actual observed passing times at scheduled stop points. When deviations exceed defined thresholds, a DELAY classified as a type of PUBLIC TRANSPORT SITUATION, is recorded. Each delay has an associated cause and can trigger operational events that require control actions to mitigate service impacts. These actions are applied within the affected scope in time and are governed by the service calendar, extending their influence to related PT SCOPE elements such as VEHICLE JOURNEY, SERVICE JOURNEY, SCHEDULED STOP POINT, the responsible OPERATOR, etc. This conceptual framework enables for a system to aggregates these entries into LATE DATED VEHICLE JOURNEY COUNT for the specified time frame and scope (e.g., by operator, line, or service calendar), supporting performance monitoring and service quality management.

It is expected that number of late journeys should be reportable on the following basis:

- on a per stop base (especially first and last stops),

- on an origin/destination base,

- on a peak/off-peak base,

- on an area (i.e. region or city) base,

The definition of late shall be very clearly stated:

- maximum delay to be paid on time (may depend on mode)

- there may be a specific definition for headway services

- additional services shall be clearly identified.

The following figure shows conceptual classes and attributes for the number of late journeys model elements.

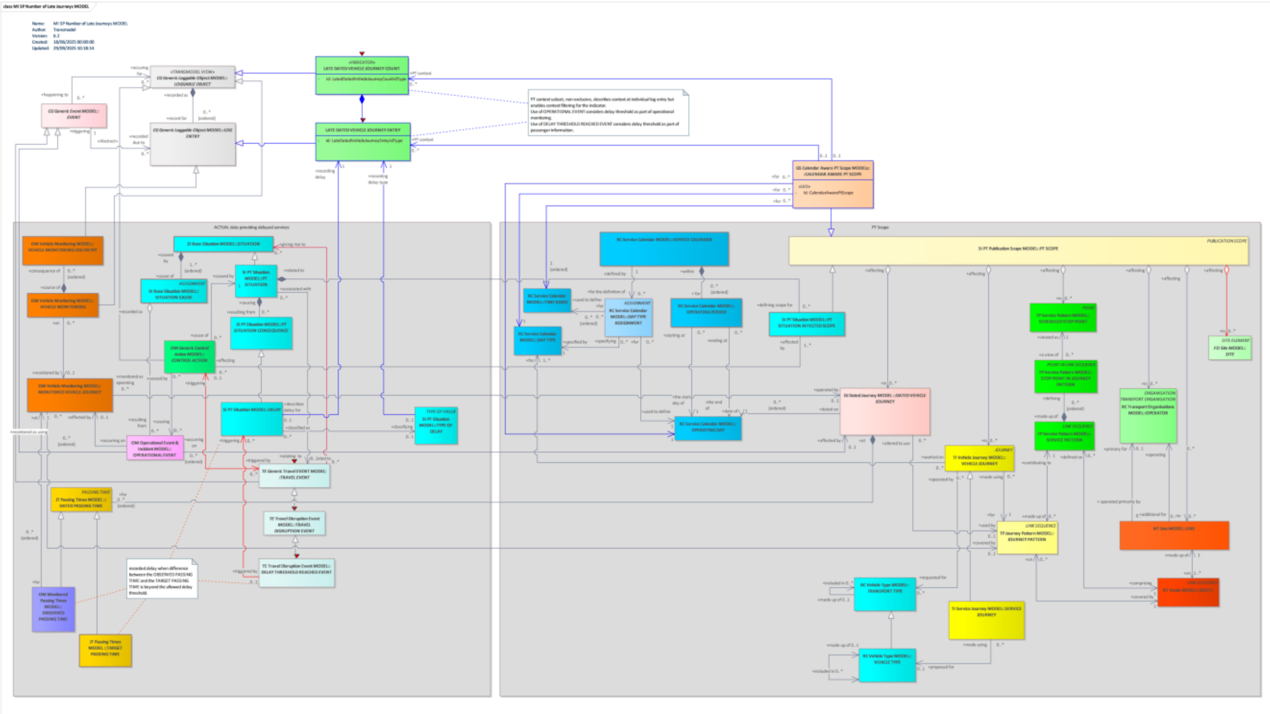

Figure 18 Example UML: Service efficiency – Number of Late Journeys

The next Late Journeys Aggregations MODEL builds on the foundation established by the Number of Late Journeys MODEL, which captures individual lateness events through LATE DATED VEHICLE JOURNEY ENTRY and aggregates them into LATE DATED VEHICLE JOURNEY COUNT. While the first model focuses on recording and counting late journeys, this aggregation model introduces a statistical layer that enables deeper analysis and reporting. It leverages generic components like DURATION INTERVAL and OCCURRENCE from the Generic Aggregations MODELS to classify delays into time-based intervals and calculate both absolute and relative frequencies. These are specialized into LATE JOURNEY INTERVAL and LATE JOURNEY OCCURRENCE, which group late journeys by delay duration and compute metrics such as counts and percentages. At the top level, the INDICATOR LATE DATED VEHICLE JOURNEY COUNT consolidates these occurrences into KPI-style indicators, contextualized by PT SCOPE to define the operational or reporting domain. Together, these two models form a complete framework: the first ensures accurate capture of lateness events, and the second transforms this raw data into meaningful statistical insights for performance monitoring and service quality evaluation.

