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Public Transport — Reference Data Model — Part 1 : Common Concepts

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Contents

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Foreword

This document (prEN 12896-1:2014, “Transmodel V6 - part 1”) has been prepared by Technical Committee CEN/TC 278, the secretariat of which is held by NEN.

This document is a working document.

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.

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of an identical text or by endorsement, at the latest by month 20xx, and conflicting national standards shall be withdrawn at the latest by month 20xx.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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 **6.0** 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 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.

For an organisation 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 organisation. This will enable the organisation 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 organisation also has a greater likelihood that information exchange interfaces with external organisations will be easily achieved.

For an organisation 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 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 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 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 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.

Applicability of the Transmodel Standard

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.

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 on-line 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 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.

Transmodel origins

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 organisations 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.

Titan

The EC project Titan concerned validation and further development of ENV 12896. The different organisations 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).

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 ENV12896; these were validated during 1999-2000. A successor project, SITP2, developed the standard further during 2001-2002.

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 EN12896.

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

Reference to the previous version and other projects and documents

Transmodel was published in 2006 as Transmodel V5.1 under the number EN12896. It has been the basis for the development of the SIRI, IFOPT and NeTEx standards and specifications.

SIRI

The project SIRI has used EN12896:2006 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 EN12896, 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.

IFOPT

The project IFOPT has used EN12896:2006 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 EN12896:2006 and has been published as EN28701:2009.

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 EN12896:2006 and EN28701:2009.

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 Appendix 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 & 2 & 3. The informative Appendix B indicates the sources of the textual description.

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 (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 NeTEx documentation.

Methodology for conceptual modelling

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 summarises 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).

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/

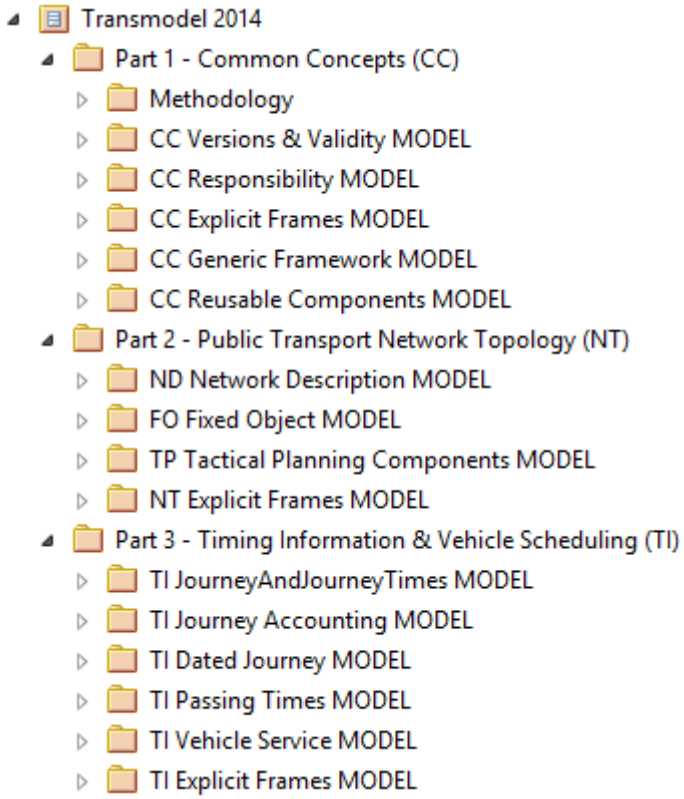

Figure 1 - Transmodel Hierarchy of Packages

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 & 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 Organisation Model”, which contains 8 classes. Each class has one and only one “home” package.

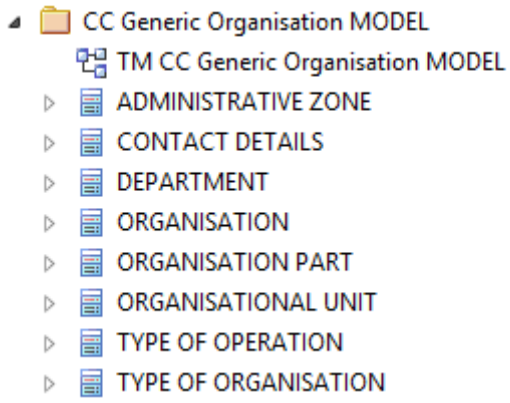

Figure 2 - Package Content Example

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 Organisation Model” (described in the Common Concepts part).

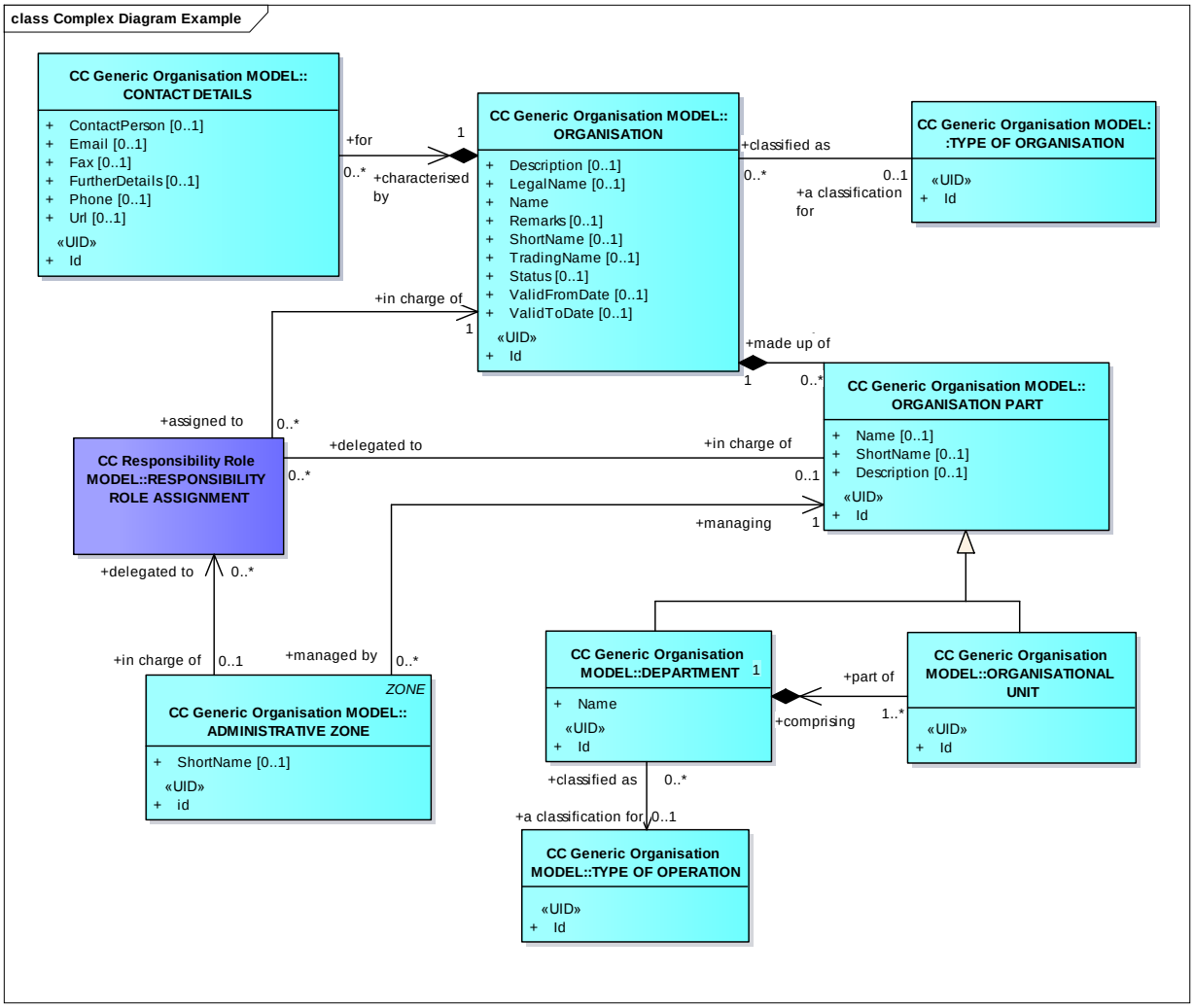

Figure 3 - Complex Diagram Example - Generic Organisation model

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 ORGANISATION with its attributes.

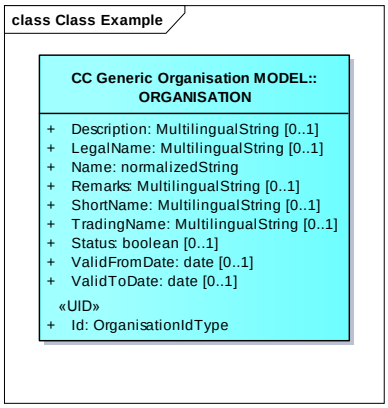

Figure 4 - Class Example - ORGANISATION

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

Table 1 : Elements in the class ORGANISATION

Notation	Semantics
CC Generic Organisation Model	Name of the package “Generic Organisation Model”, described in the Common Concepts (CC) part.
ORGANISATION	Name of the class “ORGANISATION” defined in the package “Generic Organisation Model”.
Description: MultilingualString [0..1]	Attribute “Description” of type “MultilingualString” is optional (mutiplicity: 0 or 1) for the class “ORGANISATION”
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 & 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 & 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 & Link Model :: POINT). Attributes of external classes are hidden.

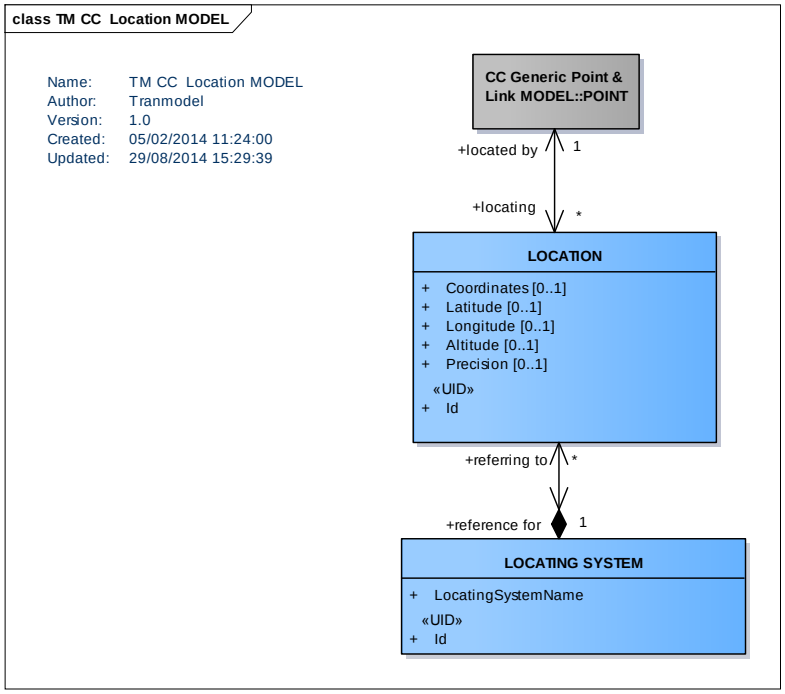

Figure 5 - Simple Diagram Example

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 & Link Model:: POINT	Class “POINT” linked from the external package “Generic Point & 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.

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.

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.

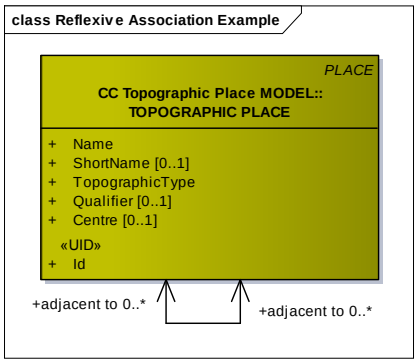

Figure 6 - Reflexive Association Example

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 must be referring to one and only one (1) LOCATING SYSTEM.

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.

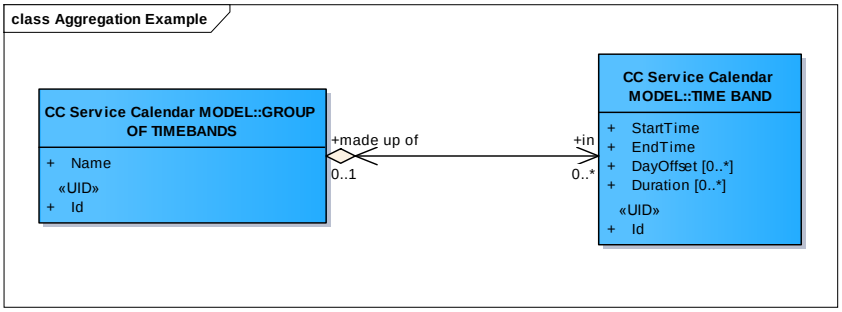

Figure 7 - Aggregation Example

Generalisation association relationship

A generalisation relationship indicates inheritance and is represented by a solid line with a white arrowhead at the relationship end. In the generalisation 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. Generalisation relationships do not have names.

Figure 8 shows generalisation relationship where “AUTHORITY and OPERATOR inherit from ORGANISATION”.

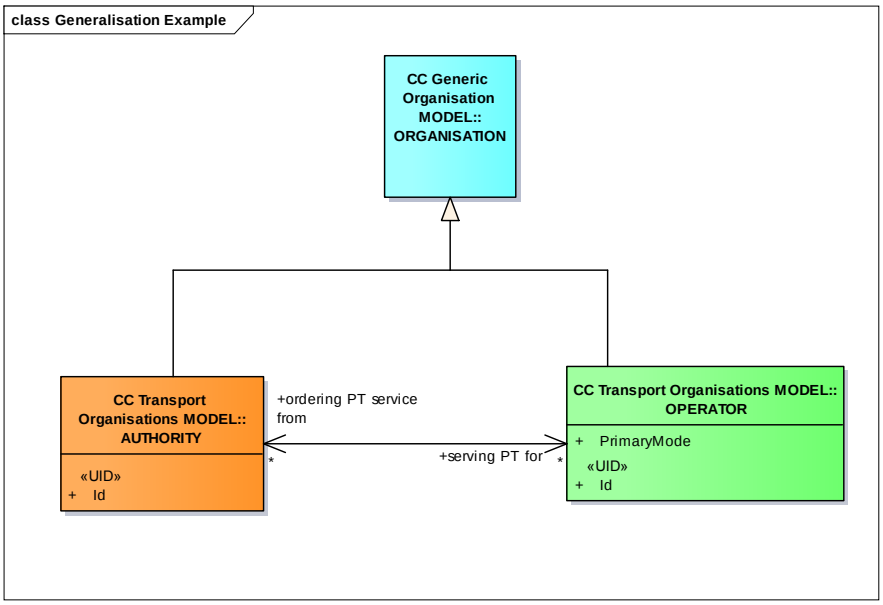

Figure 8 - Generalisation Example

The “parent class ORGANISATION” may also appear on the diagram in the upper right corner of the corresponding class(es):

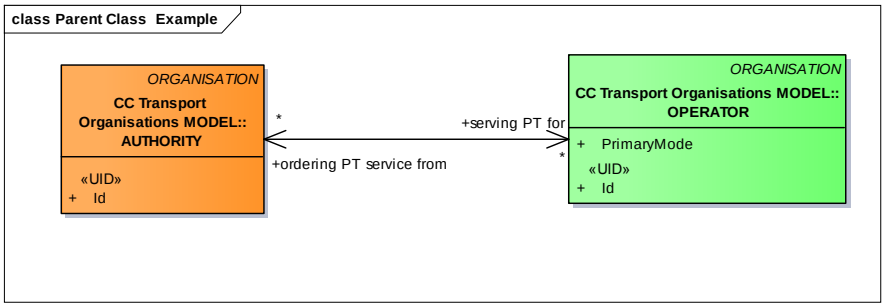

Figure 9 - Parent Class Example

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 must 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 the present standard is to present the Public Transport Reference Data Model based on:

- the Public Transport Reference Data Model published 2006 as EN12896 and known as Transmodel V5.1,
- the model for the Identification of Fixed Objects for Public transport, published 2009 as EN 28701and known as IFOPT,

incorporating the requirements of

- EN15531-1 to 3 and TS15531-4 and 5: Service interface for real-time information relating to public transport operations (SIRI),
- TS16614-1 and 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 EN12896:2009 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 utilisation 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 utilisation 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 is 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 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;
- 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 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 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
- Appendix 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 Appendix B, indicating the data model evolutions.

2 Normative references

[1] EN 12896:2006: Public Transport Reference Data Model (Transmodel V5.1)

[2] EN 12701:2009: Identification of Fixed Objects for Public Transport (IFOPT)

[3] TS16614-1; Network and Timetable Exchange — Part 1: Network Topology (NeTEx)

[4] TS16614-2, Network and Timetable Exchange — Part 2: Timing Information (NeTEx)

[5] EN15531-1 to 3 and TS15531-4 and 5 — Service interface for real-time information relating to public transport operations (SIRI)

[6] ISO/IEC 19501-1:2002, Unified Modelling Language (UML) – Part 1: Specification

[7] EN12896-2:2015. Public Transport - Reference Data Model - Part 2: Public Transport Network (Transmodel V6)

[8] EN12896-3:2015. Public Transport - Reference Data Model - Part 3: Timing Information and Vehicle Scheduling (Transmodel V6)

3 Terms and definitions

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

3.1 attribute

property of an entity

3.2 conceptual data model

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

3.3 conceptual level

in the context of data modelling, the conceptual data model

3.4 database

collection of data; often used in the sense of the physical implementation of a data model

3.5 data domain

data structure (in this European Standard, a part of the Reference Data Model for Public Transport) made up of data related to each other, through the fact that there is a functional area or group of functions using this data set as a whole

3.6 data model

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

3.7 entity

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

3.8 fare management

all activities related to the collection of money from passengers

3.9 function

activity. In this European Standard, a sub-activity of a functional area

3.10 functional area

arbitrarily defined set of activities, used, in this European Standard, to define the objectives and limits of the data model

3.11 GDF

standard defining the contents and format of Geographical Data Files, used for the description, classification and encoding of road networks and road environment features

3.12 GDF database

database containing geographical information on the road network in a particular application area, possibly including information on the location of public transport points, links and services (routes)

3.13 interoperability

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

3.14 logical data model

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

3.15 logical denormalized model

relational data model that is not fully normalized, i.e. does not completely follow the normalization rules and thus may be redundant

3.16 logical level

in the context of data modelling, the logical data model

3.17 management information

all activities allowing the company management to collect the information necessary to meet problem-solving needs. Data of operational systems are filtered and aggregated for this purpose, and made available to the user interactively, or in the form of pre-defined reports and summaries. Such functions are in principle related to all functional areas of a company, with particular reference to the management of statistical results

3.18 object-oriented data model

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

3.19 operations monitoring and control

all activities related to the transportation process, i.e. real-time functions related to the driving and transportation of passengers according to given instructions, including the monitoring of the driving process and its control in case of deviations, as well as all activities that support the driving process (traffic light priority, track switching, bay selection, advance/delay advice etc.). Such functions are often assisted by computer-aided tools, known as Automated Vehicle Monitoring (AVM)

3.20 passenger information

all activities related to informing the users either about the planned or about the actual transportation services

3.21 personnel disposition

all activities related to the mid term and short-term management of drivers

3.22 real-time control

see Operations monitoring and control

3.23 relational data model

type of logical data model giving the information as series of tables (relations) and attributes. It must have the following characteristics: 1. all attribute values are atomic, 2. all "tuples" (rows/occurrences) are distinct, 3. no part of the primary key may be null, 4. foreign key values must correspond to an existing primary key in another relation or be null

3.24 scheduling

see Tactical Planning

3.25 tactical planning

all activities related to the tactical planning of transportation, split into vehicle scheduling, driver scheduling, rostering

4 Abbreviations

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.
PT	Public Transport.
PTO	Public Transport Operator.
SIRI	Service Interface for Real-time Information.
UML	Unified Modelling Language.
URI	Uniform Resource Identifier.
URL	Universal Resource Locator.
VDV	Verband Deutscher Verkehrsunternehmen (D).
WGS	World Geodetic Standard.

