STN	Verejná preprava. Referencie o modelových informáciách. Časť 1: Bežné pojmy.	STN EN 12896-1 01 8549

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

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 02/17

Obsahuje: EN 12896-1:2016

Spolu s STN EN 12896-2 a STN EN 12896-3 ruší
STN EN 12896 (01 8549) z júla 2006

124061

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12896-1

September 2016

ICS 35.240.60

Supersedes EN 12896:2006

English Version

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

Transports publics - Modèle de données de référence - Partie 1: Concepts communs

Öffentlicher Verkehr - Datenreferenzmodell - Teil 1: Gemeinsame Konzepte

This European Standard was approved by CEN on 5 May 2016.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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 United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 12896-1:2016 E

Contents

Page

European foreword

This document (EN 12896-1:2016) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

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 March 2017, and conflicting national standards shall be withdrawn at the latest by March 2017.

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 together with documents EN 12896-2:2016 and EN 12896-3:2016 supersedes EN 12896:2006.

The series comprises the following documents:

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

Together these create version 6 of the European Standard EN 12896, known as “Transmodel” and thus replace Transmodel V5.1.

The split into several documents is intended to ease the task of users interested in particular functional domains. Modularisation of Transmodel undertaken within the NeTEx project has contributed significantly to this new edition of Transmodel.

In addition to the eight Parts of this European Standard an informative Technical Report (Public Transport – Reference Data Model – Informative Documentation) is also being prepared to provide 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 all the eight parts are completed.

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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.

0 Introduction

0.1 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 organization, and also to connecting applications between interworking organizations (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.

0.2 Use of the Transmodel Standard

This European Standard presents version **6.0** of the European Standard EN 12896, known as "Transmodel". Transmodel **6.0** is a reference standard which provides a conceptual data model for use by organizations 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:

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

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

For an organization within the public transport industry wishing to specify, acquire and operate information systems, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the organization. This will enable the organization to specify its database structures and/or its system interfaces, in such a way that separate modules can be openly tendered but will still integrate easily. The organization also has a greater likelihood that information exchange interfaces with external organizations will be easily achieved.

For an organization wishing to design, develop and supply information systems for the public transport industry, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the product suite. This will enable the organization 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 complex model, and 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 management system, or a particular organizational boundary, as between two connecting transport operators.

For such situations, Transmodel provides a wider setting and a starting point. The specific elements of Transmodel have to 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 of 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.

0.3 Applicability of the Transmodel Standard

0.3.1 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 organization's 'information architecture';

— specification of a database;

— specification of a data exchange interface.

0.3.2 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.

An information architecture made up of independent modules with well-defined interfaces is easier to maintain. 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 organizational 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 organization. Technological changes in communications and computing are continuously bringing forward new opportunities for evolving the systems supporting the business.

0.3.3 Specification of a database

At a more technical level, an organization'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.

0.3.4 Specification of an interface

Public transport organizations may require different applications to exchange data with each other. Also, public transport organizations may exchange data with other organizations. 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.

0.4 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 data domains, and which 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 data domains as described in the normative part of the document: description of the network, versions/validity/layers, tactical planning components, vehicle scheduling, driver scheduling, schedules and versions, rostering, personnel disposition, operations monitoring and control, passenger information, fare collection, management information, multi-modal operation, multiple operators' environment;

— alternatively, the corresponding UML diagrams as presented in this document.

The level 2 conformance statement shall be presented as a table in which the data concepts used in the specification are described as:

— "Unmodified": concepts in the specification which have the same definition, properties and relationships as in the corresponding Transmodel domain;

— "Modified": concepts in the specification which are similar to a Transmodel concept but which differ in the details of certain attributes and/or relationships (e.g. attributes added);

— "Alternative": concepts or groups of concepts in the specification which model the same concepts as Transmodel but in a significantly different way;

— “Additional”: concepts in the specification which are not drawn from Transmodel;

— “Omitted”: concepts in Transmodel which are not used in the specification.

0.5 Transmodel origins

0.5.1 ENV 12896

The prestandard ENV 12896 was prepared by the work area Transmodel of the EuroBus project (1992-1994) and by the DRIVE II task force Harpist (1995). The EuroBus/Transmodel and Harpist kernel team was established as a subgroup (SG4) of CEN TC278 Working Group 3 (WG3) and led by TransExpert (F). The results of these projects were based upon earlier results reached within the Drive I Cassiope project and the ÖPNV data model for public transport, a German national standard. The prestandard reflected the contents of deliverable C1 of the Harpist task force, published in May 1995, with modifications resulting from the discussion process in CEN TC278/WG3 between May and October 1995.