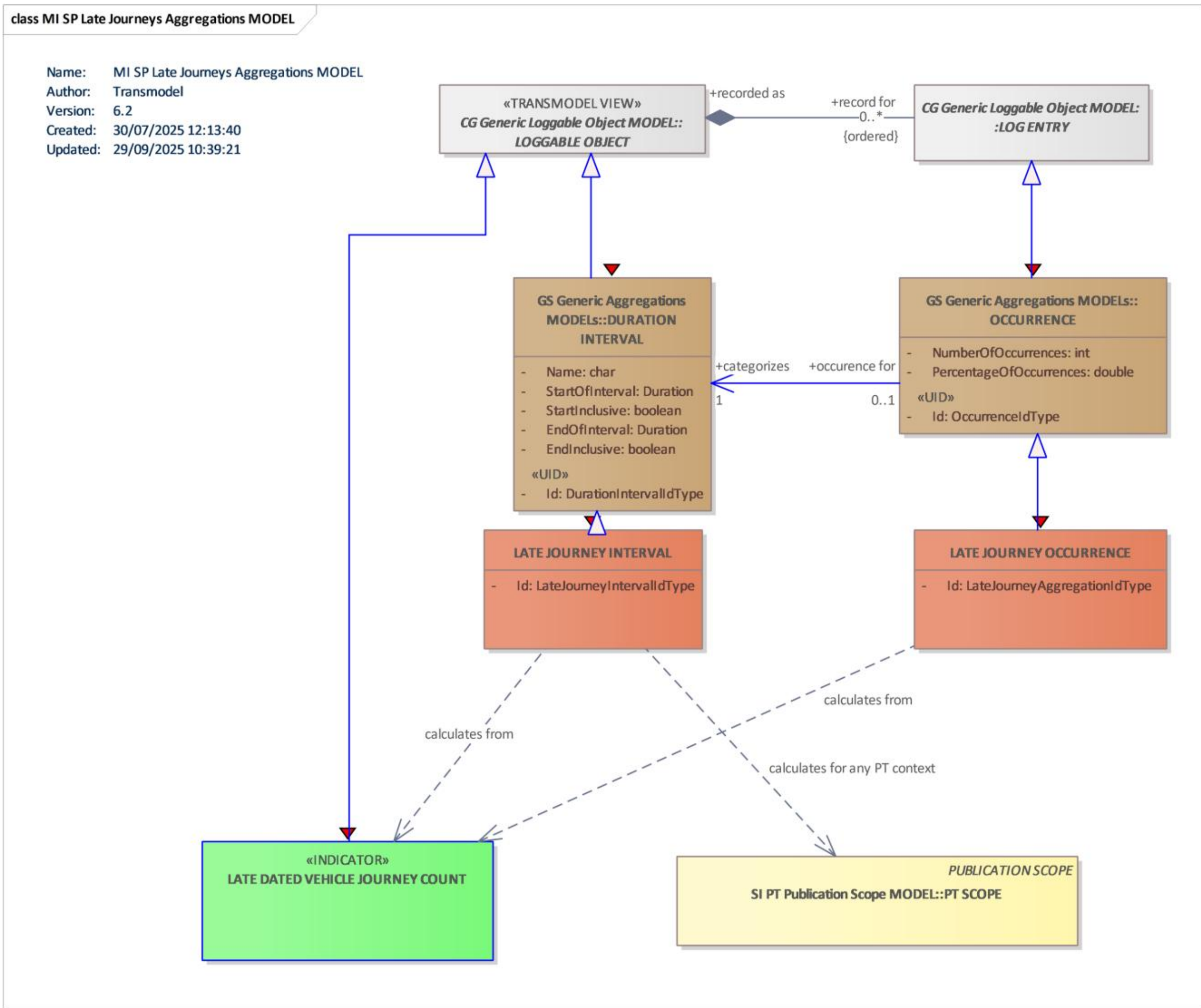

Figure 19 — Example UML: Service efficiency – Late Journeys Aggregations

Annex A
(normative)

Data dictionary

A.1 Introduction

In addition to the definitions given in the series of standards EN 12896 1to 7, the definitions given in the sections which follow also apply for this standard.

A.2 Data dictionary — Management information and statistics

A.2.1 ACTUAL SERVICE FRAME

Description of ACTUAL SERVICE FRAME.

Table A.1 — ACTUAL SERVICE FRAME – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*VERSION FRAME*	::>	***ACTUAL SERVICE FRAME*** inherits from ***VERSION FRAME***.
«UID»	***id***	*ActualServiceFrameIdType*	1:1	Identifier of ACTUAL SERVICE FRAME.

A.2.2 AGGREGATED BOARDING AND ALIGHTING ENTRY

The class AGGREGATED BOARDING AND ALIGHTING ENTRY represents a summarized record of passenger movements at a higher level of aggregation, typically for a group of stops, a leg, or an entire journey. It consolidates multiple BOARDING AND ALIGHTING ENTRY instances into a single entry, providing total counts of passengers boarding and alighting rather than individual observations.