5 Common Concepts Domain

5.1 Introduction to the Common Concepts

This section describes the data domain called Common Concepts (CC) of Transmodel that is shared by all Transmodel functional parts. This data domain has three different aspects.

Common mechanisms: provides mechanisms for common aspects of all Transmodel objects that are needed for effective data management and exchange, such as versioning, validity, grouping, and responsibility tracking. The mechanisms, implemented through common super types and containers, and specialized in the various Transmodel functional modules, can be understood and implemented uniformly for all Transmodel components, rather than on an ad-hoc basis. This part splits into:

Versions & Validity model: describes the successive versions of data elements and the conditions to be attached to elements to precisely know when they should be used:

- Generic Entity Model
- Generic Version Model
- Generic Version Frame Model
- Generic Validity Model
- Generic Delta Model

Responsibility model: describes the type of responsibility or role the different organisations may have over the data:

- Generic Responsibility Model
- Generic Responsibility Role Model
- Generic Organisation Model

Generic framework: describes a number of generic objects and representational mechanisms that are not specific to transport but which are specialized or used by Transmodel transport related objects. This part splits into:

- Generic Location Model
- Generic Grouping Model
- Generic Point & Link Model
- Generic Point & Link Sequence Model
- Generic Zone and Feature Model
- Generic Layer Model
- Generic Projection Model
- Generic Accessibility Model
- Generic Place Model

Reusable Components: Certain common low-level components, for example TRANSPORT MODE, SERVICE CALENDAR, DAY TYPE, etc. are not specific to any particular functional part of Transmodel but are widely used in several different functional areas. Such components are defined centrally as part of the Common Concepts.

Reusable Components model: describes generic and reusable objects specific to public transport.

- Transport Mode Model

- Transport Submode Model
- Service Calendar Model
- Availability Condition Model
- Topographic Place Model
- Transport Organisations Model
- Additional Organisation Model
- Generic Equipment Model
- Actual Vehicle Equipment Model
- Vehicle Type Model
- Vehicle Passenger Equipment Model
- Facility Model
- Train Model
- Schematic Map Model
- Notice Model
- Service Restriction Model
- Alternative Name Model

Explicit Frames model describes the mechanisms useful to build coherent sets of versioned data. Part 1 presents explicit frames for data referring to the Common Concepts domain.

The present document is structured according to the model structure as shown above.

5.2 Versions & Validity

5.2.1 Introduction

Information systems for public transport operation typically require the definition of many different types of data, produced by different organisations or operating divisions, and are subject to a multistage lifecycle from planning through to production and realization in real-time. These data are continuously evolving and are subject to a variety of different validity conditions as to when they are current, and as to which data is needed for a particular purpose. Transmodel includes uniform version and validity mechanisms to address these requirements; the mechanisms are part of the Transmodel framework and that can be applied to all data elements throughout their various lifecycles.

The **versioning** model allows successive versions of data elements to be identified, allowing the fine-grained identification of just those elements that have changed, and the auditing of changes. All references can also be versioned so that for composite data sets that comprise a number of related elements it is possible to be precise as to which version of each element is required. The versioning model also allows schemes where the responsibility for maintaining different parts of the data is split among several organisations and systems, each providing its partial data separately. In this case, references to external data are not explicitly versioned, but instead the correct version of the different referenced entities are deduced from validity conditions when combining the data.

A **version frame** mechanism provides a versionable container that allows a coherent set of related elements to be managed as a set or exchanged. Since pragmatically actual systems that contain data to be exchanged differ in the sophistication of their support for versioning, the mechanisms are designed so that they may be used either just in a course-grained manner at the level of the whole data set, or if support is available, in a more powerful way at the level of the individual data element.

The **validity** model allows conditions to be attached to elements as to when they are current or the circumstances in which they should be used. Validity conditions can be attached to specific elements and also, through version frames, to whole sets of objects so that it is possible to be explicit about the exact conditions governing the coherence and relevance of data. This makes it possible for systems to express the currency conditions for data they require and to describe the validity of data that is returned by a system.

5.2.2 Version & Validity – Model overview

The versioning mechanisms are part of the core Transmodel framework, and are provided by a common set of modules that are referenced by all other Transmodel modules. The fundamental models are described in detail in the following sections.

- The ENTITY model describes the Transmodel basic object structure.
- The VERSION model adds in version control elements and attributes. VERSION FRAMES group multiple instances of versions of entities that make up a coherent version set .
- The RESPONSIBILITY model adds in metadata for ENTITY ownership and roles for data management.
- The VALIDITY package defines generic validity conditions for use in the framework.
- The DELTA package refers to the detailed changes of a given ENTITY IN VERSION from one VERSION to the next one.

5.2.3 Generic Entity

5.2.3.1 Generic ENTITY – Conceptual Model

The entity ENTITY represents an actual object instance of data present in an exchanged data set. An ENTITY may represent any instance of a CLASS IN REPOSITORY, corresponding to an instance of the object as stored in a specific database. All Transmodel objects are formal descendants of ENTITY.

CLASSes IN REPOSITORY can be grouped into sets of coherent versions using a CLASS IN FRAME. CLASS IN REPOSITORY and CLASS IN FRAME are part of the Transmodel conceptual model and help to make clear the difference between classes of objects effectively present in a repository (CLASS IN REPOSITORY) and classes of objects grouped to be managed as a coherent set (e.g. to be exchanged). Instances of objects are ENTITies, more precisely a repository may contain many versions of an ENTITY. The TYPE of ENTITY defines a set of sub-categories that can be used to make arbitrary classifications of a specific ENTITY. Thus it is really a “category of ENTITY” rather a class or type. TYPE OF ENTITY is an abstract mechanism that is present in Transmodel to indicate the possibility of categorization. Actual Transmodel objects generally have a more specific categorization, e.g. TYPE OF POINT, etc. that specifies a category that is specific to the ENTITY type.

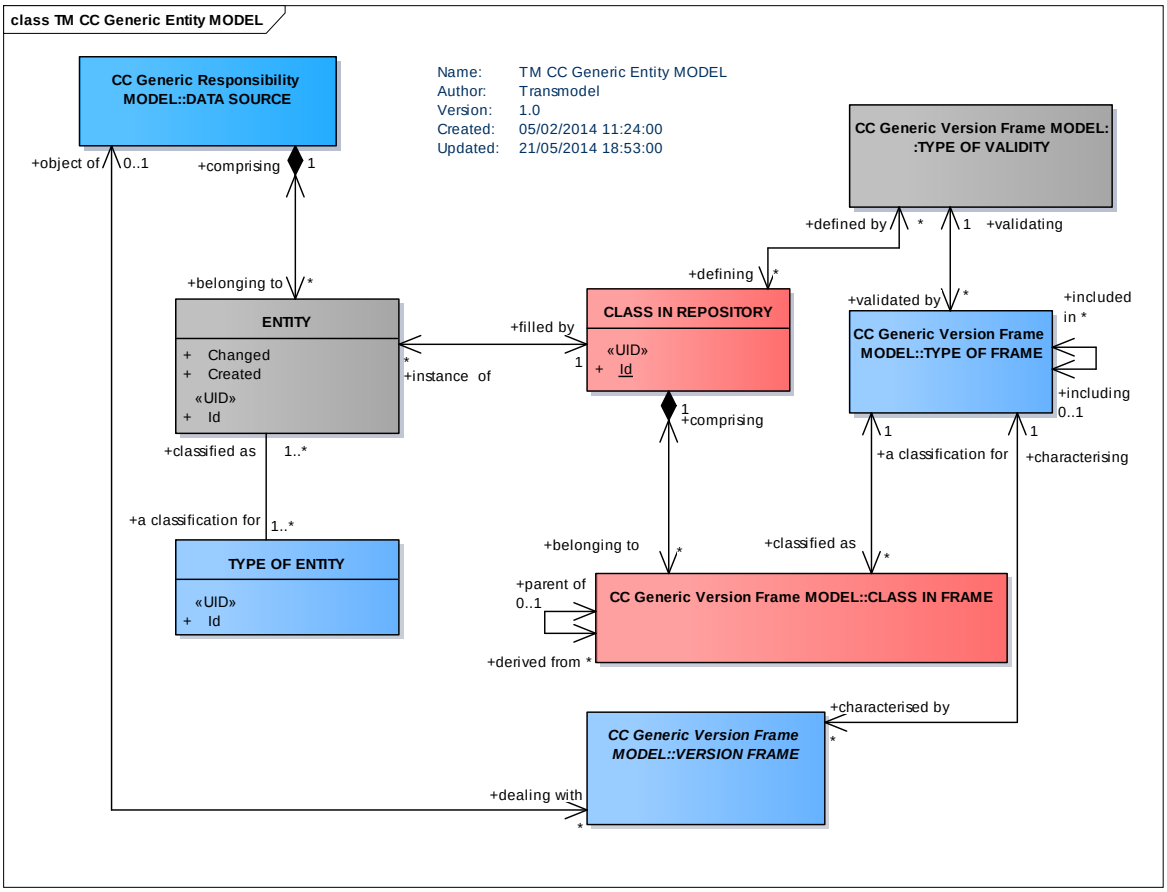

Figure 10 — Generic Entity – Conceptual Model

5.2.4 Generic Version

The modelling of versions in Transmodel is in effect a version description model, not a model of a version management system. However, it is allows for fine grained versioning, and uses a uniform and generic approach that can be used for any time of complex data object. This versioning mechanism is available on all Transmodel elements, but not mandatory, thus allowing legacy systems without any versioning mechanism to use Transmodel simply by omitting the versioning attributes. In practice versioning will be often just done at an aggregate level and not that of the individual data instance.

Public transport data are in a permanent process of evolution; schedule and operational data typically undergo a regular cycle of planning, distribution and execution, whilst reference data describing the network, such as stop and line data, will change if the network or physical environment is modified. It is therefore necessary to be able to organize data elements to support such a lifecycle, with multiple versions of a given element being in use concurrently, and different assemblies of data referencing different versions for different purposes. This is achieved in Transmodel with VERSIONs and VERSION FRAMEs.

5.2.4.1 Generic VERSION – Conceptual Model

Each state of an object, or a set of objects, is called a VERSION. VERSIONs of an object may be consecutive or competitive. *Consecutive* VERSIONs describe the successive states of an object, whilst *competitive* VERSIONs describe an alternative version to use in particular circumstances, i.e. under specific VALIDITY CONDITIONs (cf. Generic VALIDITY – Conceptual Model below). For example, there may be for a single line at the same time competitive versions of the line; a simulated line (for planning work or for study), and the operational line for particular operating periods.

The VERSION describes the identifier and purpose of a version state. The actual version state of the objects is described by an instance of ENTITY IN VERSION. Thus in a given repository or documents there will be a single instance of each Transmodel ENTITY and one or multiple instances of ENTITY IN VERSIONs for that ENTITY; these will be tried together by a common identifier and differentiated by distinct VERSION identifiers. For example an instance of the entity SCHEMATIC MAP may have multiple SCEMATIC MAP IN VERSION instances, etc.

The purpose of the VERSION may be categorized with an arbitrary classification using a TYPE OF VERSION, for example planning, scheduled, operational, etc.

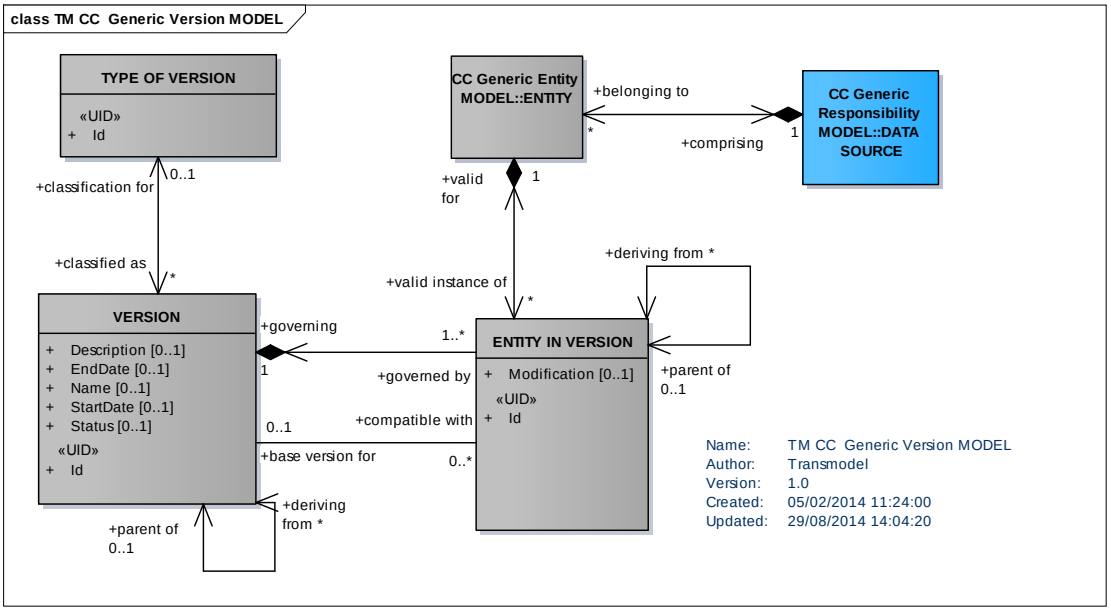

Figure 11 — Generic Version – Conceptual Model

5.2.5 Generic Version Frame

5.2.5.1 Generic VERSION FRAME – Conceptual Model

VERSION FRAMEs allow data to be managed and exchanged as a coherent version, that is a set of instances (ENTITies IN VERSION) of different entity types that are consistent and correct as to referential integrity and other business semantics and so are suitable for use without extensive consistency checking, for example, by an importing application. A VERSION FRAME contains a list of specific versions of an entity, that is, instances of ENTITY IN VERSION.

The possibilities for including specific types of ENTITies in VERSION in a FRAME are limited by the generic rules set by a corresponding CLASS IN FRAME. All the classes that are allowed to be present in the frame are defined by the CLASS IN FRAME, and each frame is defined by its TYPE OF FRAME. VERSION FRAMEs may have common properties as regards validity. This is described by the TYPE OF FRAME entity (e.g. vehicle schedules, network description for line versions, etc.). The main property of a TYPE OF FRAME is the purpose it is designed for.

Thus a particular VERSION FRAME, defined according to a TYPE OF FRAME, is usually limited by operational parameters: For example VERSION FRAME for network description of "*area West*" or for fare versions on "*tramway lines*", etc. When these limiting parameters are actual instances data, this may be described by instances of the VALIDITY CONDITION (cf. Validity Condition Conceptual Model below), related to the VERSION FRAME. For instance, a VALIDITY CONDITION may represent a TOPOGRAPHIC ZONE (*"area West")* or a VEHICLE MODE *("tramway"*).

A TYPE OF FRAME thus may be associated with a particular TYPE OF VALIDITY, which expresses a general validity environment. The TYPE OF VALIDITY will apply to any VERSION FRAMEs of that type. For instance, if the schedules designed for day types are to be distinguished from schedules planned for a particular operating day, different TYPEs OF VALIDITY, which will serve as a basis to select general validity rules, may specify this difference. Similarly, certain VERSION FRAMEs may be designed only for simulation purposes and be distinguished from production data, this classification being expressed with a different TYPE OF VALIDITY.

A TYPE OF FRAME may include other TYPEs OF FRAME, for which the validity rules and processes may be different. This is represented by a circular relationship on TYPE OF FRAME.

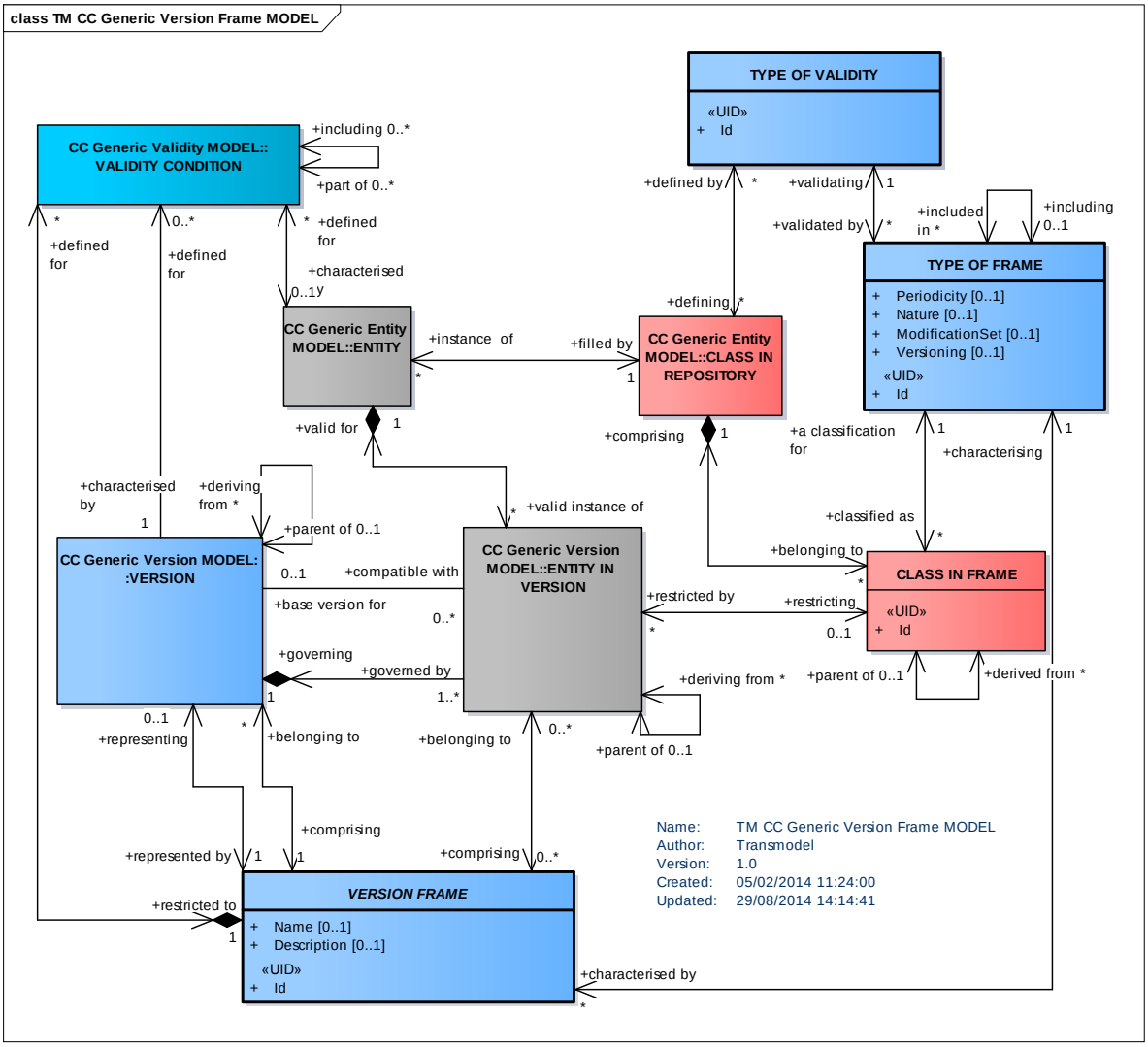

Figure 12 — Generic Version Frame – Conceptual Model

The VERSION FRAME itself is versioned, so that if any change is made to the contents of a frame to add, change or delete its entities, then a new version of the frame must be created..