The different organizations that have technically contributed to the preparation of the prestandard ENV 12896 were the partners of EuroBus/Transmodel and the Harpist task force: Beachcroft Systems (UK), CETE-méditerranée (F), CTA Systems (NL), Ingénieur Conseil Bruno Bert (F), Koninklijk Nederlands Vervoer (NL), Leeds University (UK), Régie des Transports de Marseille (F), SNV Studiengesellschaft Verkehr (D), Stuttgarter Straßenbahnen AG (D), TransExpert (F), TransTeC (D) and VSN Groep (NL).

The sponsors of the project were the European Communities (EC, DG XIII, F/5, Drive Programme, 1992-94), the French Ministry of Transportation, the Dutch Ministry of Transportation and the German Federal Ministry of Research and Technology.

0.5.2 Titan

The EC project Titan concerned validation and further development of ENV 12896. The different organizations that have technically contributed to the Titan project were: CETE-Méditerranée (F), Üstra (D), OASA (GR), RATP (F), SLTC (F), Salzburger Stadtwerke AG (A), TransExpert (F), TransTeC (D), Synergy (GR), TRUST EEIG (D).

The sponsoring partner was the French Ministry of Transport (DTT/SAE). The project was co-funded by the European Communities and some of the partners, in particular the pilot sites – Lyon (F), Hanover (D) and Salzburg (A).

0.5.3 SITP and SITP2

The French-led project SITP (Système d'Information Transport Public) was sponsored by the French Ministry of Transport (Direction des Transports Terrestres – DTT), the companies Gemplus (F) and Setec ITS (F), and the Transmodel Users’ Support Team EEIG (F and D).

SITP built on the prestandard ENV 12896 (issued May 1997) and the results of the EC project Titan (1996-1998). SITP produced the extensions requested of ENV 12896; these were validated during 1999-2000. A successor project, SITP2, developed the standard further during 2001-2002.

0.5.4 CEN TC 278 WG 3 SG 4

During 2002-2003, CEN continued to convene SG4 of TC 278 WG3 to consider how Transmodel should be taken forward. It considered responses to previous drafts of Transmodel as well as the work of SITP/SITP2, the German VDV specifications, and a range of UK projects.

SG4 was led by the UK Department for Transport, with participants from VDV (D), RATP (F), HÜR (DK), Setec (F), TRUST E.E.I.G. (Transmodel Users' Support Team) (F and D) and Centaur Consulting (UK). This group completed the work required for Transmodel v5.1 to be adopted as EN 12896.

Related documentation can be found (in French) at http://www.billettique.fr/spip.php?rubrique18.

0.6 Reference to the previous version and other projects and documents

0.6.1 General

Transmodel was published in 2006 as Transmodel V5.1 under the number EN 12896. It has been the basis for the development of the SIRI, IFOPT and NeTEx standards and specifications.

0.6.2 SIRI

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 intend to consider the task to 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 taken into account in the relevant parts of Transmodel 6.0.

0.6.3 IFOPT

The project IFOPT has used EN 12896:2006 as an input to develop a logical data model for the fixed objects, relevant for public transport, in particular for stops and points of interest. IFOPT has established an implicit link to EN 12896:2006 and has been published as EN 28701.

0.6.4 NeTEx

The project NeTEx developed 2009-2013 standard interfaces between systems aiming at the exchanges of network topology and timetable data based on the models EN 12896:2006 and EN 28701.

One of the tasks of NeTEx was to bring together both models (Transmodel V5.1 and IFOPT). The result of this task is one single conceptual model covering the domains network topology, timing information and information on fares.

The part of Transmodel diagrams that relate to the scope of the NeTEx project have been modularised within NeTEx. In some cases extensions or enhancements of the model have taken place. In order to keep the coherence between the standards, the NeTEx *conceptual diagrams* have been incorporated in the present version of the Public Transport Reference Data Model, generally without changes. The informative Annex B clarifies the status of the changes in comparison to the NeTEx conceptual diagrams.

The *textual descriptions* of this present version of the Public Transport Reference Data Model rely on one hand on the textual descriptions as in Transmodel V5.1, and on the other hand on the new descriptions as in NeTEx – Parts 1 and 2 and 3. The informative Annex B indicates the sources of the textual description.