Table A.2 — AGGREGATED BOARDING AND ALIGHTING ENTRY – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***AGGREGATED BOARDING AND ALIGHTING ENTRY*** inherits from ***LOG ENTRY***.
	id	*AggretedBoardingAndAlightingEntryIdType*	1:1	Identifier of AGGREGATED BOARDING AND ALIGHTING ENTRY.

A.2.3 AGGREGATED VALIDATION ENTRY

AGGREGATED VALIDATION ENTRY created from VALIDATION ENTRies for context defined by the PT SCOPE, which is the as the one for the TICKETING BASED PASSENGER COUNT INDICATOR.

Table A.3 — AGGREGATED VALIDATION ENTRY – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***AGGREGATED VALIDATION ENTRY*** inherits from ***LOG ENTRY***.
	id	*AggregatedValidationEntryIdType*	1:1	Identifier of AGGREGATED VALIDATION ENTRY.

A.2.4 AGGREGATED VEHICLE PASSENGER DETECTION ENTRY

The class AGGREGATED VEHICLE PASSENGER DETECTION ENTRY represents a consolidated record of passenger detection data collected from a vehicle over a defined period or operational segment. Instead of storing individual detection events, this class aggregates multiple VEHICLE PASSENGER DETECTION ENTRY instances into a single summary, providing total passenger counts or occupancy levels for the entire MONITORED VEHICLE JOURNEY, OPERATING DAY, or a specific LEG.