For a defined group of object instances, there may be several (consecutive or competitive) VERSIONs of a VERSION FRAME. For example, the contents of a frame containing the stop points for a town will change as they are added, updated or deleted, so there will be successive versions of the same frame, or there may be

successive instances of a given VERSION FRAME for timetables reflecting successive changes to a given schedule. In summary:

- A given aggregation may undergo successive versions as the data evolves through its lifecycle, so there may be several *consecutive* VERSIONs of a VERSION FRAME.

- A given aggregation may represent an alternative to be used in particular conditions ,so there may be several *competitive* VERSIONs of a VERSION FRAME in which case a VALIDITY CONDITION must be attached to the frame to discriminate the conditions for use.

5.2.6 Generic Validity

5.2.6.1 Generic VALIDITY – Conceptual Model

An ENTITY, a VERSION or a VERSION FRAME may be associated with VALIDITY CONDITION, detailing under which conditions expressed e.g. by space- or time-related parameters a version is active or available.

Each VALIDITY CONDITION can consist of:

— a parameter (e.g. a start date);

— a type of application of this parameter (“for”, “from”, “until”, etc.).

A VALIDITY CONDITION parameter may be:

— a time-related parameter, which will be in general an instance of an ENTITY: OPERATING DAY, , PROPERTY OF DAY, DAY TYPE, TIME BAND, etc.;

— a VALIDITY TRIGGER (road works, rainy weather, until further advice, etc.), which will be activated thanks to a mechanism, an external output or a manual entry;

— Any other VALIDITY RULE PARAMETER.

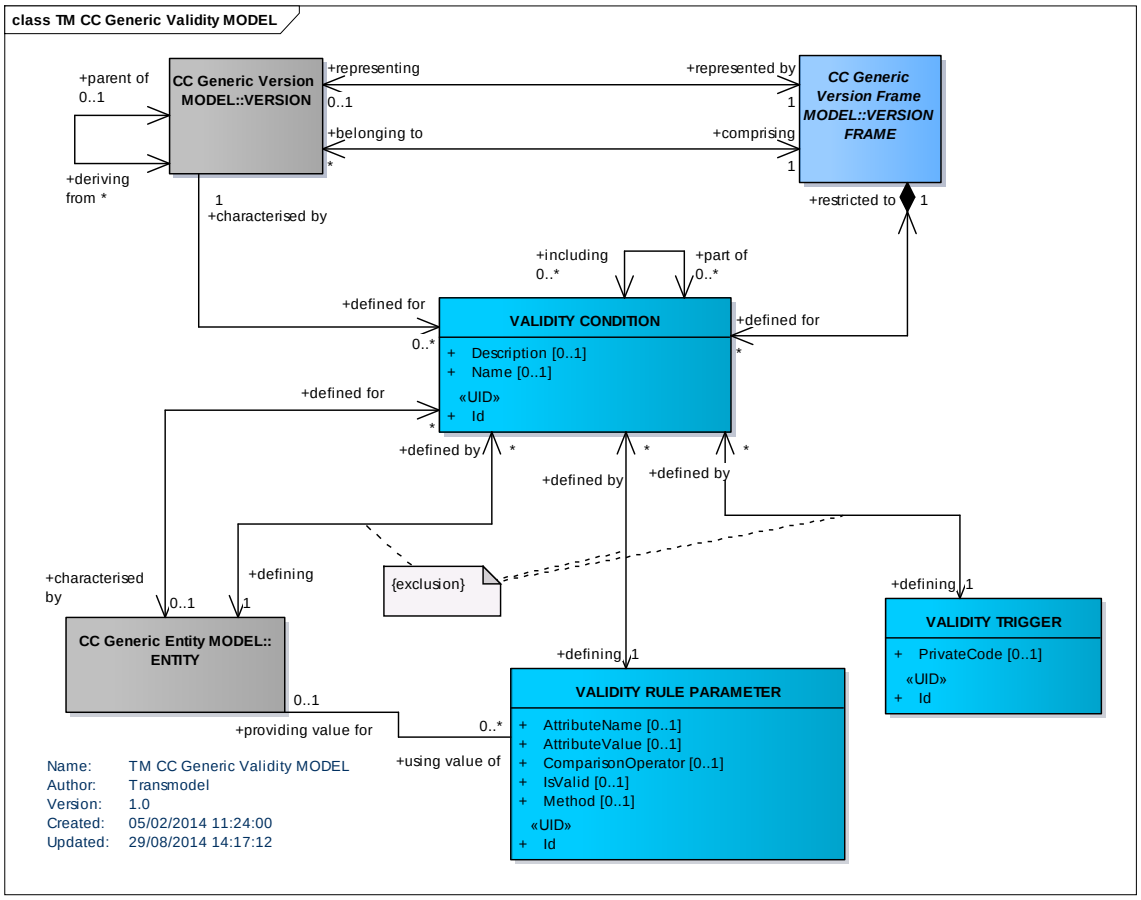

Figure 13— Generic Validity Model

5.2.7 Generic Delta Model

A data linked to a VERSION may be deriving (possibly with some modifications) from another. It may be of interest to record this inheritance, in particular when there are successive states of a data in different VERSIONs and that it is of interest to record the modifications. This is described by a circular relationship on ENTITY IN VERSION.

In a more detailed way, it may be of interest to record the values that are modified. This is described by the entity DELTA, which stores the changes in values of one or several attributes, from a VERSION to another. This applies either when the same ENTITY may be present in several VERSIONs, or when different ENTITies are deriving from each other (circular relationship described above) between different VERSIONs.

However, the data stored within a VERSION is not necessarily frozen and may be allowed to evolve (according to the TYPE OF VALIDITY). This is of course in particular the case where only one implicit VERSION exists. In such a situation, it may be of interest to record TRACEs of changes operated on an ENTITY within the same VERSION (date of modification, user, changed value, etc.).

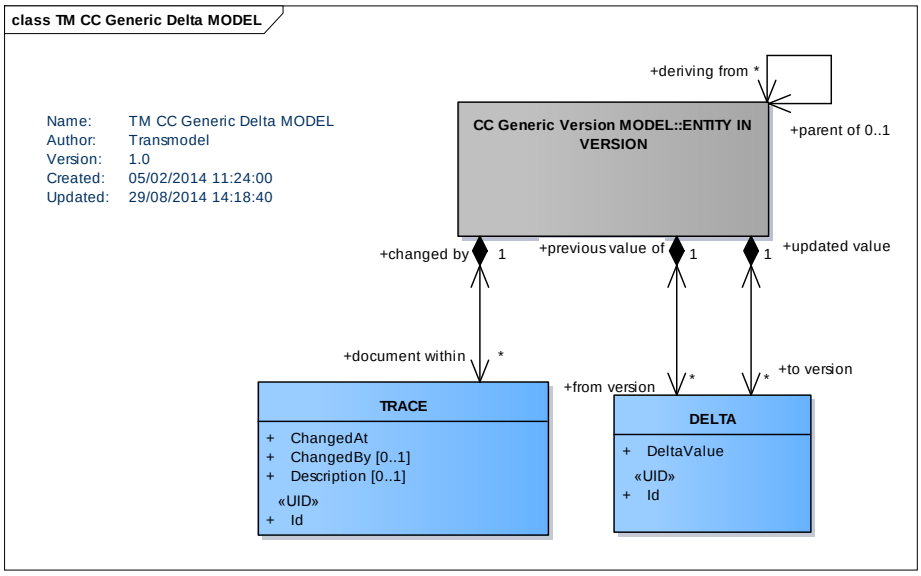

Figure 14 — Generic Delta Model

5.3 Responsibility

5.3.1 Introduction

Transmodel data will be used in different environments that can have a complex organisational structure. For instance, information is planned, revised, forwarded, enriched, combined with other plans and forwarded again to the final user at some time. This process often involves several organisations or departments that each add, change or remove information in a complex workflow. These participating organisations can be strictly PT concerns, or can be external, such as governmental departments or other management agents. Which organisations are involved, what roles they have and what responsibility they execute cannot be determined beforehand for all possible environments in which Transmodel will be used. Even the structure and implementation of the processes for information planning, collecting and forwarding depend on various factors that cannot be determined beforehand. Hence, Transmodel has a generic organisational and responsibility model that can be applied in a variety of different environments and workflows and be used for a variety of purposes. The model in effect defines metadata as to the ownership of data that can be used to help manage the data.

The use of the responsibility model in a specific situation or environment is optional.

The responsibility model makes it possible:

— To define operational responsibility for the real-life entities that are described by the information. For example, in processes for a stop information model it can specify which organisation is responsible for planning and maintenance of the physical stop.

— To define data management related responsibilities for the information itself. e.g. functional or technical IT data management regarding a set of produced, collected or forwarded plan information. This can be used to identify who needs to be contacted to correct or amend data.

— To exchange partial information falling under a certain responsibility set.

If used, the responsibility model can be applied to achieve the following goals:

— Provide as part of the passenger information the contact information of agencies or help-desks to turn to in case of reservations, questions, complaints, etc.

- Provide IT and PT related responsibility information for the purpose of management, assessment, etc. activities concerning Quality Management and Quality Control.

- Associate Intellectual Property Rights with individual data elements or groups of elements.

- Allow delegation of data management: a receiving system can check the authorizations in relation to responsibility for provided data and see if the provider is authenticated to manage that data. This concept can be used to protect data in VERSION FRAMEs from being changed by the wrong parties.

5.3.2 Responsibility – Model overview

The Responsibility Model is referenced by all other parts. There are three sub models. They extend the basic Entity & Versioning models:

- The core RESPONSIBILITY model describes basic concepts related to the responsibility description over data;

- The RESPONSIBILITY ROLE model describes the roles different organisations may take;

- The ORGANISATION model defines the common structures of an organisation. Note that this is further extended in the Reusable Components model (see later) with specific classes for specific types of organisation such as OPERATOR, AUTHORITY, SERVICED ORGANISATION, etc.

The Responsibility Model extends the basic Entity & Versioning models to create the fundamental framework classes from which all the useful Transmodel models are built.

5.3.3 Generic Responsibility

5.3.3.1 Generic RESPONSIBILITY – Conceptual Model

A certain aspect, or set of aspects, of responsibility in relation to an ENTITY is specified by associating a RESPONSIBILITY SET with the ENTITY. Each RESPONSIBILITY SET can contain one or more RESPONSIBILITY ROLE ASSIGNMENTs that allocate different types of RESPONSIBILITY ROLE to an ORGANISATION or a specific ORGANISATION PART.

RESPONSIBILITY SETs may be used at different levels of aggregation. It is possible to specify a different set for each different ENTITY (or rather ENTITY IN VERSION), or just at the Frame Level. The RESPONSIBILITY SET for an ENTITY may change in successive ENTITY IN VERSIONs

The RESPONSIBILITY ROLE describes the kind of responsibility that is enacted; the RESPONSIBILITY ROLE ASSIGNMENT assigns the responsibility to the RESPONSIBILITY SET.

The ADMINISTRATIVE ZONE and RESPONSIBILITY ROLE ASSIGNMENT are used to describe the specific situation of the delegation of the regional responsibility of an authority to an organisation. This can be e.g. the delegation using a concession for the operation of a PT service or the delegation of a regional travel information provision service.

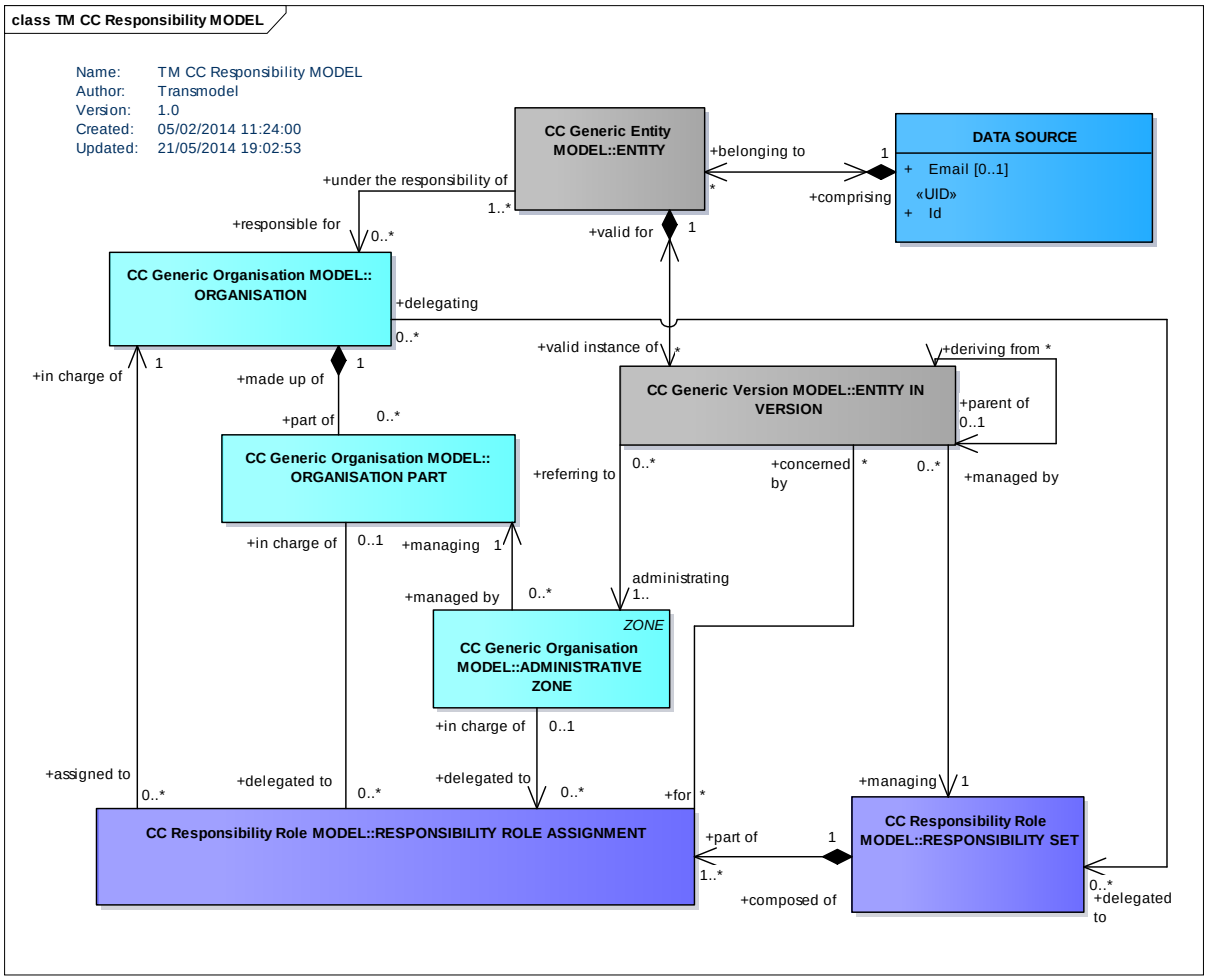

Figure 15 — Responsibility – Conceptual Model

5.3.3.2 Example of RESPONSIBILITY SETs

For example, in the UK, the NPTG (Nation Public Transport Gazetteer) corresponds to a centrally managed set of RESPONSIBILITY SETs managed by the Department for Transport that describe how coordinate the management of stop data.

— For managing most types of stop data (i.e. for bus stops, airports, ferry stops etc) the country is divided into regions and areas within regions. This can be indicated by a RESPONSIBILITY SET for each area; each set is associated with an ADMINISTRATIVE ZONE that designates the area's boundaries and is used to associate the codespace and prefix to use for stop identifiers from that region. Within a designated area, all stop data other than rail station and certain other location data is collected and maintained by the ORGANISATION indicated by the RESPONSIBILITY SET (usually an AUTHORITY). In this case the ADMINISTRATIVE ZONEs do not overlap.

— Certain types of stop data, for example for rail stations, are maintained centrally for the whole country. There is a RESPONSIBILITY SET for each type of data that associates it with the appropriate organisation and zone. The ADMINISTRATIVE ZONEs overlap the zones for other types of stop data.

— A single RESPONSIBILITY SET defines the Department for Transport's central responsibility for creating all the other RESPONSIBILITY SETs. Another RESPONSIBILITY SET defines the responsibility of a contracting organisation to aggregate and distribute the data.

5.3.4 Responsibility Role

5.3.4.1 RESPONSIBILITY ROLE – Conceptual Model

The RESPONSIBILITY ROLE model describes the specific properties of a RESPONSIBILITY SET as a set of assignments of specific roles to specific ORGANISATIONs or ORGANISATION PARTs.

Each RESPONSIBILITY ROLE ASSIGNMENT allocates a specific role to a specified ORGANISATION or ORGANISATION PART.

A full information delivery chain for Travel Information could involve multiple actors. This model will allow identifying the different roles actor can have in such a multi-organisation process.

As different aspects of public transport could be handled by different organisation parts, and sometimes are subcontracted to third parties, it is often useful to describe who is responsible for a specific role, within the delivered data.

Examples of roles are:

- Data Origination
- Data Augmentation
- Data Aggregation
- Data Distribution
- Planning
- Operation
- Control Centre (directive pt-management centre)
- Monitor Centre (only receiving and collecting data)
- Data IPR Ownership
- Entity Legal Ownership
- Scheduler,
- StopPointManager,
- RoadManager,
- RoadDisplayManager,
- SubContractor,
- TravelInformationServiceProvider,
- Other

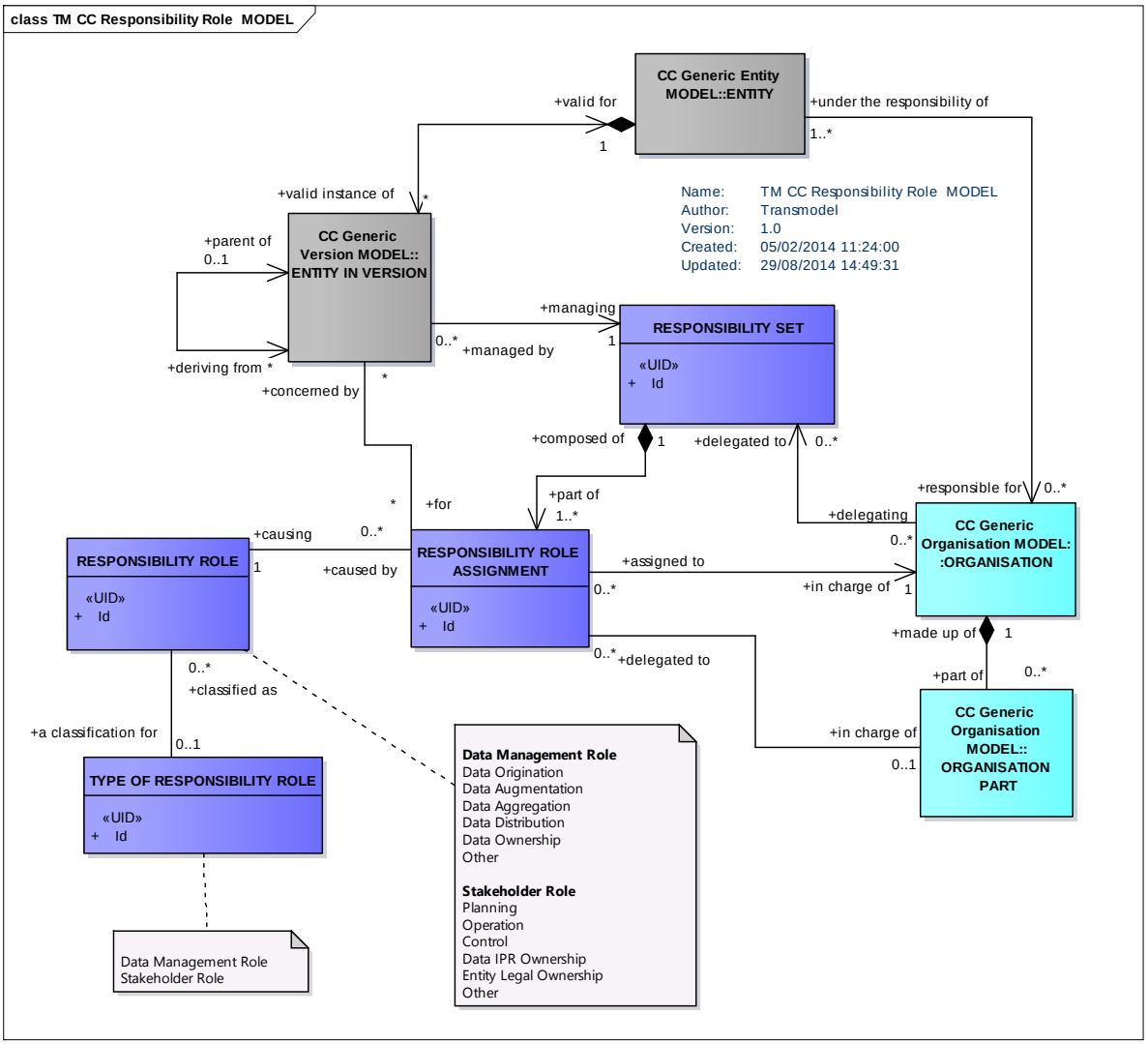

Figure 16 — Responsibility Role – Conceptual Model

5.3.5 Generic Organisation

The Generic ORGANISATION Model defines abstract ORGANISATION elements that can be used wherever there is a need to describe an organisation. It is extended in the Reusable Components section with AUTHORITY, OPERATOR and other concrete organisation definitions specifically relevant for the transport domain.