0.7 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 complete 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 (specializations);

— 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 NeTEx documentation.

0.8 Methodology for conceptual modelling

0.8.1 General

Notation UML 2 is object–oriented modelling notation and is used for describing (specifying, documenting and visualizing) the conceptual data model in Transmodel. The UML specification has proved efficient because it facilitates common understanding and use of conceptual data model.

Transmodel uses a notation that bears some features of UML 1 (or E/R conceptual modelling), in particular as regards the labelling of roles/relationship names.

The following section summarizes the UML features used in Transmodel and illustrates them with corresponding example diagrams. Diagrams in Transmodel documents are designed with the modelling tool Enterprise Architect version[1] 10.0 (EA).

0.8.2 Packages

Transmodel EA model is structured into main packages corresponding to the different parts (Part 1, Part 2, etc) containing sub-packages (models), which group classes according to a common functional objective. Specific packages "Explicit Frames" in the different parts are created and details of the models contained in them will be discussed in the relevant parts. The hierarchical modular structure is shown in Figure 1.

[1] A useful reference may be found at the following address:

http://www.sparxsystems.eu/resources/project-development-with-uml-and-ea/

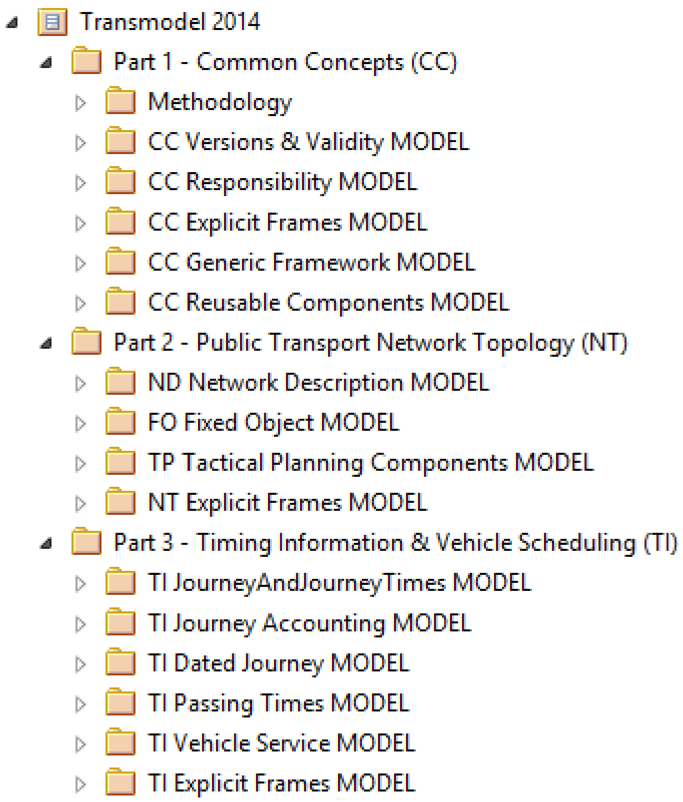

Figure 1 — Transmodel hierarchy of packages

A prefix in front of each package name indicates the part if the standard where this package has been introduced and described first, e.g.:

CC stands for common concepts

NT stands for network topology

ND stands for network description

FO stands for fixed objects

TP stands for tactical planning components

TI: timing information and vehicle scheduling

Etc

The classes are grouped together in a package for a specific task or functional purpose. Figure 2 shows content of the package “generic organization model”, which contains 8 classes. Each class has one and only one “home” package.

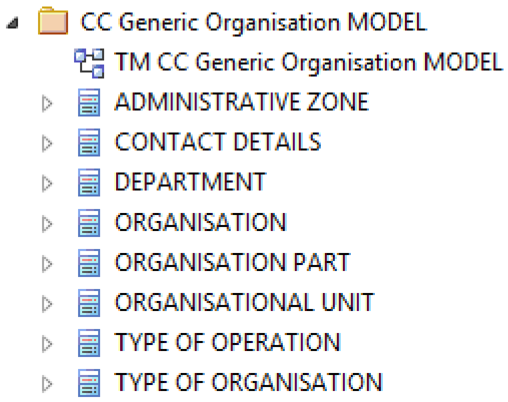

Figure 2 — Package content example

0.8.3 Class diagrams

Class diagram is a visual representation of the structure of a system by showing the system's classes, their attributes, operations and the relationships among the classes. Class diagram shows how objects in a system interact with each other. Figure 3 shows an example class diagram from the package “generic organization model” (described in the common concepts part).