Table A.4 — AGGREGATED VEHICLE PASSENGER DETECTION ENTRY – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***AGGREGATED VEHICLE PASSENGER DETECTION ENTRY*** inherits from ***LOG ENTRY***.
	id	*AggregatedVehiclePassengerDetectionIdType*	1:1	Identifier of AGGREGATED VEHICLE PASSENGER DETECTION ENTRY.

A.2.5 BOARDING and ALIGHTING

The numbers of passengers boarding and alighting at a SCHEDULED STOP POINT during a RECORDED STOP.

Table A.5 — BOARDING AND ALIGHTING – Attributes

Classification	Name	Type	Cardinality	Description
:: >	:: >	VEHICLE MONITORING LOG ENTRY	:: >	BOARDING AND ALIGHTING inherits from VEHICLE MONITORING LOG ENTRY
«UID»	Id	BoardingAndAlightingIdType	1:1	Identifier of BOARDING AND ALIGHTING.
	Occupancy	boolean	1:1	Whether the VEHICLE is occupied.
	NumberOfAlighters	nonNegativeInteger	1:1	Number of passengers alighting.
	NumberOfBoarders	nonNegativeInteger	1:1	Number of passengers boarding.

A.2.6 BOARDING AND ALIGHTING BASED PASSENGER COUNT

Possible implementation of LOGGABLE OBJECT designed for passenger counting based on BOARDING AND ALIGHTING (independent from the counting method).

Table A.6 — BOARDING AND ALIGHTING BASED PASSENGER COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***BOARDING AND ALIGHTING BASED PASSENGER COUNT*** inherits from ***LOGGABLE OBJECT***.
	id	*BoardingAndAligthingBasedPassengerCountIdType*	1:1	Identifier of BOARDING AND ALIGHTING BASED PASSENGER COUNT.
	numberOfPassengers	*int*	1:1	Actual number of passengers (boarding and/or alighting).

A.2.7 CALENDAR AWARE PT SCOPE

A data scope consisting of public transport entities or combinations of entities such as OPERATORs, NETWORKs, LINEs, SCHEDULED STOP POINTs, STOP PLACEs, PLACEs, etc. that is also related to temporal scope.

Table A.7 — CALENDAR AWARE PT SCOPE – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*PT SCOPE*	::>	***CALENDAR AWARE PT SCOPE*** inherits from ***PT SCOPE***.
«UID»	***Id***	*CalendarAwarePtScope*	1:1	Identifier of CALENDAR AWARE PT SCOPE.

A.2.8 <u>CANCELLED DATED VEHICLE JOURNEY COUNT</u>

The class CANCELLED DATED VEHICLE JOURNEY COUNT aggregates the number of cancelled DATED VEHICLE JOURNEY instances within a defined context, such as an OPERATING DAY, a LINE, or a NETWORK. Instead of storing individual entries, it provides a summarized count, enabling performance monitoring and statistical analysis of service reliability. This class is essential for high-level reporting and trend evaluation, supporting KPIs related to cancellations.

Table A.8 — CANCELLED DATED VEHICLE JOURNEY COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***CANCELLED DATED VEHICLE JOURNEY COUNT*** inherits from ***LOGGABLE OBJECT***.
	Id	*CancelledDatedVehicleJourneyCountIdType*	1:1	Identifier of CANCELLED DATED VEHICLE COUNT.

A.2.9 CANCELLED DATED VEHICLE JOURNEY ENTRY

The class CANCELLED DATED VEHICLE JOURNEY ENTRY represents an individual record of a specific DATED VEHICLE JOURNEY that was cancelled. It provides detailed information about the cancellation, including the reference to the OPERATING DAY, the associated SERVICE JOURNEY, and the planned VEHICLE JOURNEY. This class ensures traceability by linking the cancellation event to the original scheduled journey and may include attributes such as cancellation reason, timestamp, and responsible authority. Its purpose is to capture granular cancellation data for operational analysis and reporting.