5.3.5.1 Generic ORGANISATION – Conceptual Model

The entity ORGANISATION represents an organisation that is involved in the planning, collecting or provision of PT information. For example, a company providing a public transport information service, an authority, an operator, or a company providing an information collection service.

Many organisations break down their operations in different organisation parts. This may be important not only from the operational point of view, but also for data administration, as such units may have different responsibilities. Some common data will be shared between them whereas some other data will be managed by a specific part. The RESPONSIBILITY ROLE ASSIGNMENT can be used to describe these responsibilities.

An ORGANISATION can consist of several DEPARTMENTs or ORGANISATIONAL UNITs. Those departments or units are modelled in the ORGANISATION PART.

A DEPARTMENT can consist of one or more ORGANISATIONAL UNITs, which are in charge of operational functions. In a PTO context, a DEPARTMENT could comprise all ORGANISATIONAL UNITs responsible for the lines served by the same transport mode, or using the same type of operation (e.g. regular service, night service).

In some cases, the organisational aspect of responsibilities for planning and operation need not necessarily be present in a company data model. Therefore, the relationships to (and the existence of) these organisational entities are optional.

The ADMINISTRATIVE ZONE represents a set of PT objects related to a district, a region, a city, a municipality, a traffic system, a set of lines or other subdivision for a specific purpose.

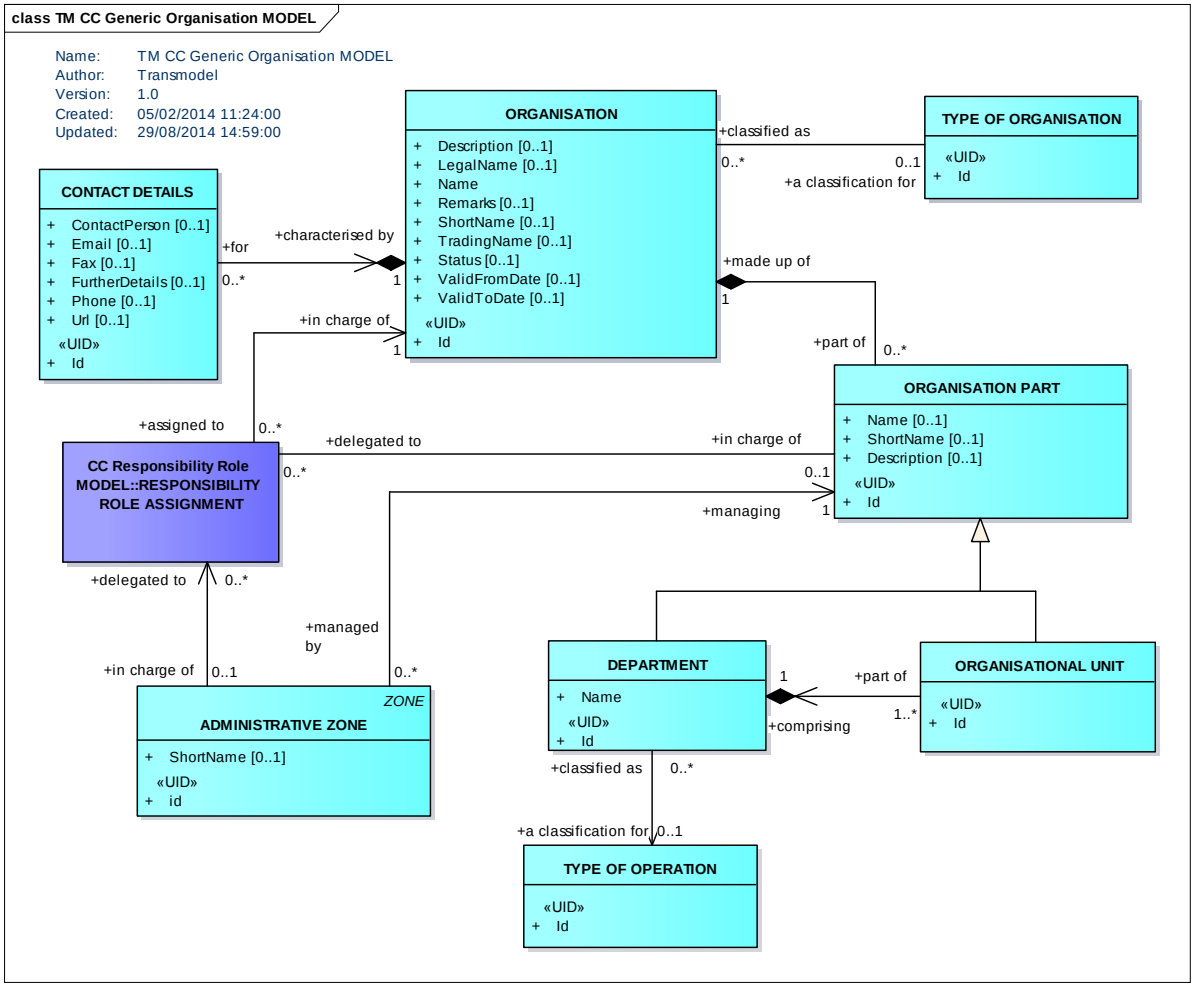

Figure 17 — Generic Organisation — Conceptual Model

5.4 Explicit Frames

The Generic Version Frame Conceptual Model above provides a tool to specify the contents of a given frame using the CLASS IN FRAME mechanism which in effect provides metadata that a system following the Transmodel specification can use to check that all of the necessary elements are present to built a coherent set of versioned data.

This general frame mechanism is complemented by a more specific set of “Explicit“ VERSION FRAMES that specify sets of data elements appropriate for a particular use case or set of related use cases; for example, INFRASTRUCTURE FRAME, SITE FRAME, TIMETABLE FRAME, etc. Each of these represents a predefined combination of data types that are commonly managed and/or exchanged together as part of the data management processes.

Sometimes data elements from more than one type of an explicit frame are needed: a COMPOSITE FRAME can be used to group a coherent set of explicit frames.

The explicit frames correspond to various parts of Transmodel and in most cases are described in the appropriate section along with their contents. In most cases a given Transmodel element appears only in one explicit frame. A summary of the identified frames is given below.

There are in addition two types of explicit VERSION FRAMEs that have a general purpose and so are described here as part of the framework.

COMPOSITE FRAME – A container used to group other frames that meet the same validity conditions.

GENERAL FRAME – A general purpose frame that can contain an arbitrary group of ENTITies.

RESOURCE FRAME – A container to group generic resource data considered as being useful for all functional domains e.g. referring to responsibilities, organisations, vehicle types, etc

5.4.1 Composite Frame

5.4.1.1 COMPOSITE FRAME – Conceptual Model

The COMPOSITE FRAME is used to group other frames that have the same VALIDITY CONDITIONs.

A COMPOSITE FRAME may contain another COMPOSITE FRAME.

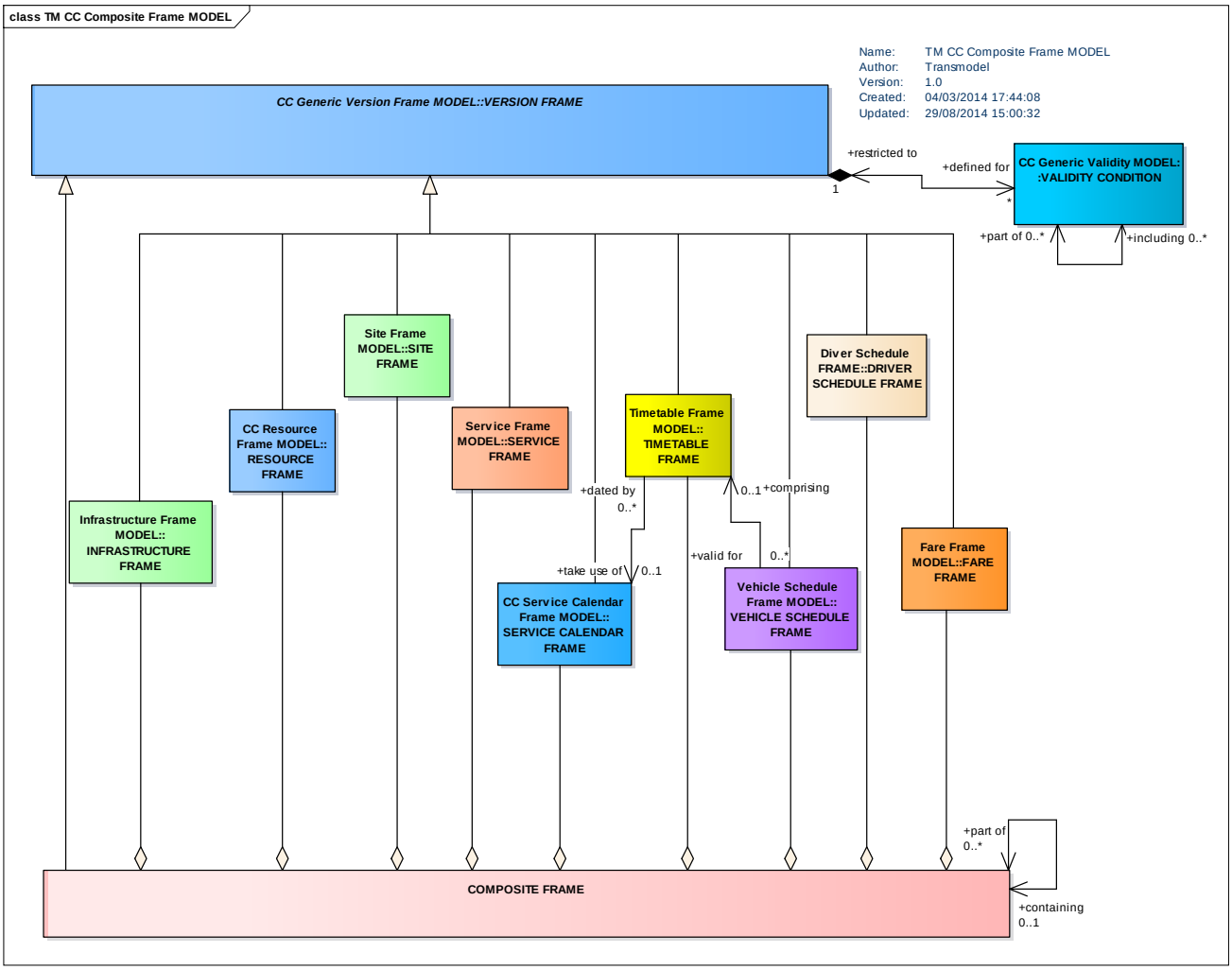

Figure 18 — Composite Frame – Conceptual Model

5.4.2 General Frame

5.4.2.1 GENERAL FRAME – Conceptual Model

The GENERAL FRAME is for general purpose use and may contain any type of Transmodel object.

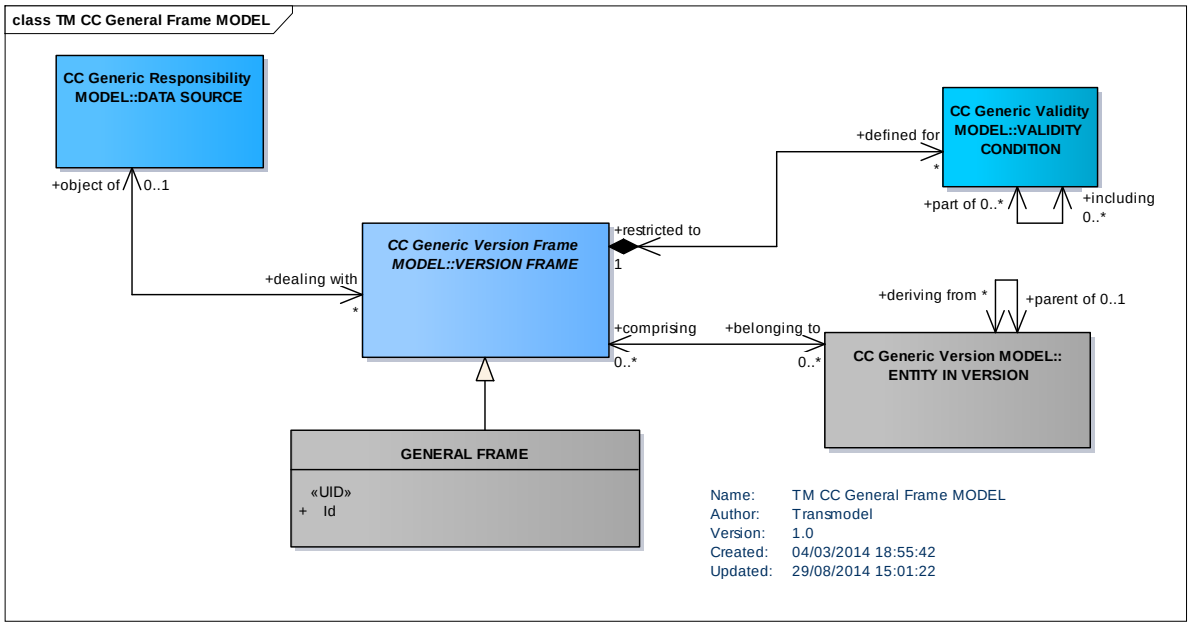

Figure 19 — General Frame – Conceptual Model

5.4.3 Resource Frame

5.4.3.1 RESOURCE FRAME – Conceptual Model

A RESOURCE FRAME contains general purpose components such as ORGANISATIONs, VEHICLE TYPEs, etc. described in further sections of this document.

The diagram below presents the main elements of the RESOURCE FRAME which may comprise also other elements of use for the different functional domains.

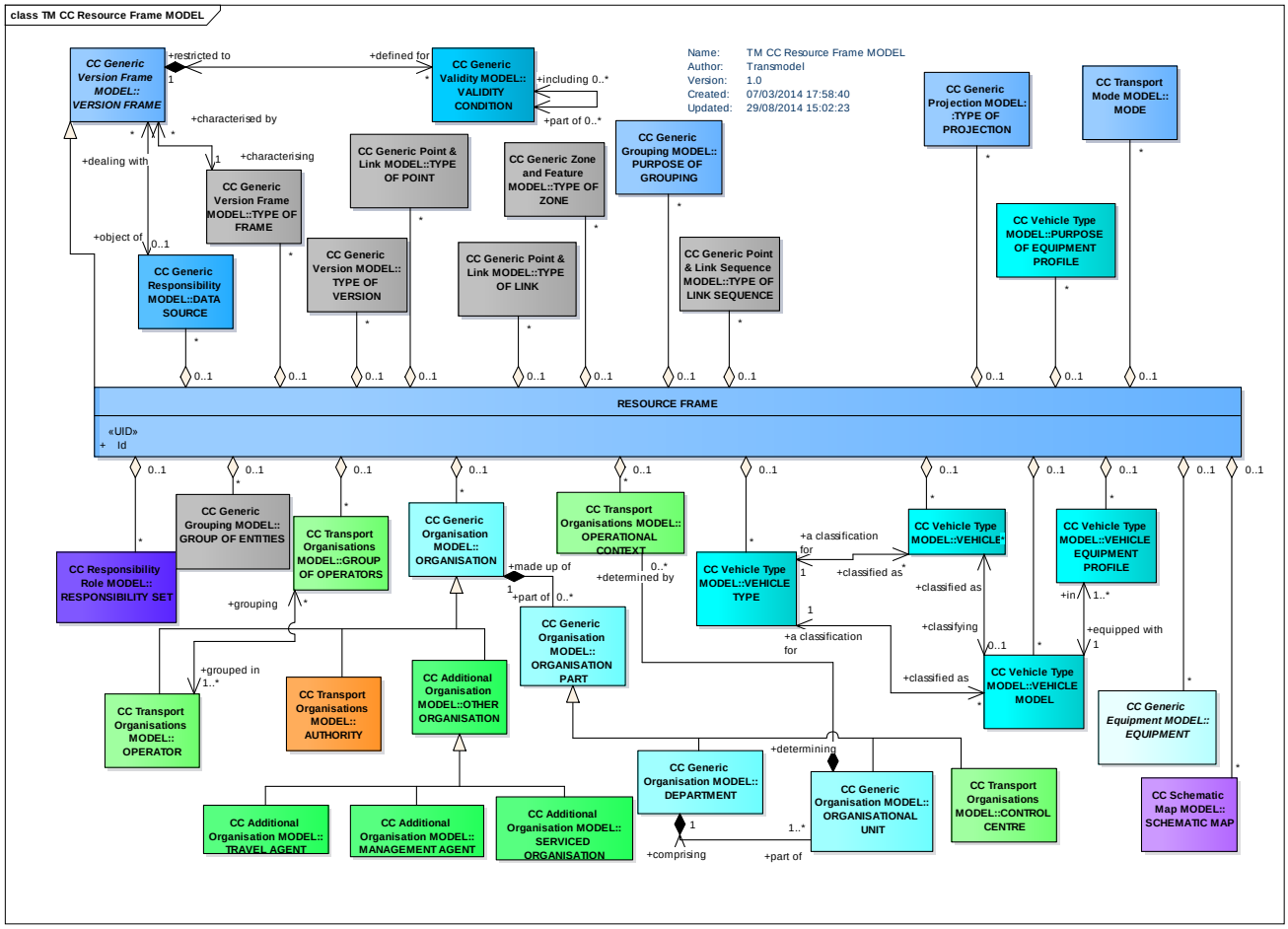

Figure 20 — Resource Frame – Overview

5.4.4 Service Calendar Frame

5.4.4.1 SERVICE CALENDAR FRAME– Conceptual Model

In further sections data characterising time-related information will be described. The set of data containing service calendar information, to which the same VALIDITY CONDITIONs have been assigned is an explicit frame called SERVICE CALENDAR FRAME.