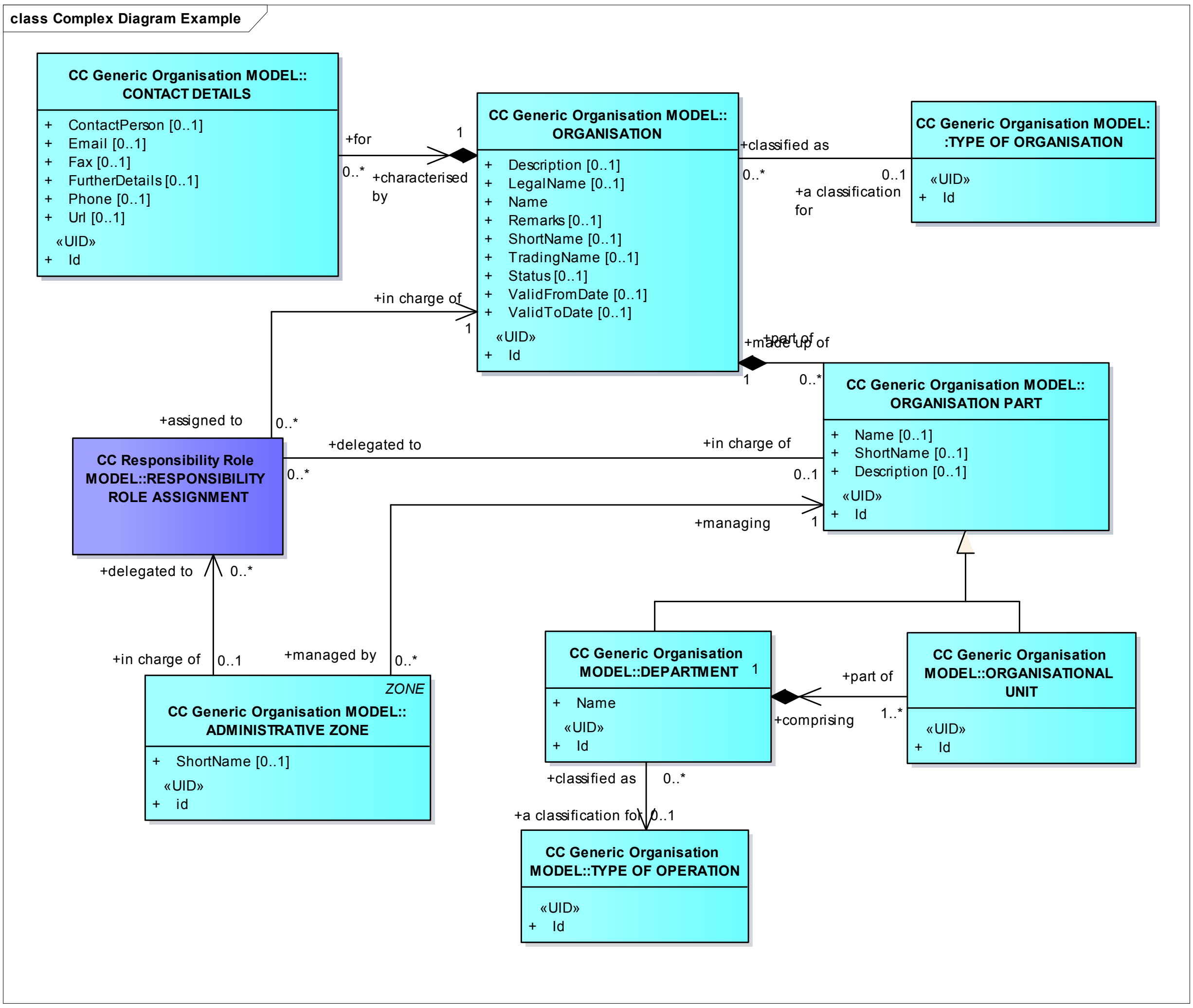

Figure 3 — Complex diagram example - Generic organization model

0.8.4 Classes and attributes

Classes are represented by boxes that are divided into three parts: the top part contains name of the class, the middle part contains the class's attributes and the bottom part shows possible operations that are associated with the class. In Transmodel only the top and middle parts are used for class name and attributes, respectively.

Figure 4 shows a class diagram containing a single class ORGANIZATION with its attributes.