Table A.9 — CANCELLED DATED VEHICLE JOURNEY ENTRY – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***CANCELLED DATED VEHICLE JOURNEY ENTRY*** inherits from ***LOG ENTRY***.
	Id	*CancelledDatedVehicleJourneyEntryIdType*	1:1	Identifier of CANCELLED DATED VEHICLE JOURNEY ENTRY.

A.2.10 CANCELLED JOURNEY OCCURRENCE

The class CANCELLED JOURNEY OCCURRENCE represents an aggregated indicator of how often cancellations occur within a defined public transport context. It is derived from CANCELLED DATED VEHICLE JOURNEY COUNT and expresses the number of cancellations or their percentage relative to the total scheduled journeys. This class is linked to the OCCURRENCE concept from the generic aggregation model, which provides attributes such as NumberOfOccurrences and PercentageOfOccurrences. Its purpose is to enable high-level reporting and KPI calculations for service reliability, allowing operators to monitor cancellation trends across different scopes such as LINE, NETWORK, or OPERATING DAY.

Table A.10 — CANCELLED JOURNEY OCCURRENCE – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*OCCURRENCE*	::>	***CANCELLED JOURNEY OCCURRENCE*** inherits from ***OCCURRENCE***.
	Id	*CancelledJourneyOccurrenceIdType*	1:1	Identifier of CANCELLED JOURNEY OCCURRENCE.

A.2.11 DATED JOURNEY INFORMATION RECORDING

Possible implementation of LOGGABLE OBJECT designed for recording DATED VEHICLE JOURNEY information.

Table A.11 — DATED JOURNEY INFORMATION RECORDING – Attributes

Classification	Name	Type	Cardinality	Description
:: >	:: >	LOGGABLE OBJECT	:: >	**DATED JOURNEY INFORMATION RECORDING** inherits from **LOGGABLE OBJECT**

A.2.12 DURATION INTERVAL

Representation of duration interval - related statistics.

Table A.12 —DURATION INTERVAL – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***DURATION INTERVAL*** inherits from ***LOGGABLE OBJECT***.
«UID»	***Id***	*DurationIntervalIdType*	1:1	Identifier of DURATION INTERVAL.
	Name	*char*	1:1	Name of the duration interval (i.e. "10 minutes")
	StartOfInterval	*Duration*	1:1	Start of the duration interval.
	StartInclusive	*boolean*	1:1	Signals if the start value is included in the interval (longer-than or longer-or-equal-than.
	EndOfInterval	*Duration*	1:1	End of the duration interval.
	EndInclusive	*boolean*	1:1	Signals if the end is included in the interval (shorter-than or shorter-or-equal-than).

A.2.13 EXPECTED NUMBER OF PASSENGERS

Implementation of LOGGABLE OBJECT designed for recording planned number of passengers for a PT SCOPE (i.e. LINE) based on PASSENGER CARRYING REQUIREMENT of a VEHICLE TYPE.

Table A.13 —EXPECTED NUMBER OF PASSENGERS – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***EXPECTED NUMBER OF PASSENGERS*** inherits from ***LOGGABLE OBJECT***.
	id	*ExpectedNumberOfPassengerIdType*	1:1	Identifier of EXPECTED NUMBER OF PASSENGERS.
	numberOfPassengers	*int*	1:1	Expected number of passengers.

A.2.14 EXPECTED PASSENGERS COUNT

The class EXPECTED PASSENGERS COUNT represents the estimated number of passengers anticipated for a specific operational context, such as a SERVICE JOURNEY, VEHICLE JOURNEY, or STOP POINT. This estimation is typically based on historical data, demand forecasts, or planning assumptions. It provides a reference value for comparing actual passenger counts against expected figures, supporting performance analysis and demand validation. Attributes may include the expected boarding and alighting numbers, time frame, and calculation method.