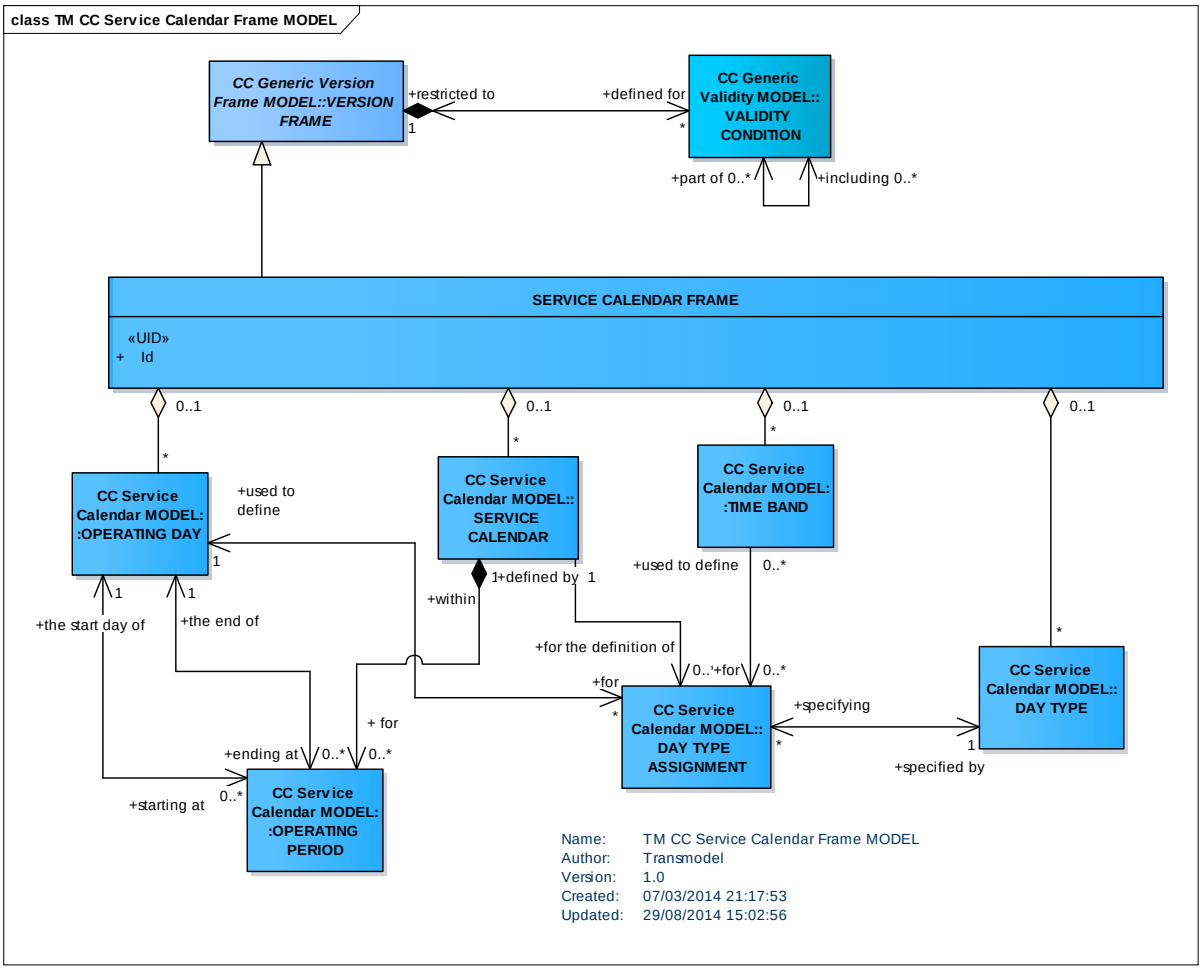

Figure 21 — Service Calendar Frame – Conceptual Model

5.4.5 Other Explicit Frames

The detailed structure of the following explicit frames will be given in the corresponding parts of the Public Transport Reference Data Model.

Space- related concepts:

INFRASTRUCTURE FRAME*:* grouping of data describing the infrastructure network and the restrictions related to it.

SITE FRAME: grouping sites, stop places, points of interest and other fixed objects.

SERVICE FRAME: network topology description elements such as lines, routes, scheduled stop points, work patterns for vehicles, etc.

Time- related concepts:

TIMETABLE FRAME: timetable elements and journeys with timings.

VEHICLE SCHEDULE FRAME: vehicle schedules and their components.

Fare related concepts:

FARE FRAME: tariffs, access rights, fare products, etc

5.5 Generic Framework Model

The Generic Framework model defines common framework objects and relationships that are used as a basis for defining the elements of the Transmodel functional models. The framework defines common abstract supertypes that can be specialized to create the concrete elements of the Transmodel modules.

5.5.1 Generic Framework – Model overview

The Framework Models extend the core Transmodel models for responsibility, versioning etc. so that all framework elements can be versioned and managed.

- The LOCATION Model defines location related elements such as coordinates.
- The GROUPING model provides a means of grouping elements.
- The POINT & LINK model provides a model for defining one-dimensional points and two-dimensional links.
- The LINK SEQUENCE model provides a means of defining graphs of points and links such as are commonly found in layered PT models.
- The ZONE model provides a model for defining two-dimensional zones (with possible one-dimensional point centroid).
- The PROJECTION model provides a means of defining mappings between different graphs of POINTs and LINKs.
- The PLACE model provides a model for defining named places and links between them.

5.5.2 Location Model

5.5.2.1 LOCATION – Conceptual Model

The Location provides a representation of the basic coordinates of those entities that are located in space, for example, POINTs and LINKs and ZONEs.

Transmodel uses a subset of the Open Geospatial Consortium's Geographic Mark-up Language (OGC GML)() schema to define coordinates. This allows different spatial reference systems (SRS) to be used to express the geographic location of objects of different shape (point, linestring, polygon, and multi-points if using the OGC normalized wording at http://www.opengeospatial.org/standards,). The spatial reference defines an ellipsoid, a datum using that ellipsoid, and either a geocentric, geographic or projection coordinate system. The projection also always has a geographic coordinate system associated with it.

Some of the commonly used spatial reference systems are: 4326 - WGS 84 Long Lat, 4269 - NAD 83 Long Lat, and 3395 - WGS 84 World Mercator, but several hundred are available depending on the country, required precision, purpose of the location, etc. See http://spatialreference.org/ for more details.

The location of a POINT is dependent on the LOCATING SYSTEM used. Given a LOCATING SYSTEM, every POINT may be located in this system by a LOCATION. One of the classical ways to locate a POINT is to assign coordinates to it. The LOCATION is hence defined by two coordinates in a two-dimensional representation and possibly by a third coordinate relating the point to a surface. Examples of coordinates are x- and y-values in a plane graphic or diagram, degree of longitude and latitude on a globe, GPS-coordinates, the angle to the North and the distance from an origin, etc.

Every LOCATION must be defined according to one and only one LOCATING SYSTEM and must be located at one and only one POINT. Any POINT may be located by one or more LOCATIONs, each of which may refer to only one LOCATING SYSTEM. The LOCATING SYSTEM may be specified implicitly by the context (e.g. on the VERSION FRAME, or on an individual LOCATION).

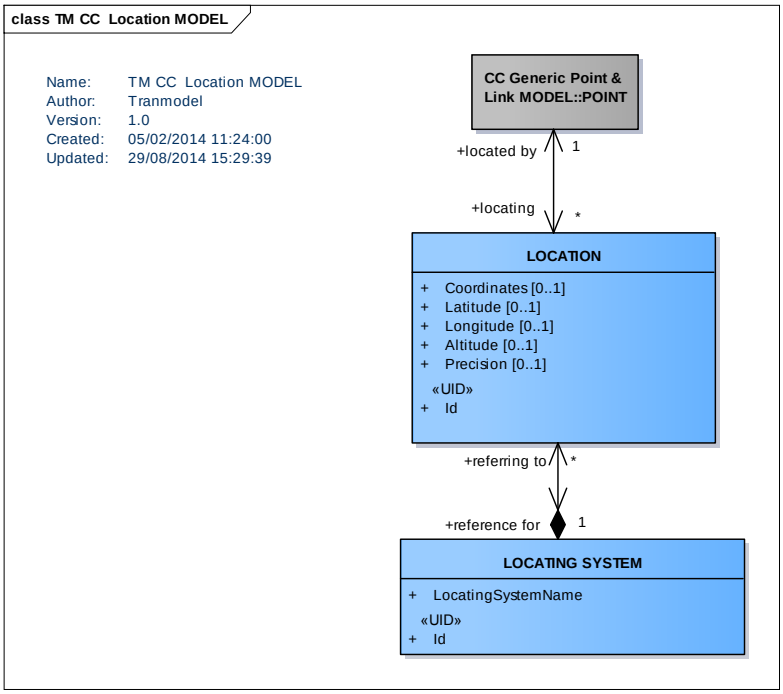

Figure 22 — Location – Conceptual Model

5.5.3 Generic Grouping

5.5.3.1 Introduction

There is often a need in public transport to group objects into a set, for example a group of lines, group of points, etc. Some kinds of grouping are very frequent; others are specific to a particular local situation. Transmodel provides an explicit grouping mechanism that can be used for the more commonly found cases, such as GROUP OF POINTs, and a generic grouping mechanism that can be used to group any kind of object.

Grouping may be very useful in situations like:

— Defining a bus network by grouping a set of LINK SEQUENCEs together,

— Defining zones by grouping sets of POINTs,

— etc.

5.5.3.2 GROUPING – Conceptual Model

One or more ENTITIes of any type may be grouped using a GROUP of ENTITIes.

Objects like POINT, LINK, and LINK SEQUENCE may be grouped by the corresponding entities GROUP OF POINTS, GROUP OF LINKS, and GROUP OF LINK SEQUENCES respectively.

Each of these groups can be classified by a PURPOSE OF GROUPING. Such a group is the association of specific elements of a given type into a group needed for a particular functional purpose (for example, WIRE ELEMENTs having a specific power supply type). The PURPOSE OF GROUPING refers to the functional purpose for which the associated groups of elements are defined.

Some other types of ENTITY also have an inherent grouping semantic. For example, for example STOP AREA (or also indeed ZONE) incorporates the generic concept of a grouping of POINTs.

The assignment of elements to groups of such elements is represented by many-to-many relationships. An ENTITY can belong to more than one group, either for the same or a different PURPOSE OF GROUPING.

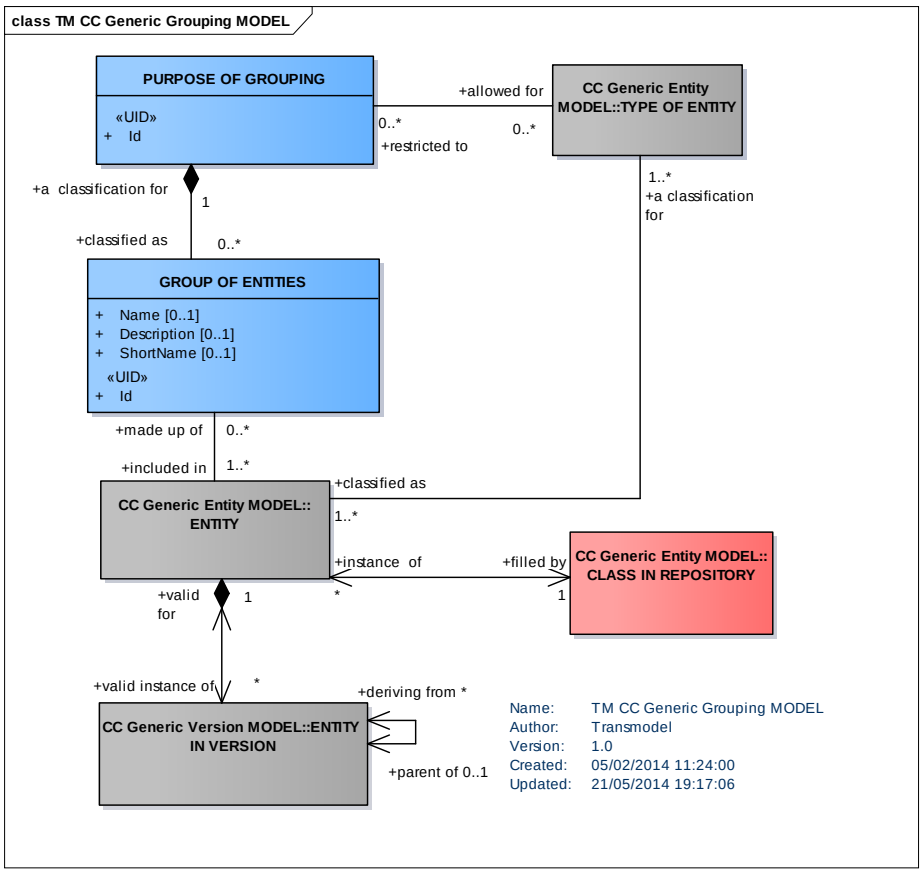

Figure 23 — Generic Grouping – Conceptual Model

5.5.3.3 Classifying Groups

The PURPOSE OF GROUPING can be used to explain the purpose of arbitrary groupings of elements and to specify the allowed members.

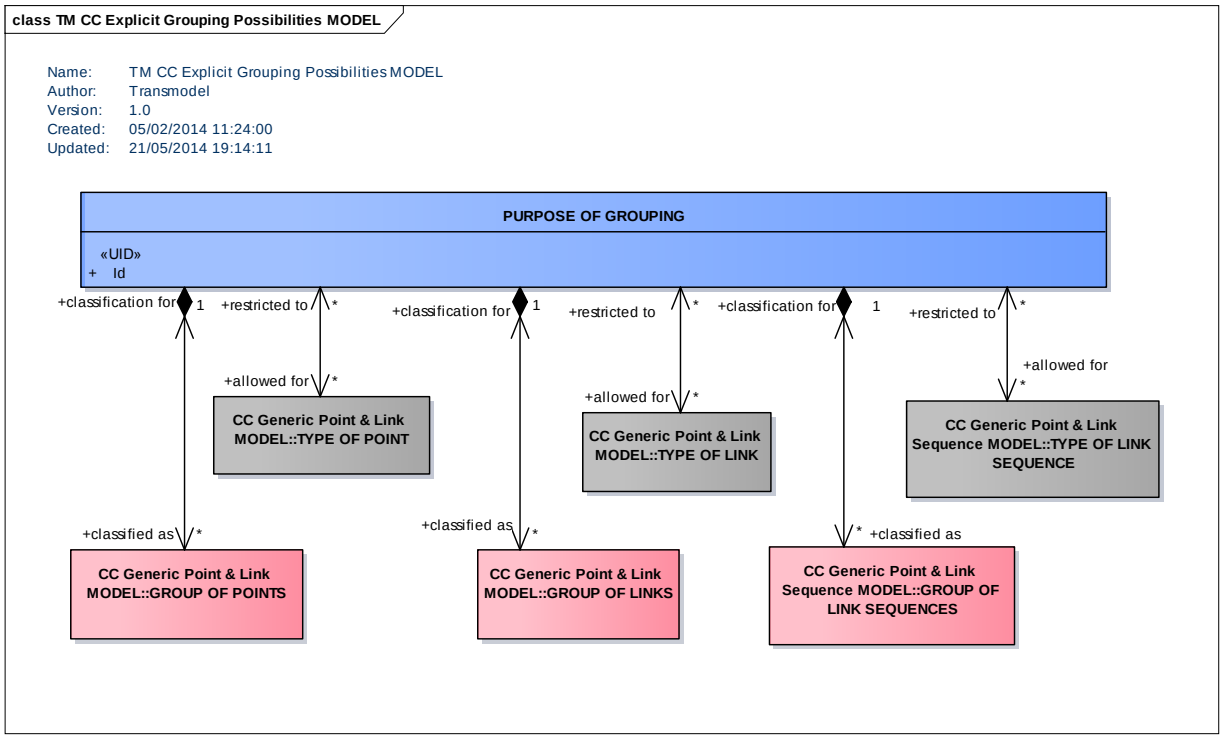

Figure 24 — Explicit Grouping Possibilities – Conceptual Model

5.5.4 Generic Point & Link

5.5.4.1 Generic POINT & LINK – Conceptual Model

One of the most important aspects of information systems dealing with public transport is the representation of the networks over which the services are operated. Such a representation describes the objects comprising a network (e.g. stations, lines, etc.) using simplified and conventional topological objects: points, links and for some purposes, zones. Specific roles are assigned to these simple objects, according to the functional purpose of the description.

The representation is chosen to be independent of the underlying geospatial context in which the network resides, but may be projected onto it or other spatial contexts using a projection model – see later.

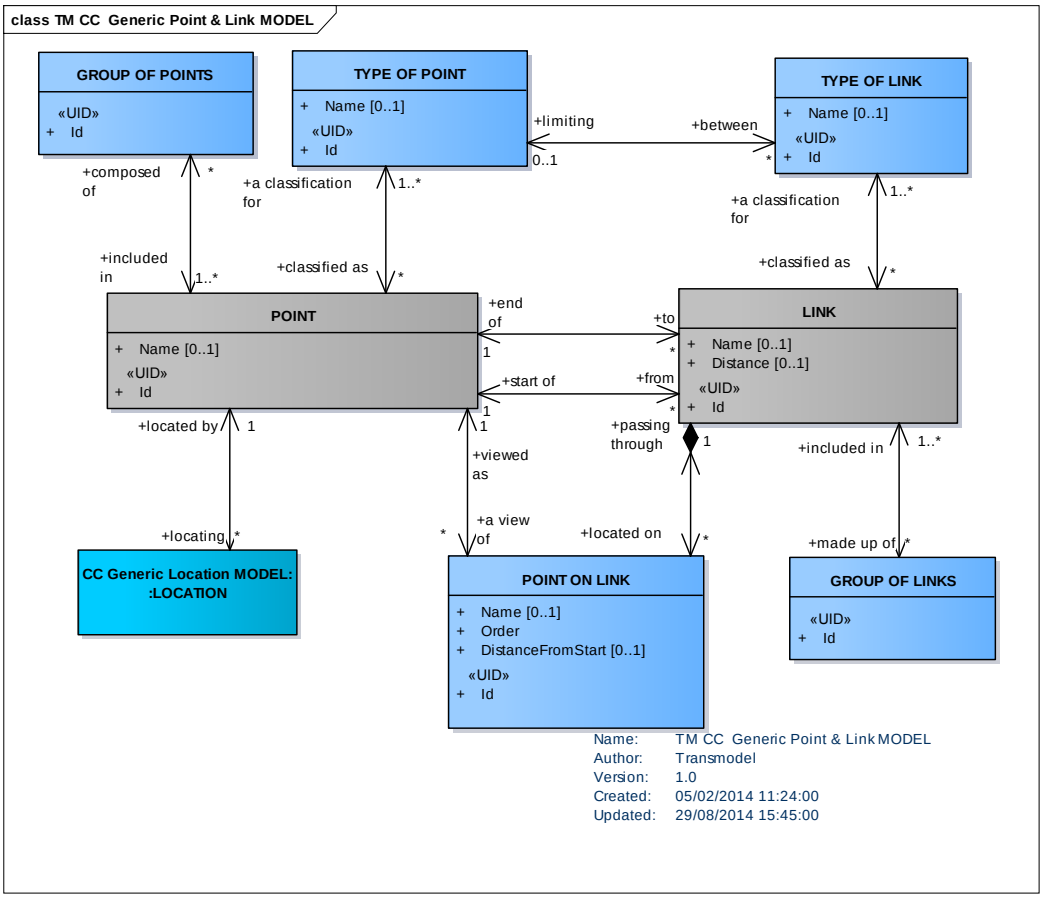

Figure 25 — Generic Point & Link – Conceptual Model

5.5.4.2 Points

Topological descriptions of the spatial structure of a public transport network are generally built with points. Thus, an entity POINT is defined as the most basic entity of the network model. A POINT represents a 0-dimension node of the network. It marks the location of bus stops, parking places or other types of POINTs.

A TYPE OF POINT is defined as an entity to describe common roles played by a number of POINTs. Each POINT is functionally classified as being of one or more types, according to the specific information needs of a particular functional domain.