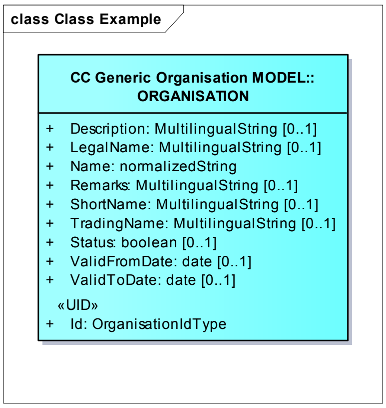

Figure 4 — Class example - ORGANIZATION

Table 1 describes some of the elements from the class “ORGANIZATION”:

Table 1 — Elements in the class ORGANIZATION

Notation	**Semantics**
CC Generic Organization Model	Name of the package “Generic organization model”, described in the Common Concepts (CC) part.
ORGANIZATION	Name of the class “ORGANIZATION” defined in the package “Generic organization model”.
Description: MultilingualString [0..1]	Attribute “Description” of type “MultilingualString” is optional (mutiplicity: 0 or 1) for the class “ORGANIZATION”
Name: normalizedString	Attribute “Name” is mandatory
‹‹UID››	Stereotype indicating that a particular attribute (in general named id) is a unique identifier for this class.
+	Scope of the attribute is “Public”: in general all attributes introduced are public
~	Scope of the attribute is “Package”

The attributes are indicated by at least their name. The full syntax is:

[Visibility] [Name [:Type] [Multiplicity]

Visibility (scope) is indicated by a:

— ‘+’ if visibility is public;

— ‘~’ if visibility is limited to its package.

Each class in Transmodel contains a UID (Unique Identifier) named “id”. The id guarantees uniqueness for instances of the class.

Visibility of attribute types (example: MultilingualString [0..1]) is subject to the layout of the diagram. However, attribute types are always described in the class documentation.

The multiplicity indicates whether the attribute is:

— Optional: marked as [0..1] or;

— Mandatory: marked as [1] (or omitted).

Figure 5 shows a class diagram with three classes. The two (internal) classes LOCATION and LOCATING SYSTEM are defined in the package "location model", while the (external) class POINT is defined in another package called "generic point and link model".

For internal classes the package name is not mentioned in front of the class names.

The class POINT is inserted as a link from another (external) package named "generic point and link model".

For the classes defined in external packages, the package name appears as a stereotype in front of the class name (e.g. generic point and link model:: POINT). Attributes of external classes are hidden.

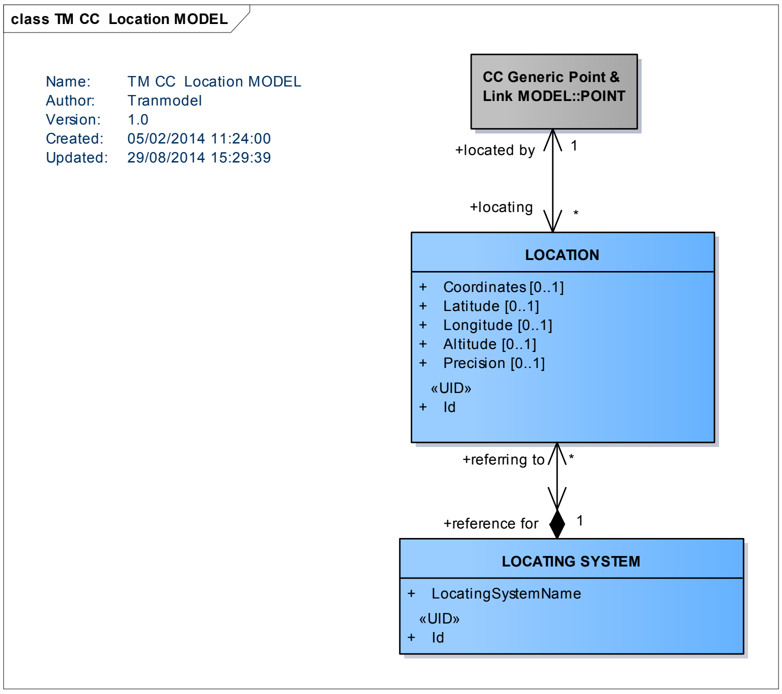

Figure 5 — Simple diagram example

Table 2 describes some elements of the class diagram.