Table A.13 — EXPECTED PASSENGERS COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***EXPECTED PASSENGERS COUNT*** inherits from ***LOG ENTRY***.
	Id	*ExpectedPassengerCountIdType*	1:1	Identifier of EXPECTED PASSENGER COUNT.

A.2.15 EXTERNAL EXPECTED PASSENGER COUNT

The class EXTERNAL EXPECTED PASSENGER COUNT stores expected passenger numbers provided by an external source, such as a third-party system, operator, or demand forecasting tool. Unlike internally calculated estimates, this class ensures integration of externally supplied data into the operational model. It maintains associations with SERVICE JOURNEY, STOP POINT, and OPERATING DAY, and may include metadata about the source and reliability of the data. Its purpose is to enable comparison between internal and external expectations for improved planning and reporting.

Table A.14 — EXTERNAL EXPECTED PASSENGER COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*AGGREGATED BOARDING AND ALIGHTING ENTRY, EXPECTED PASSENGERS COUNT*	::>	***EXTERNAL EXPECTED PASSENGER COUNT*** inherits from ***AGGREGATED BOARDING AND ALIGHTING ENTRY, EXPECTED PASSENGERS COUNT***.
	id	*ExternalBoardingAndAlightingPassengerCount*	1:1	Identifier of EXTERNAL EXPECTED PASSENGER COUNT.

A.2.16 INTERCHANGE STATUS

The information about the actual status of a SERVICE JOURNEY INTERCHANGE on a specified OPERATING DAY. Recorded information on missed interchanges may be of particular interest.

Table A.15 — INTERCHANGE STATUS – Attributes

Classification	Name	Type	Cardinality	Description
:: >	:: >	VEHICLE MONITORING LOG ENTRY	:: >	**INTERCHANGE STATUS** inherits from **VEHICLE MONITORING LOG ENTRY**

«UID»	**Id**	InterchangeStatusIdType	1:1	Identifier of INTERCHANGE STATUS.
	NumberOfPassengers	nonNegativeInteger	1:1	Number of passengers making interchange.
	CauseOfMissedInterchange	Multilingual String	1:1	Cause of failing to make interchange, if any.

A.2.17 KPI FRAME

A coherent set of KPIs to which the same frame VALIDITY CONDITIONs have been assigned.

Table A.16 —KPI FRAME – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*VERSION FRAME*	::>	***KPI FRAME*** inherits from ***VERSION FRAME***.
«UID»	***id***	*KpiFrameIdType*	1:1	Identifier of KPI FRAME.

A.2.18 LATE DATED VEHICLE JOURNEY COUNT

The class LATE DATED VEHICLE JOURNEY COUNT aggregates the number of late DATED VEHICLE JOURNEY instances within a defined scope, such as an OPERATING DAY, a LINE, or a NETWORK. Instead of storing individual delay records, it summarizes occurrences to support high-level reporting and performance monitoring. This class is essential for generating KPIs related to service punctuality and for trend analysis across multiple operating periods.

Table A.17 —LATE DATED VEHICLE JOURNEY COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***LATE DATED VEHICLE JOURNEY COUNT*** inherits from ***LOGGABLE OBJECT***.
	Id	*LatedDatedVehicleJourneyCountIdType*	1:1	Identifier of LATE DATED VEHICLE JOURNEY COUNT.

A.2.19 LATE DATED VEHICLE JOURNEY ENTRY

The class LATE DATED VEHICLE JOURNEY ENTRY represents a detailed record of a specific DATED VEHICLE JOURNEY that experienced a delay beyond its scheduled time. It captures the operational context by referencing OPERATING DAY, SERVICE JOURNEY, and VEHICLE JOURNEY, and includes attributes such as the actual delay duration, the point of delay detection, and possibly the reason for lateness. This class provides granular data for analyzing punctuality and identifying patterns of delay at the journey level.