Certain TYPEs of POINTs are regarded as important enough to be additionally represented by a separate concept. The most important of these are the SCHEDULED STOP POINT, TIMING POINT and ROUTE POINT entities, described in a further part of this standard. Other examples are ROAD JUNCTION, ACTIVATION POINT, etc. The types, if not explicitly defined by an entity of the reference model, may be specified by the generic entity TYPE OF POINT. Any POINT may be of more than one type. For example, the same POINT may be a ROUTE POINT, a TIMING POINT and may be an ACTIVATION POINT as well.

5.5.4.3 Links

Between two POINTs of any type, a LINK may be defined to store spatial information (e.g. the distance a vehicle will cover crossing this link). LINKs represent 1-dimensional connections between POINTs. There must be no LINKs without one limiting POINT at each end. Two relationships between the POINT and the LINK entity specify the limiting POINTs of a LINK.

A LINK is **oriented** from its start POINT to its end POINT. This order has to be interpreted in a rather abstract sense of an artificial orientation, to be possibly used for expressions like “left of” or “right of” the LINK. The

order does not necessarily express the direction of the traffic flow, for instance, which must be defined by appropriate entities, relationships or attributes, depending on the functional context. LINKs are usually not used as standalone objects, but through specialized objects (by inheritance): if the orientation of the LINK has a specific meaning, or if the LINK is bidirectional, the specialized object will carry specific attribute to express it.

The network structures used by different functions may be subject to different conditions and constraints. In some structures, the ordered connection between two POINTs may have to be unique. This means that there cannot be more than one LINK between the two same end POINTs. In other words, such a link is logically a straight line (if it has a curvilinear shape, it is only for a drawing purpose). In other structures, there may be two or more different connections between the same start and end POINTs. This means that such alternative LINKs follow different paths between the two POINTs, therefore have different shapes. In this case, the shape is implicitly associated to a LINK. For instance, between two stops there may be several links if the vehicles covering these links follow different paths.

The LINK entity is therefore identified by its own ID attribute, which allows multiple LINKs between the same pair of POINTs. This ID does not represent explicitly the path followed by the LINK. The projection mechanism allows it to indicate an exact geospatial path. For applications in which a LINK must be identified by its limiting POINTs, these may be used as an alternative unique key, or the artificial ID may be implemented as a combination of the two end point identifiers.

The entity TYPE OF LINK expresses the different functional roles of a LINK. For instance, this classification may include a distinction between “commercial links” to be used for passenger carrying journeys and “connecting links” to be used by dead runs or turnarounds at the terminals. It may be useful to express a difference between LINKs with separate bus lanes and without, or to describe activation specifications (to control announcements, ticketing devices, etc.) that are identical for each LINK of a given TYPE OF LINK.

Each LINK is functionally classified as being of one or more types, according to the specific information needs of a particular functional domain. As for the TYPE OF POINT, certain TYPEs OF LINK are explicitly defined by an entity in the reference model (e.g. SERVICE LINK, TIMING LINK, ROUTE LINK will be discussed in further part of this standard).

In most cases, LINKs of a given type must be only between POINTs of a corresponding TYPE OF POINT. An optional relationship between TYPE OF LINK and TYPE OF POINT expresses that only points of the specified type must be used as limits for links of a given type (or several types).

5.5.4.4 Point on Link

It is often necessary to define POINTs that are simply located on a LINK of a certain type. For instance, on a LINK defined for activation of traffic light priority, some intermediate points may be necessary, at which a vehicle should confirm or cancel the priority request. If a platform is described by a LINK, it may be necessary to define the different coach stopping positions as POINTs on this LINK. Such a POINT ON LINK is a POINT that is defined on a LINK belonging to the same layer.

Each POINT ON LINK is identified by the LINK it is located on and by an order on that LINK. The distance from the start point of the LINK is only optional information, but the order attribute ensures that all the intermediate POINTs ON a LINK are sequenced in a unique way.

5.5.4.5 Group of Points & Group of Links

The present standard also shows two explicit grouping mechanisms: GROUP OF POINTS and GROUP OF LINKS (already introduced the section GROUPING – Conceptual Model).

A GROUP OF POINTS may be used to describe a central or complex station, consisting of all stops serving the whole area of this station, or any important interchange area. In such a case, the PURPOSE OF GROUPING of the GROUP OF POINTS will limit the grouped POINTs to a certain TYPE OF POINT. This allows one to use classical stop areas to describe limited sets of stops (e.g. a couple of bus stops close to the station).

Passenger information functions, in particular information on interchanges, may use such GROUPs OF POINTS in various ways.

A GROUP OF POINTS may also be used to describe operational clusters, consisting of POINTs of different types, e.g. located close to each other and/or operationally belonging to an object known by a particular name (e.g. train station, from the operational point of view).

A GROUP OF LINKs may be all LINKs in a tunnel, all LINKs in an urban area, etc.

5.5.5 Generic Point & Link Sequence

5.5.5.1 Generic POINT & LINK SEQUENCE – Conceptual Model

The LINK SEQUENCE Model defines a set of POINTs and/or LINKs making up a path through a network.

It allows a path to be described as a sequence of points, a sequence of links, or both; both views are relevant for different use cases. Specialisations of LINK SEQUENCEs will be discussed in further parts of this standard (e. g. ROUTE, JOURNEY PATTERN, TIMING PATTERN etc.).

All LINK SEQUENCEs have common properties – such as an overall distance, some of which can be derived from the individual links.

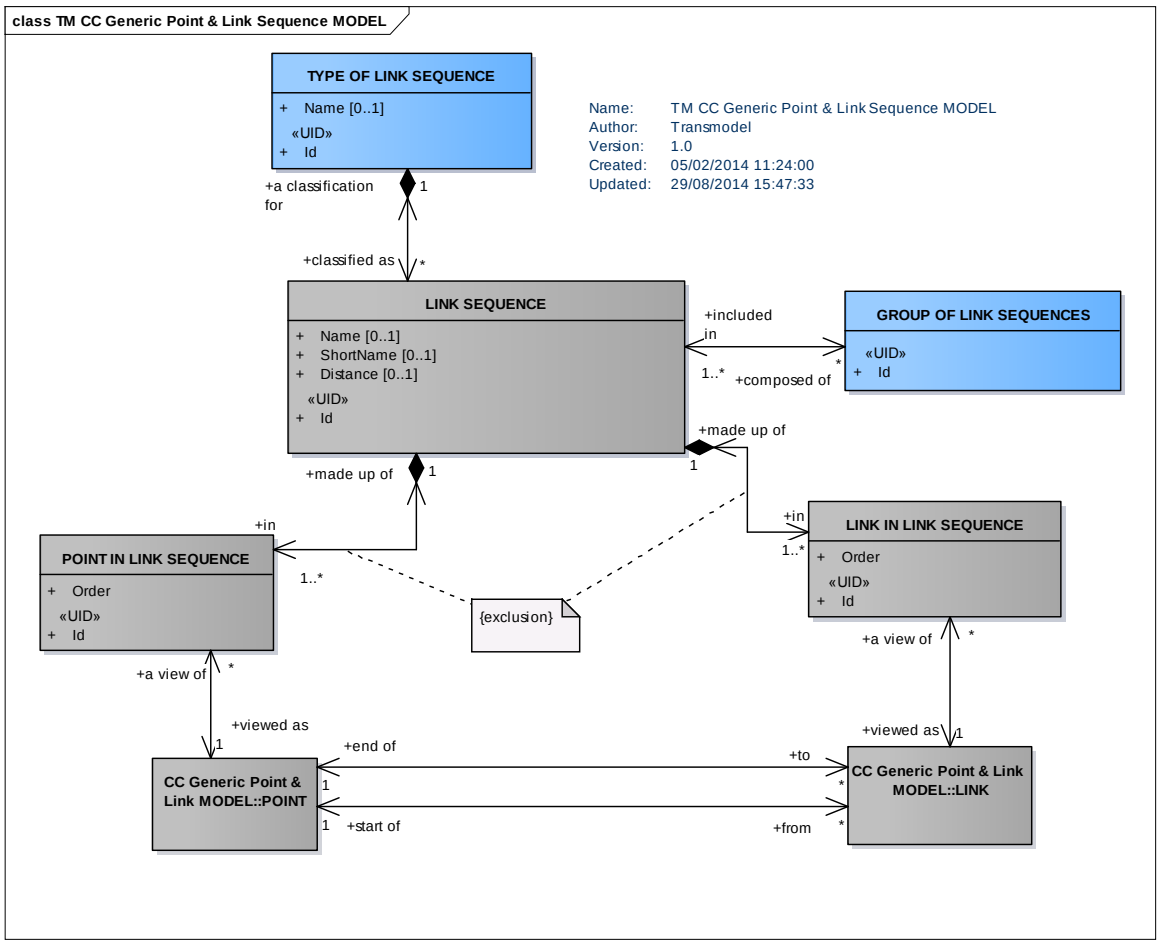

Figure 26 — Generic Point & Link Sequence – Conceptual Model

5.5.6 Generic Zone and Feature

5.5.6.1 Generic ZONE AND FEATURE – Conceptual Model

5.5.6.1.1 Zone – Conceptual Model

A ZONE is a two-dimension object used in the network description (e.g. administrative area, tariff zone, flexible transport zone). ZONEs are classified according to a TYPE OF ZONE.

A ZONE may be defined by a GROUP OF POINTS belonging to the ZONE. For instance, a TARIFF ZONE used to define a zonal fare structure in a zone-counting or zone-matrix system may be composed of a set of stop points.

A ZONE may also be defined as a geometric area, bordered by a LINK SEQUENCE (a polygon). In such a case, this LINK SEQUENCE has to be a closed one (i.e. the first and last POINTs IN LINK SEQUENCE must be a view of the same POINT).

A ZONE may be recursive, and include other smaller ZONEs. This is expressed by the reflexive relationship on ZONE.

A ZONE may be represented by a single POINT. Within one particular layer, this representing POINT has to be unique.

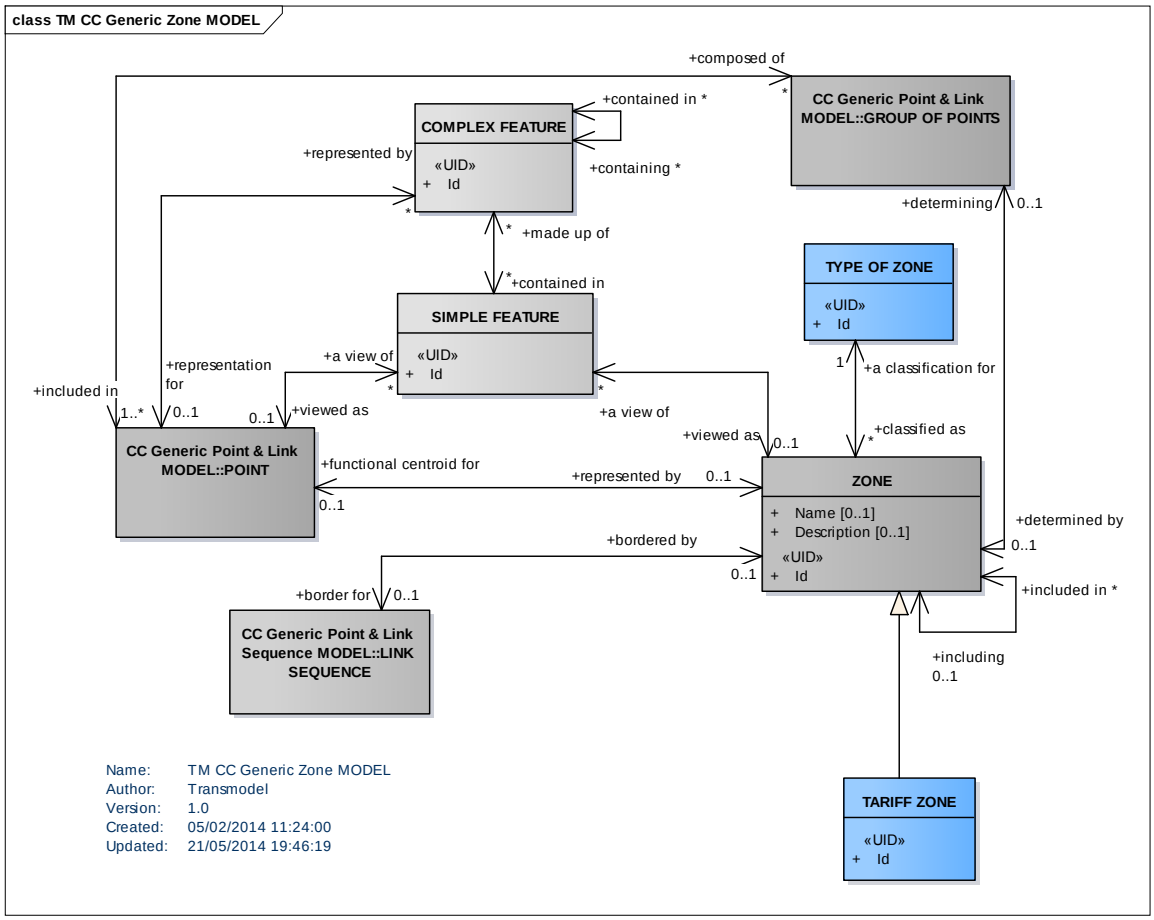

Figure 27 — Generic Zone – Conceptual Model

5.5.6.1.2 Feature – Conceptual Model

It is often necessary to define a group of objects of different types in a simpler representation, omitting the details. For instance, a train station composed of tracks, platforms, vending machines, etc., or a depot composed of halls, parking areas, lanes, maintenance facilities, etc., are viewed in some layers as single POINTs. This is described by the entity COMPLEX FEATURE (named by analogy with the GDF standard and usual GIS wording).

A COMPLEX FEATURE is composed of one or more SIMPLE FEATUREs. A SIMPLE FEATURE is identical to an instance of either a POINT, a LINK, or a ZONE.

A COMPLEX FEATURE usually combines elements of different kinds such as POINTs, LINKs, ZONEs (each of them not necessarily of the same type), and even other COMPLEX FEATUREs. It should not be mixed up with a group of elements (e.g. GROUP OF POINTS), combining elements of one single type only (e.g. one GROUP OF LINKs may be all LINKs in a tunnel, which is not a COMPLEX FEATURE).

As a ZONE, a COMPLEX FEATURE may be represented by a single POINT.

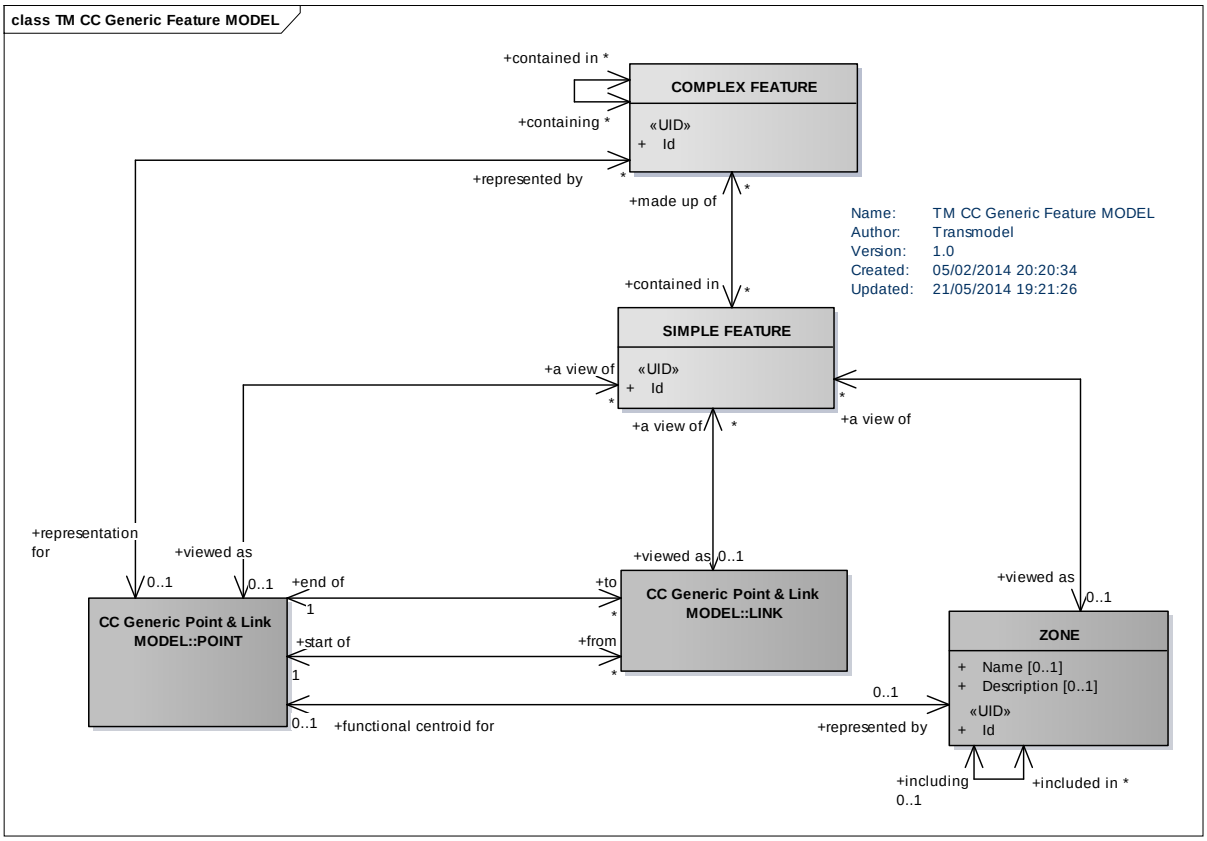

Figure 28 — Generic Feature – Conceptual Model

5.5.7 Generic Projection

5.5.7.1 Generic LAYER – Conceptual Model

Topological ENTITIES used for describing a transport network can be grouped into different LAYERs. Such sets are actually VERSION FRAMEs with a specific property, namely each LAYER is associated with a one and only one LOCATING SYSTEM, and the entities belonging to the LAYER have a position within this LOCATING SYSTEM. Examples of layers include:

- Infrastructure layer: describes road or rail network.
- Route layer: describes route topology.
- Service layer: describes network of stops served by routes.
- Timing layer: describes location of timing points and times between them.

Different aspects of the network planning process deal with different layers of data. For instance, strategic planning does not have to deal with details of the infrastructure like signals, switch points etc., but tactical planning may very well have to do so.

Obviously there are many cases where information from different layers is needed to produce a result: e.g. a map showing routes and stops needs to be drawn, distances between passenger stops need to be calculated for statistical analysis etc.