Table 2 — Elements in a class diagram

Notation	Semantics
Location Model::LOCATION	Internal class “LOCATION” defined in the package “location model”
Generic Point and Link Model:: POINT	Class “POINT” linked from the external package “generic point and link model”
located by	Role name “located by” for the class POINT, which means: “each POINT is located by”
1	Multiplicity of the class POINT
locating	Role name “locating” for the class LOCATION, which means “each LOCATION is locating”
*	Multiplicity of the class LOCATION

The associations on the diagram present the following relationships between the classes LOCATION, POINT and LOCATING SYSTEM:

— a LOCATION is locating one and only one POINT;

— a POINT may be located by many LOCATIONs;

— a LOCATION is referring to one and only one LOCATING SYSTEM.

This means in particular that each POINT may be located through different types of LOCATIONs depending on the LOCATING SYSTEM.

In a class diagram, multiple classes can be in specific relation to each other. Different notations are used for different types of relationships. In the following subsections relationship types relevant for Transmodel are explained.

0.8.5 Association relationships

Association is the general relationship type between classes represented by a solid line connector. The connector may include role names at each end, cardinality (multiplicity), direction (arrowheads) and constraints. A relationship can be named to describe the nature of the relationship between the two classes.

Figure 5 shows a class diagram with two associations; one general association relationship and one composite association relationship. Each side of the relationship connector has a role name and a multiplicity (cardinality) number.

0.8.6 Reflexive association relationship

A reflexive (also called recursive) relationship is represented by a solid line connector that connects a single class to itself.

Figure 6 shows a class with reflexive relationship named “is adjacent to”. A topographic place in PT network may have zero or many adjacent topographic places, which in turn may be adjacent to other topograhic places as well.

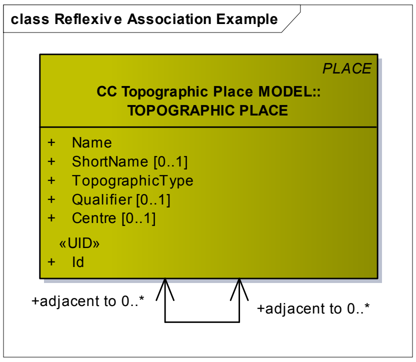

Figure 6 — Reflexive association example

0.8.7 Composition association relationship

A composition relationship is a strong form of association represented by a solid line with a filled (black) diamond at the relationship end, which is connected to the composite class. In a composition relationship component class depends on the composite class. If a composite object is removed, the component object is also removed.

Figure 5 shows a composition relationship between the classes LOCATION and LOCATING SYSTEM, which means:

— a LOCATING SYSTEM is a reference for zero or more (*) LOCATIONs;

— a LOCATION shall be referring to one and only one (1) LOCATING SYSTEM.

0.8.8 Aggregation association relationship

An aggregation relationship is a weak form of association represented by a solid line with a white diamond at the relationship end, which is connected to the aggregate class. In an aggregation relationship an aggregate class represents an assembly of component classes. If one aggregate object is removed, the component object may still exist.

Figure 7 shows an aggregate relationship between two classes, which means:

— a TIME BAND may be (optional relationship) in one GROUP OF TIME BANDS or A TIME BAND is in “0 or 1” GROUP OF TIME BANDS;

— a GROUP OF TIMEBANDS is made up of “0 to n” TIME BANDs.

This means in particular that a GROUP OF TIMEBANDs may still exist even if a TIME BAND is suppressed.

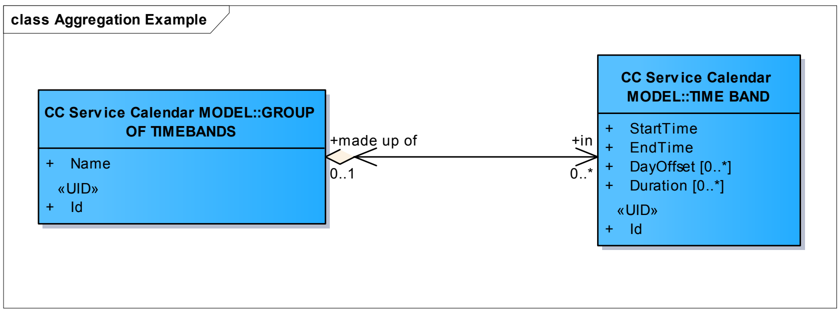

Figure 7 — Aggregation example

0.8.9 Generalization association relationship

A generalization relationship indicates inheritance and is represented by a solid line with a white arrowhead at the relationship end. In the generalization relationship, a child class is based on a parent class. The child class captures and inherits attributes and relationships in the parent class. Child classes define only the attributes and relationships that are distinct from the parent class. Generalization relationships do not have names.