Table A.18 — LATE DATED VEHICLE JOURNEY ENTRY – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***LATE DATED VEHICLE JOURNEY ENTRY***

				inherits from ***LOG ENTRY***.
	id	*LateDatedVehicleJourneyEntryIdType*	1:1	Identifier of LATE DATED VEHICLE JOURNEY ENTRY.

A.2.20 LATE JOURNEY INTERVAL

The class LATE JOURNEY INTERVAL defines a time-based category used to classify delays of DATED VEHICLE JOURNEY instances into predefined duration ranges. It is associated with the DURATION INTERVAL concept, which includes attributes such as start and end duration, inclusiveness, and interval type. This class enables grouping of late journeys by severity (e.g., 0–5 minutes, 6–10 minutes) for reporting and KPI calculations. It is essential for aggregating punctuality data into meaningful intervals for trend analysis and performance evaluation.

Table A.19 — LATE JOURNEY INTERVAL – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*DURATION INTERVAL*	::>	***LATE JOURNEY INTERVAL*** inherits from ***DURATION INTERVAL***.
	Id	*LateJourneyIntervalIdType*	1:1	Identifier of LATE JOURNEY INTERVAL

A.2.21 LATE JOURNEY OCCURRENCE

The class LATE JOURNEY OCCURRENCE represents the aggregated number of late journeys within a specific LATE JOURNEY INTERVAL category. It includes attributes such as the number of occurrences and percentage of occurrences, providing statistical insight into how often delays fall into each interval. This class supports high-level reporting and helps identify patterns of lateness across different operational contexts, such as LINE, NETWORK, or OPERATING DAY.

Table A.20 — LATE JOURNEY OCCURRENCE – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*OCCURRENCE*	::>	***LATE JOURNEY OCCURRENCE*** inherits from ***OCCURRENCE***.
	Id	*LateJourneyAggregationIdType*	1:1	Identifier of LATE JOURNEY OCCURRENCE.

A.2.22 LOCATED EVENT

An EVENT with additional location and timing information.

Table A.21 — LOCATED EVENT – Attributes

Classification	Name	Type	Cardinality	Description
:: >	:: >	EVENT	:: >	**LOCATED EVENT** inherits from **EVENT**
	receivedAt	dateTime	1:1	Date and time when the event was received (possibly different from when the

				event occurred)

A.2.23 OCCURRENCE

Representation of occurrence-related statistics.

Table A.22 — OCCURRENCE – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOG ENTRY*	::>	***OCCURRENCE*** inherits from ***LOG ENTRY***.
«UID»	***Id***	*OccurrenceIdType*	1:1	Identifier of OCCURRENCE.
	NumberOfOccurrences	*Int*	1:1	Absolute number of occurrences of a statistical group.
	PercentageOfOccurrences	*Double*	1:1	Relative occurrence of a statistical group within a domain.

A.2.24 ONBOARD DEVICE BASED PASSENGER COUNT

Possible implementation of LOGGABLE OBJECT designed for passenger counting based on an onboard counting device (counting the number of passengers in the VEHICLE).

Table A.23 — ONBOARD DEVICE BASED PASSENGER COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***ONBOARD DEVICE BASED PASSENGER COUNT*** inherits from ***LOGGABLE OBJECT***.
	id	*OnboardDeviceBasedPassengerCountIdType*	1:1	Identifier of ONBOARD DEVICE BASEC PASSENGER COUNT.
	numberOfPassengers	*int*	1:1	Actual number of passengers (boarded).

A.2.25 PLANNED SERVICE FRAME

The planned service within the frame VALIDITY CONDITIONs.

Table A.24 — PLANNED SERVICE FRAME – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*VERSION FRAME*	::>	***PLANNED SERVICE FRAME*** inherits from ***VERSION FRAME***.
«UID»	***id***	*PlannedServiceFrameIdType*	1:1	Identifier of PLANNED SERVICE FRAME.

A.2.26 RAW DATA FRAME

A coherent set of OpRa data to which the same frame VALIDITY CONDITIONs have been assigned.