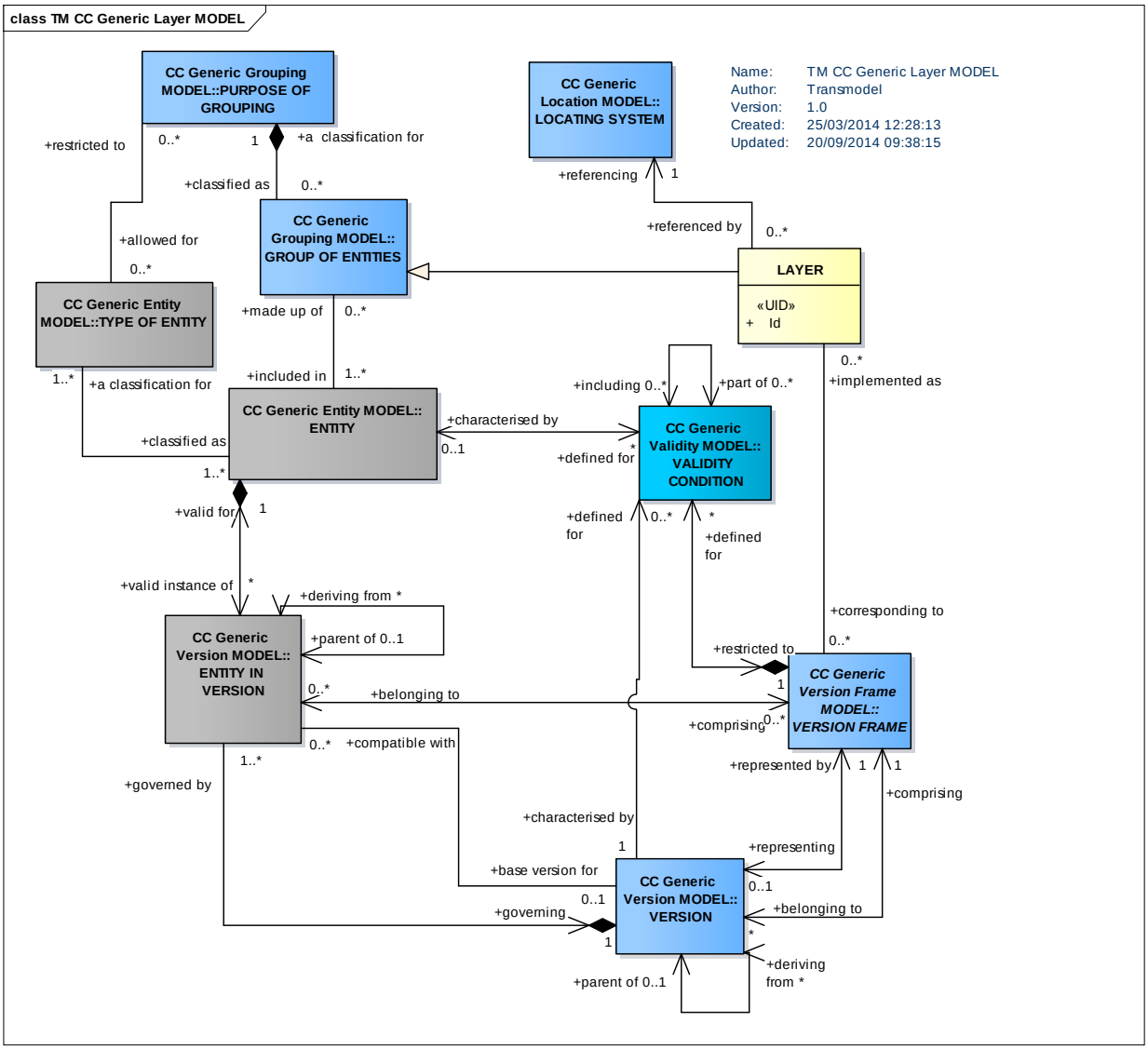

Figure 29 — Generic Layer – Conceptual Model

5.5.7.2 Generic PROJECTION – Conceptual Model

The mechanism for relating ENTITIES of one LAYER to ENTITIES of another LAYER is called projection. Projection can happen implicitly by transforming the entity position from the source LOCATION SYSTEM to the destination LOCATION SYSTEM. However, there are cases where such automatic transformation is not possible or practical, e.g. if a route needs to be displayed on a schematic map, there is no way of calculating the positions from the spatial coordinates. Transmodel therefore contains a mechanism for explicitly projecting (spatial) entities of one layer to another layer.

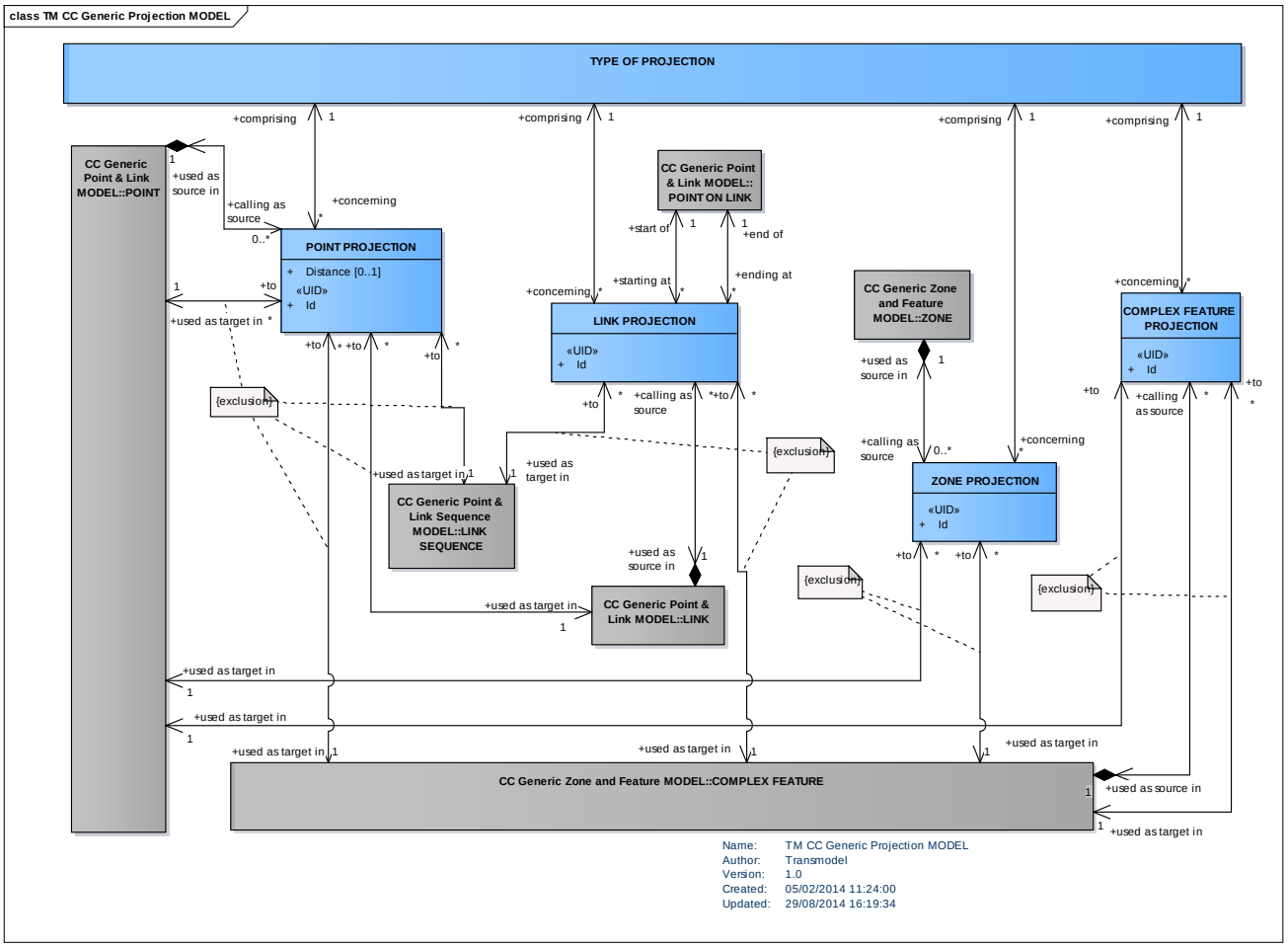

Figure 30 — Generic Projection – Conceptual Model

5.5.7.2.1 Point Projection – Conceptual Model

Explicit projection is possible between POINTs, LINKs and ZONEs. The TYPE OF PROJECTION element identifies the source and target layer of the projection and describes its purpose. A POINT may be related to a POINT on a different layer, e.g. a timing point may be projected on a stop point.

The POINT PROJECTION is used to project a point of a source layer to an ENTITY of the target layer. The target ENTITY can be a POINT or LINK, but not a ZONE. If the target of POINT PROJECTION is a link, the distance from the start of the link is set in POINT PROJECTION.

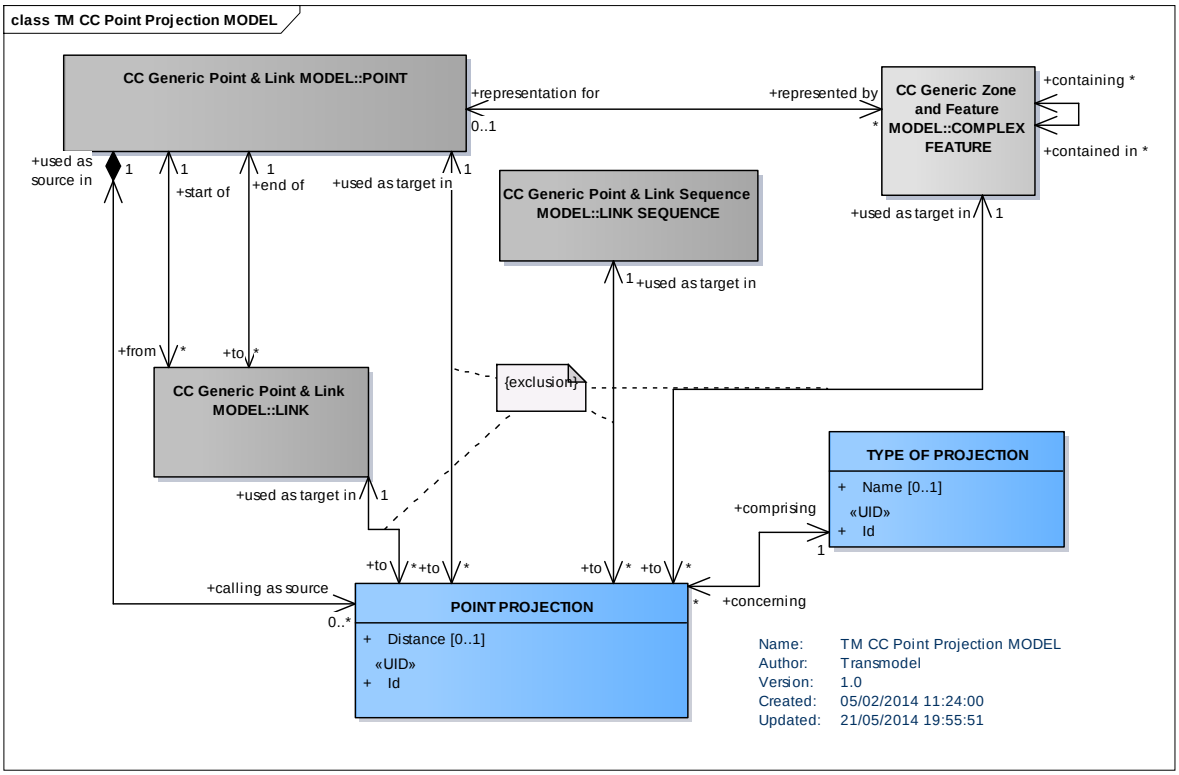

Figure 31 — Point Projection – Conceptual Model

5.5.7.2.2 Link Projection – Conceptual Model

The LINK PROJECTION is used to project a LINK on one or more LINKs of another layer. As a precondition, the destination link must have one or more POINT ON LINK entities associated with it. The start and end point of the source link are projected on POINT ON LINK of the destination LINKs. An example of LINK projection might be the projection of a LINK between two stops to the LINKs of the road (or rail).

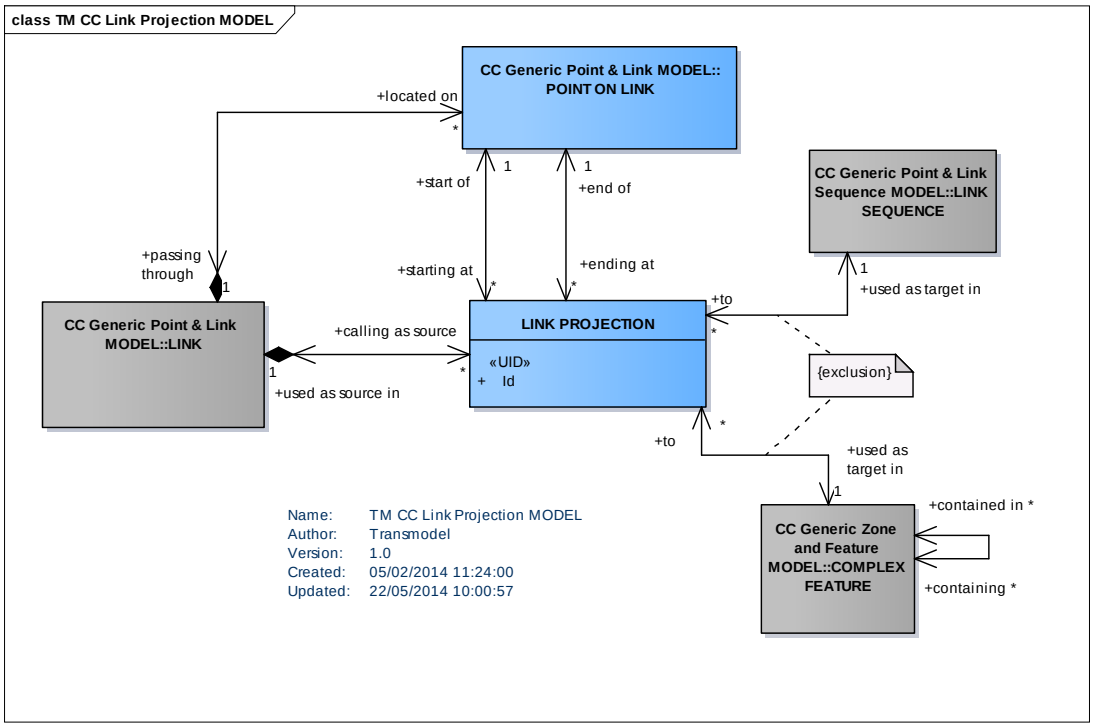

Figure 32 — Link Projection – Conceptual Model

5.5.7.2.3 Zone Projection

A ZONE PROJECTION involves a ZONE as source. The projected ZONE may be targeting either one POINT or one COMPLEX FEATURE.

The ZONE PROJECTION targeting a POINT expresses that the source ZONE is represented by a POINT in the target layer.

The ZONE PROJECTION targeting a COMPLEX FEATURE means that the source ZONE belongs to the COMPLEX FEATURE described in the target layer. This may be useful to express that a ZONE is represented by a POINT, or that it represents the area in which all components of a COMPLEX FEATURE are located. Some of these components may be changed without affecting the definition of the source ZONE.

5.5.7.2.4 Complex Feature Projection

A COMPLEX FEATURE PROJECTION involves a COMPLEX FEATURE as source. The projected COMPLEX FEATURE can be targeting another COMPLEX FEATURE or a POINT.

The COMPLEX FEATURE conceptual Model is shown on the diagram Generic Projection – Conceptual Model above.

The COMPLEX FEATURE PROJECTION targeting another COMPLEX FEATURE means that the source feature is represented by the target feature, in the target layer. This may be useful if the level of complexity of such COMPLEX FEATUREs is different (e.g. the target layer provides a simplified representation).

The COMPLEX FEATURE PROJECTION targeting to a POINT means that the target POINT represents, in the target layer, all objects included in the COMPLEX FEATURE. This is a simplified representation of a complex object. For instance a complex station description (including objects such as platforms or turnstiles) may be represented in some LAYERs as a POINT.

Similar types of target for a COMPLEX FEATURE PROJECTION (not shown on the Generic Layer – Conceptual Model, shown earlier) may be a LINK or a ZONE.

5.5.7.2.5 Shape of Linear Objects – Conceptual Model

Within a number of layers, a LINK is described as a straight line. However, a shape may be assigned to a LINK, in order for instance to draw curves on a map. The concept LINE SHAPE, describes the graph to be drawn between the limiting POINTs of the LINK, using a 'formula' recorded against this entity.

For instance, the model addresses several possibilities of assigning a shape to a LINK:

- the LOCATING SYSTEM of a LAYER may allow describing a LINK as a curve (formula, etc.);
- the projection modelling allows to project the LINK onto a sequence of consecutive straight segments (called "edge" or "segmented line", for instance) which belongs to another LAYER;
- the projection modelling allows projecting the LINK onto a curvilinear feature, described in another LAYER.

In the first example, the shape of the LINK is included in the considered layer; in the two other examples, the LINK follows the shape of a linear feature described in another layer.

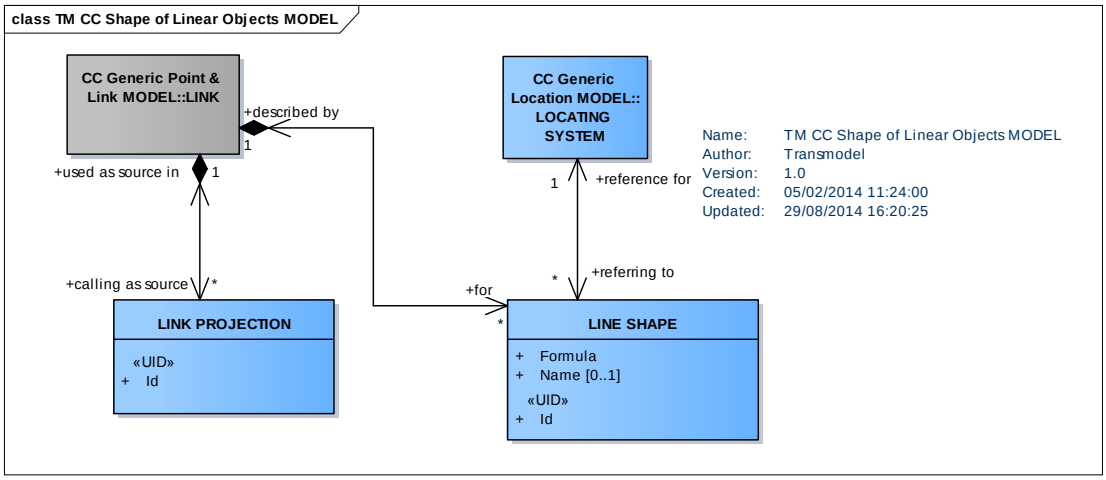

Figure 33 —Shape of Linear Objects – Conceptual Model

5.5.8 Generic Place

5.5.8.1 Generic PLACE – Conceptual Model

The PLACE model defines topographically significant places that a transport model may wish to describe. It also allows the description of the possibility of connecting between them. A PLACE may be of dimension 0 (a POINT), 1 (a road section) or 2 (a ZONE).