Figure 8 shows generalization relationship where "AUTHORITY and OPERATOR inherit from ORGANIZATION".

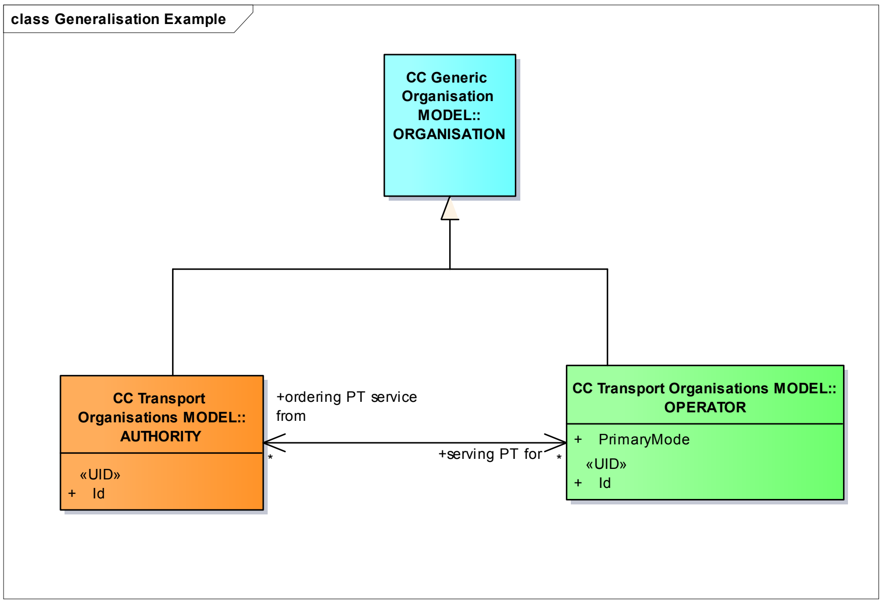

Figure 8 — Generalization example

The "parent class ORGANIZATION" may also appear on the diagram in the upper right corner of the corresponding class(es):

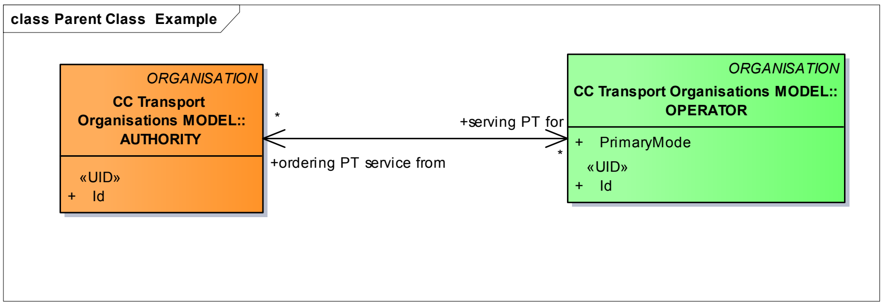

Figure 9 — Parent class example

0.9 Summary of rules for Transmodel representation

Rules for use of classes are shown in Table 3.

Table 3 — Rules for the use of classes

Rule	Description
R1.1	Class names in class diagrams are written in UPPER CASE LETTERS.
R1.2	External class in a class diagram is named with its home package followed by double colon and its class name. Pattern is HOME-PACKAGE::CLASS-NAME.
R1.3	External class in a class diagram does not show its attributes.

Rules for use of **role names** in relationships are shown in Table 4.

Table 4 — Rules for the use of role names in relationships

Rule	Description
R2.1	Role name and multiplicity (cardinality) number belonging to a class are displayed on side of the class.
R2.2	Role names may be verbs in the present continuous/progressive tense form. Examples are: “containing”, “locating”, “including”, “composing”, “referring to”, etc.
R2.3	Role names may be verbs in the passive tense form. Examples are: “contained in”, “located by”, “included in”, “composed of”, “referenced in”, etc.
R2.4	Pair of role names of the two connected classes shall be mutual in meaning. Examples are: “containing/contained in”, “locating/located by”, “including/included in”, “composing/composed of”, “referring to/referenced in” etc.
R2.5	If a relationship between classes is named then role names are not necessary.
R2.6	If role names are used then a relationship name is not necessary.