Table A.25 — RAW DATA FRAME – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*VERSION FRAME*	::>	***RAW DATA FRAME*** inherits from ***VERSION FRAME***.
«UID»	***Id***	*RawDataFrameIdType*	1:1	Identifier of RAW DATA FRAME.
	PreparednessLevel	*PreparednessEnumeration*	1:1	Preparedness level to state reliability by the data producer (i.e. raw, cleansed, processed data).

5.2.3.4 RECORDED LEG

The recording of the actual LEG followed by a passenger on an OPERATING DAY

Table A.26 — RECORDED LEG – Attributes

Classification	Name	Type	Cardinality	Description
«UID»	**Id**	RecordedLegIdType	1:1	Identifier of RECORDED LEG.

A.2.27 RECORDED STOP

The recorded stop at a SCHEDULED STOP POINT during actual service operation to possibly let passengers board or alight the vehicle.

Table A.27 — RECORDED STOP – Attributes

Classification	Name	Type	Cardinality	Description
:: >	:: >	VEHICLE MONITORING LOG ENTRY	:: >	**RECORDED STOP** inherits from **VEHICLE MONITORING LOG ENTRY**
«UID»	**Id**	RecordedStopIdType	1:1	Identifier of RECORDED STOP.
	DoorsClosedTime	dateTime	1:1	Time at which VEHICLE doors were closed.
	DoorsOpenedTime	dateTime	1:1	Time at which VEHICLE doors were opened.

A.2.28 RECORDED TRIP

The actual TRIP undertaken by a passenger from an origin to a destination.

Table A.28 — RECORDED TRIP – Attributes

Classifi	Name	Type	Cardinali	Description

cation			ty	
«UID»	**Id**	RecordedTripIdType	1:1	Identifier of RECORDED TRIP.

A.2.29 TICKETING BASED PASSENGER COUNT

Implementation of LOGGABLE OBJECT designed for passenger counting based on validated ticket.

Table A.29 — TICKETING BASED PASSENGER COUNT – Attributes

Classification	Name	Type	Cardinality	Description
::>	::>	*LOGGABLE OBJECT*	::>	***TICKETING BASED PASSENGER COUNT*** inherits from ***LOGGABLE OBJECT***.
	id	*TicketingBasedPassengerCountIdType*	1:1	Identifier of TICKETING BASED PASSENGER COUNT.
	numberOfTicketValidations	*int*	1:1	Actual number of passengers (with validated fares).

Annex B
(informative)

Data Model Evolutions

B.1 Change Requests

There are no formal change requests for Part 8. However, this part has been restructured and reformulated to account for changes within EN 12896-6.

NOTE Changes in CEN/TR 17370 (OpRa) have also been considered during reformulation of this document.

B.2 Source of Text

The text in the present document is based on the description provided in EN 12896-6, *Public transport - Reference data model - Part 6 (2019)*. Several subclauses are updated or added, if necessary, to describe the current model status.

B.3 Diagram Status

Transmodel v6 represents a revision of the Transmodel Management Information and Statistics model. Diagrams have been updated. To allow the reader familiar with Transmodel v6 to appraise roughly the changes, the following table synthetises the status of diagrams compared to Transmodel v6.

Table B.1 — Status of diagrams in Transmodel v6.2 Part 8 compared with Transmodel v6

Part 8 figure	Part 8 diagram/figure title	status compared to Transmodel v6
5	Loggable Object MODEL	Moved to Part 1
7	Logging Time and Place MODEL	moved to part 1
10	MI Recorded Objects MODEL	updated
11	MI Recorded Trip MODEL	updated
	MI Recorded Use Of Services MODEL	
12	MI RS Actual Service Demand (counts at stops)	updated
13	MI RS Actual Service Demand (counting device)	updated
14	MI RS Actual Service Demand (validated access)	updated
15	Expected number of passengers	new
	MI SP Service Journey Performance	Updated Service Journey Performance

Bibliography

[1] EN XXXX, *General title*