Rules for use of **multiplicity** (cardinality) in relationships are shown in Table 5.

Table 5 — Rules for the use of multiplicity / cardinality in relationships

Rule	Multiplicity	Description
R3.1	1 or 1..1	“exactly one”
R3.2	* or 0..*	“zero or more”, “none to many”
R3.3	0..1	“zero or one”
R3.4	1..*	“at least one”, “one or many”
R3.5	n..m	“at least n, but no more than m”

1 Scope

1.1 General scope of the Standard

The main objective of this European Standard is to present the Public transport reference data model based on:

— the Public transport reference data model published 2006 as EN 12896 and known as Transmodel V5.1;

— the model for the identification of fixed objects for Public transport, published in 2009 as EN 28701 and known as IFOPT;

incorporating the requirements of

— EN 15531-1 to 3 and CEN/TS 15531-4 and CEN/TS 15531-5, *Service interface for real-time information relating to public transport operations (SIRI)*;

— CEN/TS 16614-1 and CEN/TS 16614-2, *Network and Timetable Exchange (NeTEx).*

in particular the specific needs for long distance train operation.

Particular attention is drawn to the data model structure and methodology:

— the data model is described in a modular form in order to facilitate understanding and use of the model;

— the data model is entirely described in UML.

In particular, a reference data model kernel is described, referring to the data domain:

— network description: routes, lines, journey patterns, timing patterns, service patterns, scheduled stop points and stop places.

This part corresponds to the network description as in Transmodel V5.1 extended by the relevant parts of IFOPT.

Furthermore, the following functional domains are considered:

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

— passenger information (planned and real-time);

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

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

— management information and statistics (including data dedicated to service performance indicators).

— driver management:

  — 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).

The data modules dedicated to cover most functions of the above domains will be specified. Several concepts are shared by the different functional domains. This data domain is called "Common Concepts".

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: whether it is 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 in order 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, which 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) have to be combined. An example of such a situation is the mapping of the public transport network on the road network.

The geographical data files (GDF) standard (developed within ISO TC204 WG3) includes a data model for the geographical description of road networks. It provides a basic network description upon which various layers describing specific aspects of the use of the infrastructure network may be placed. Public transport companies or providers of other associated services may want to couple their applications and information basis to geographical information. In this case, the exchange of data between a geographical information system and the public transport applications concerned will become necessary. For this purpose, an interface between the GDF data model and the relevant part of the topological network representation in the reference data model for public transport, already drafted in EN 12896:2006 and GDF v5.0, is under development within ISO TC204 WG3 to be integrated into the next version of GDF.

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 particular methods and algorithms applied by the different software systems.

1.2.3 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 utilization 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 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.

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 corresponding application systems are available. Specific types of passenger queries may be related to fares, where the relevant information elements are included in the fare collection 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.

1.2.4 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 taken into account 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 for sale 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 in order to form sales packages to be sold to passengers. Controls may be applied to these travel documents to validate the utilization 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 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), thus providing a monitoring of these resources.

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. delay thresholds, incidents);

— 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); and

— follow-up and quality statistics.

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

1.2.6 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 company's specific data model and for which information is recorded in a database, whether for the company management or for other organizational 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;

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

— recordings of the actual use of the service offer, i.e. actual passenger rides and trips.

1.2.7 Multi-modal operation aspects

All mass public transport modes are taken into account by this standard, including train, bus, coach, metro, tramway, ferry, and their submodes. It is possible to describe airports and air journeys, but there has not been any specific consideration of any additional requirements that apply specifically to air transport.

1.2.8 Multiple operators' environment aspects

The standard takes into account 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 organizational 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 associate 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 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 in order to obtain a balanced work share among the driving personnel over the planning period, and to keep the resulting work time in harmonization 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 question, 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.

1.3 Particular scope of this document

The present European Standard entitled "Public transport - Reference data model – Common concepts" incorporates data structures used by all other data domains of Transmodel. It is composed of the following data packages:

— versions and validity;

— responsibility;

— generic framework;

— reusable components;

— explicit frames referring to generic data.

The data structures represented in this part are either generic patterns that may be explicitly reused in other domains (e.g. a generic model for version frames, a generic grouping mechanism, etc.) or are referenced by different other parts (e.g. service calendar model).

This document itself is composed of two normative parts:

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

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

and an informative Annex B, indicating the data model evolutions.

2 Normative references

Not applicable.