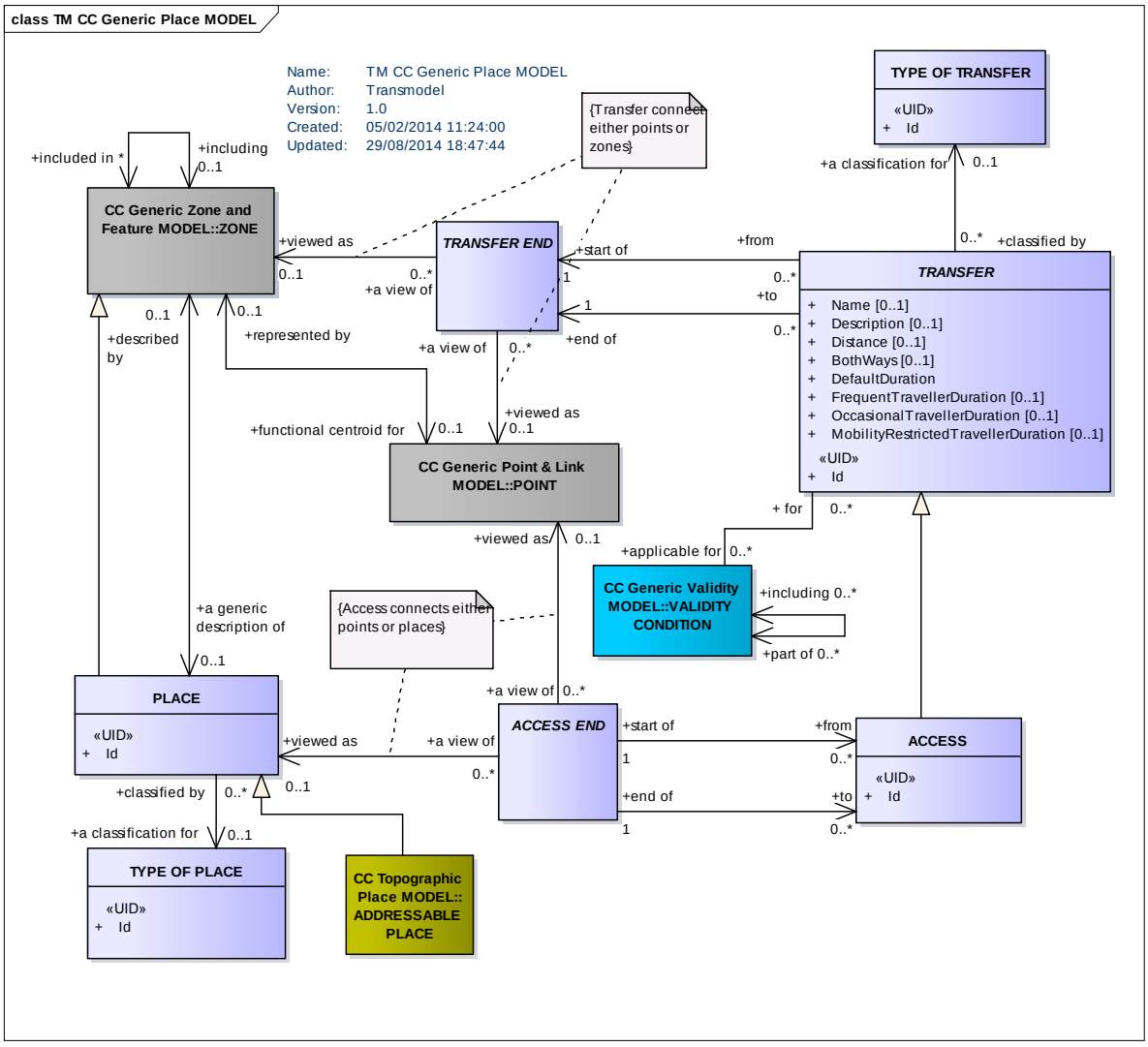

Figure 34 — Generic Place – Conceptual Model

5.5.9 Accessibility

Transmodel supports a detailed description of the accessibility of a site. This can be used in applications in various ways:

- For **computable** use the data can be used by a journey planner when calculating a journey that meets a given set of user criteria, for example, to choose stations or paths that are wheelchair accessible when planning a point-to-point journey and to direct a user to the entrances and exits most suitable according to their needs.

- For **browsing/navigation** the data can be used to show the exact properties of a given interchange so that users may rehearse a trip ahead of making it and make their own judgment as to the best path through an interchange.

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In order to journey plan across data from different data systems, a uniform set of summary assessment criteria is needed that can be used to establish possible routes of an equivalent level of accessibility. For example, can a path be followed in a wheelchair, without using steps, etc.

5.5.9.1 ACCESSIBILITY – Conceptual Model

The accessibility of a site is described using an ACCESSIBILITY ASSESSMENT: this allows to express the accessibility either in terms of suitability for specific USER NEEDs (using a SUITABILITY element) or in terms of ACESSIBILITY LIMITATIONs, or both.

To describe accessibility, Transmodel models as separate and distinct aspects: (a) the description of the USER'S NEEDs – for example *wheelchair, hearing impaired, vision impaired, lift-averse,* etc.; and (b) the ACCESSIBILITY LIMITATION, i.e. description of the limitations of a site to support a specific need, for example *Wheelchair, Step free, Escalator free, Lift free* – the last two also corresponding to some cognitive aversions (e.g. sufferers of claustrophobia may dislike lifts). These aspects can be grouped together as an ACCESSIBILITY ASSESSMENT and associated with various Transmodel topological concepts as this will be shown in further parts of this standard.

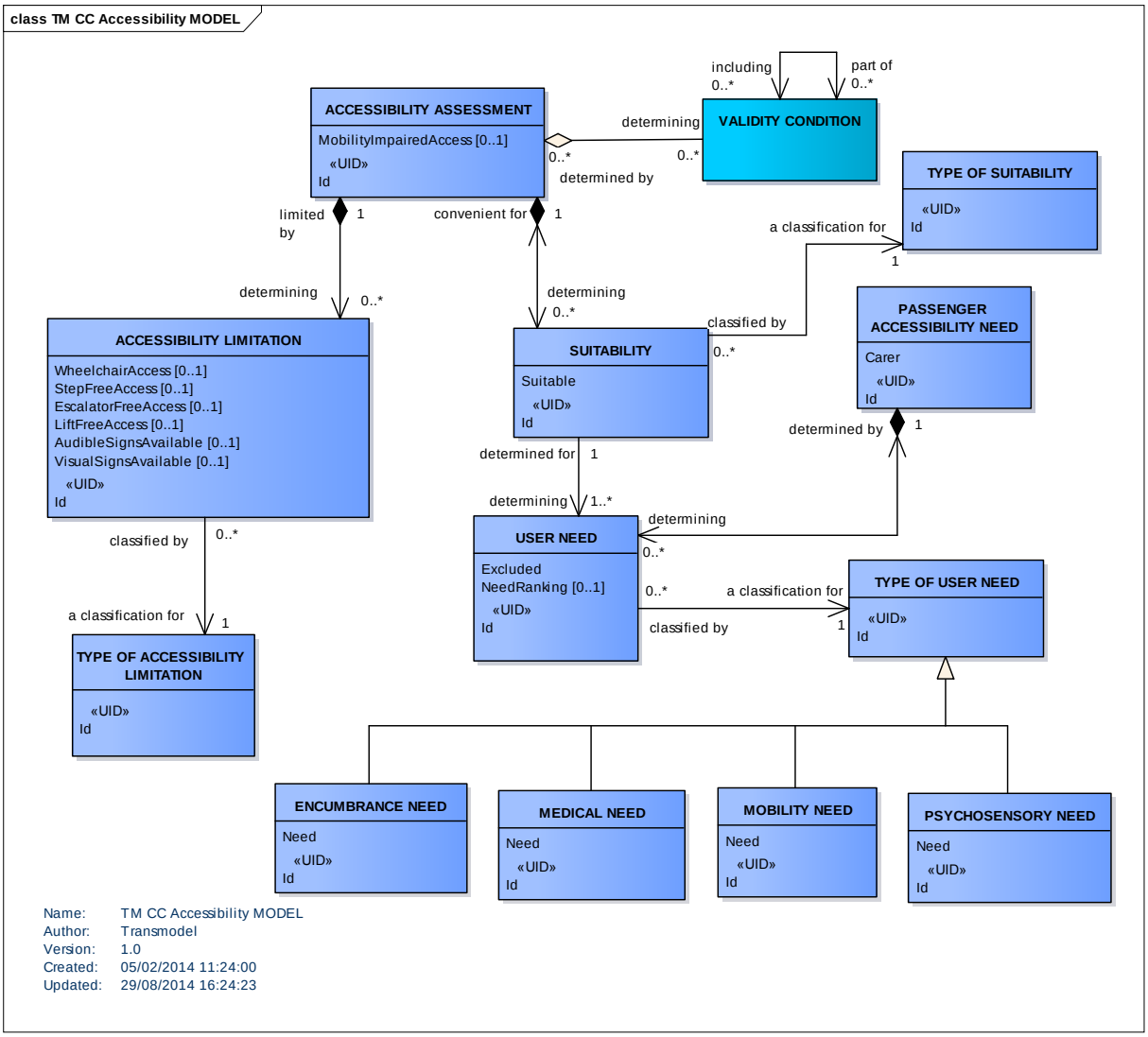

Figure 35 — Accessibility – Conceptual Model

Certain of the ACCESSIBILITY LIMITATIONs are mutually exclusive – See Table 6.

Table 6 – Accessibility Attribute Constraints (source NeTEx)

	LiftFree	StepFree	EscalatorFree	TravelatorFree	Criterion
Wheelchair	***Wheelchair*** access may involve the use of lifts	***Wheelchair*** access must be step free	***Wheelchair*** access must be escalator free	***Wheelchair*** access must be travelator free	*To be able to drive a wheelchair unassisted*
LiftFree	--	***LiftFree*** access may involve the use of steps	***LiftFree*** access may involve the use of escalators	***LiftFree*** access may involve the use of travelators	*To avoid being enclosed in a lift*
StepFree	***StepFree*** access may involve the use of lifts	--	***StepFree*** access must be escalator free too	***StepFree*** access may still involve the use of travelators	*To avoid routes that demand high mobility*
EscalatorFree	***EscalatorFree*** access may involve the use of lifts	***EscalatorFree*** access may involve the use of steps	--	**EscalatorFree** *access may still* involve the use of *travelators*	*To avoid routes that demand high mobility*
TravelatorFree	***TravelatorFree*** access may involve the use of lifts	***TravelatorFree*** access may involve the use of steps	***TravelatorFree*** access must be escalator free	--	*To avoid routes that demand high mobility*

A detailed discussion of the different attributes and their values, on a concrete use of the different accessibility characteristics is given in NeTEx-Part 1.

The *MobilityImpairedAccess* value provides an overall summary assessment of an element as accessible or not. Table 7 shows suggested derivation from the lower level values.

Table 7 – Rules for summarizing Accessibility (source NeTEx)

	Value	***MobilityImpairedAccess***
Wheelchair	*false*	*false*
	true	*true*
	unknown	*false*
LiftFree	*false*	No effect
	true	No effect
	unknown	No effect
StepFree	*false*	*false*
	true	No effect
	unknown	*false*
EscalatorFree	*false*	*false*
	true	No effect
	unknown	*false*
TravelatorFree	*false*	No effect
	true	No effect
	unknown	No effect

5.6 Reusable Components

The Reusable Components model defines common Public Transport related objects that can be used in any other Transmodel package. The reusable components are not related to a specific PT topic, but are of general relevance to a number of different topics.

5.6.1 Reusable Components – Model overview

The reusable components are modularized into separate sub-models, built on top of the common framework. The main modules are:

- TRANSPORT MODE Model – defines standard transport modes ;
- TRANSPORT SUBMODE Model – defines standard transport submodes ;
- SERVICE CALENDAR Model – defines concepts that allow to qualify temporal characteristics of other concepts, in particular DAY TYPEs, OPERATING DAYs and SERVICE CALENDARs;
- AVAILABILITY CONDITION Model – defines standardized temporal VALIDITY CONDITIONs;
- TOPOGRAPHIC PLACE Model – defines named TOPOGRAPHIC PLACES that relate to places that transport visits;
- TRANSPORT ORGANISATION Model – defines OPERATORS, AUTHORITIES and other Transport ORGANISATIONs;
- ADDITIONAL ORGANISATION Model – defines SERVICED ORGANISATIONs and other non-Transport ORGANISATIONs;
- GENERIC EQUIPMENT Model – defines general EQUIPMENT , fixed and on-board EQUIPMENT;
- ACTUAL VEHICLE EQUIPMENT Model – defines EQUIPMENT USAGE on a VEHICLE;
- VEHICLE TYPE Model – Defines VEHICLE TYPES, VEHICLE Models and VEHICLEs;
- VEHICLE PASSENGER EQUIPMENT Model – defines ACTUAL VEHICLE EQUIPMENT related to vehicle accessibility;
- FACILITY Model – defines simple service and facility categories;
- TRAIN Model – defines train structure ;
- SCHEMATIC MAP Model – defines general purpose SCHEMATIC MAP contents ;
- NOTICE Model – defines footnotes and other NOTICEs;
- SERVICE RESTRICTION Model – defines service or equipment usage restrictions in terms of fare-related parameters;
- ALTERNATIVE NAME Defines the different possible naming for PLACEs.

5.6.2 Transport Mode

5.6.2.1 TRANSPORT MODE – Conceptual Model

The MODE defines the mean of transport used or available. Transmodel subdivides the MODE into TRANSPORT MODE, used inside public transport, and ACCESS MODE, used to join public transport (from the start point of a journey, to the end point, during connections, etc.).

The entity TRANSPORT MODE refers to the classification of transport systems present in large cities or on important transport corridors, for instance: bus, tramway, light rail, metro, long-distance rail, ferry.

A VEHICLE TYPE must belong to one TRANSPORT MODE. For instance, the “bus” TRANSPORT MODE will gather standard, articulated, minibus, double-deck buses.

The ACCESS MODE is any out of vehicle mode used to reach a TRANSPORT MODE.

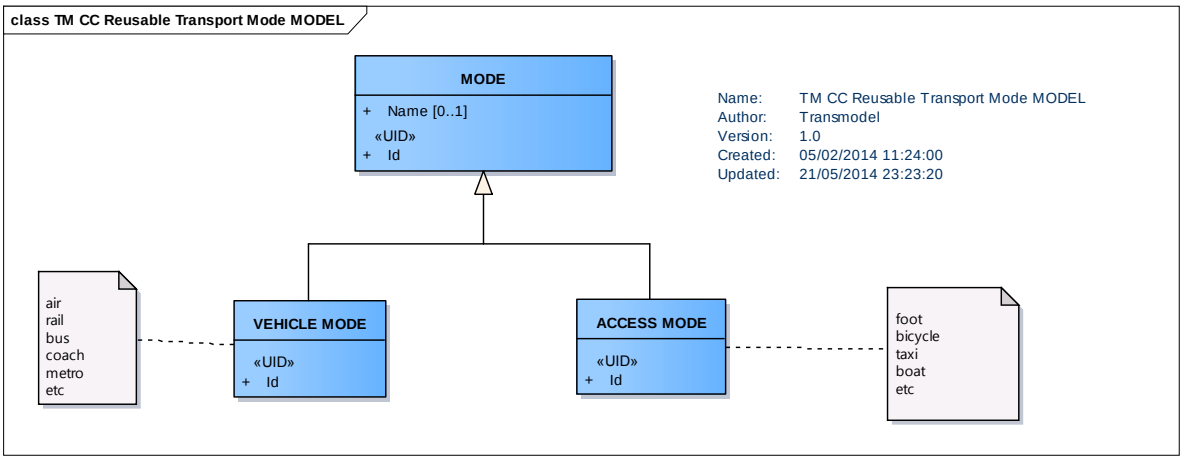

Figure 36 — Reusable Transport Mode – Conceptual Model

5.6.3 Transport SubMode

5.6.3.1 TRANSPORT SUBMODE – Conceptual Model

The SUBMODE model allows the TRANSPORT MODE to be further qualified by the specification of a SUBMODE.

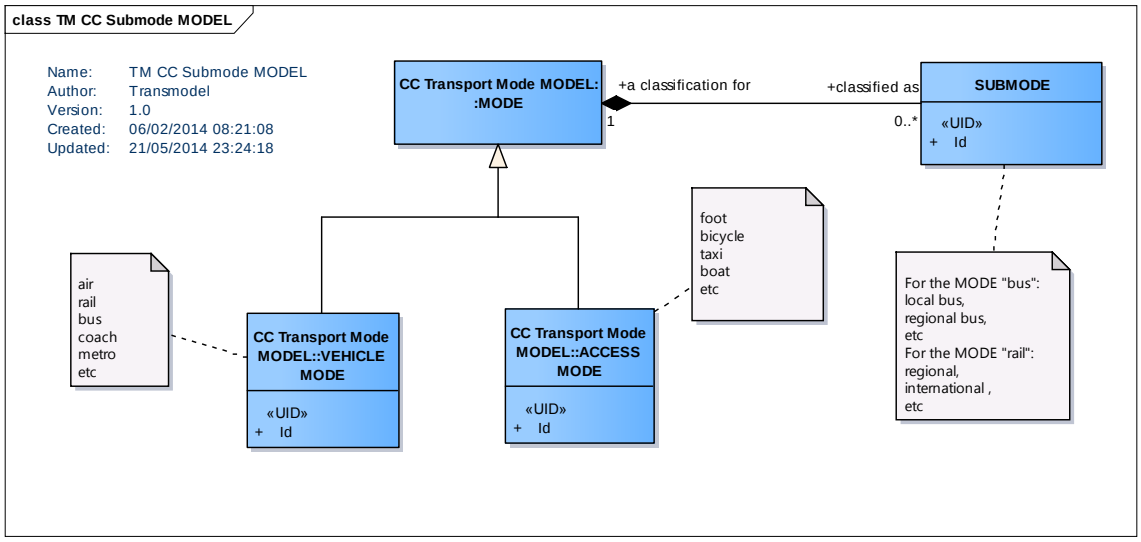

Figure 37 — Submode – Conceptual Model

5.6.4 Service Calendar

5.6.4.1 Introduction

The transport offering of a public transport company is tailored to accommodate different levels of demand. In order to simplify the planning of supply almost all operators design their production plan using a classification by type of day, which summarises the level of demand or other characteristics: for example, workday, weekend, school holiday, market day, etc. Long-term planned schedules are designed through the so-called transportation calendar, in which calendar days are classified as specific DAY TYPEs.

OPERATINGDAYs are in most cases similar to calendar days, with some possible differences (e.g. start and end times). An assignment process of DAY TYPEs to OPERATING DAY allows selection of the most appropriate schedules to meet the demand and face the traffic conditions. This leads to an operational plan for every OPERATING DAY. The plan is completed by the assignment of physical resources to the theoretical work and amended as necessary to deal with unexpected circumstances.

5.6.4.2 Service Calendar – Conceptual Model

5.6.4.2.1 Day Types

In Transmodel, a DAY TYPE is defined as a combination of various different properties a day may have, and which will influence the transport demand and the running conditions (e.g. traffic flow for buses).

Any single condition that is relevant to the demand will be recorded as a particular PROPERTY OF DAY. For example, "*workday", "Sunday", "school holiday", "market day*" would each be a PROPERTY OF DAY. A workday during school holidays, which is a market day, would be a DAY TYPE, formed with the combination of those three PROPERTies OF DAY.

The most classical PROPERTY OF DAY is the DAY OF WEEK (e.g. "Wednesday"). A DAY TYPE may associate different properties of the same type (e.g. "Tuesday or Thursday").

The production elements designed during the planning process are characterized by a DAY TYPE and will be used any day of operations to which this DAY TYPE is assigned.

5.6.4.2.2 Operating Days

The day of operation, considered from the point of view of the transportation process control, is described by the entity OPERATING DAY.

The time limits of an OPERATING DAY will often deviate from the official date. One day of operation covers for instance the period from 2.00 a.m. to 1.59 a.m. the day after, the period from 0.00 to 1.59 on the second day being assigned to the operational day which started the day before.

Moreover, an OPERATING DAY may last more than 24 hours. It may be the case in some urban PT operations, for which two OPERATING DAYs overlap during the night. It is more frequent in long-distance railway operations, for which the journeys may last more than one day. However, in such a case, many parameters, such as the schedules, the fares or the passenger information are still based on a DAY TYPE, even if the DAY TYPEs and the OPERATING DAYs last more than 24 hours. The DAY TYPE assignment, in such a case, is usually published as for the date of departure and the passengers invited to refer to this assignment. Therefore, the date characterizing an OPERATING DAY corresponds to one of the calendar dates covered by this OPERATING DAY, fixed arbitrarily and in most cases on the first calendar date.

A PERIOD is a continuous interval of several days between two particular OPERATING DAYs, which can be used for several purposes (e.g. VALIDITY CONDITION of a VERSION).

5.6.4.2.3 Day Type Assignment

The production planning requires that a DAY TYPE is assigned to each OPERATING DAY, which is frequently referred as a “transportation calendar” or – in The Conceptual Model – as a SERVICE CALENDAR. Ordinarily, this is organized thanks to a default assignment table, which would apply to the whole network. This table determines in advance the DAY TYPE that is valid in the network, for each OPERATING DAY of a given period. This is expressed as a DAY TYPE ASSIGNMENT relationship between DAY TYPE and OPERATING DAY.

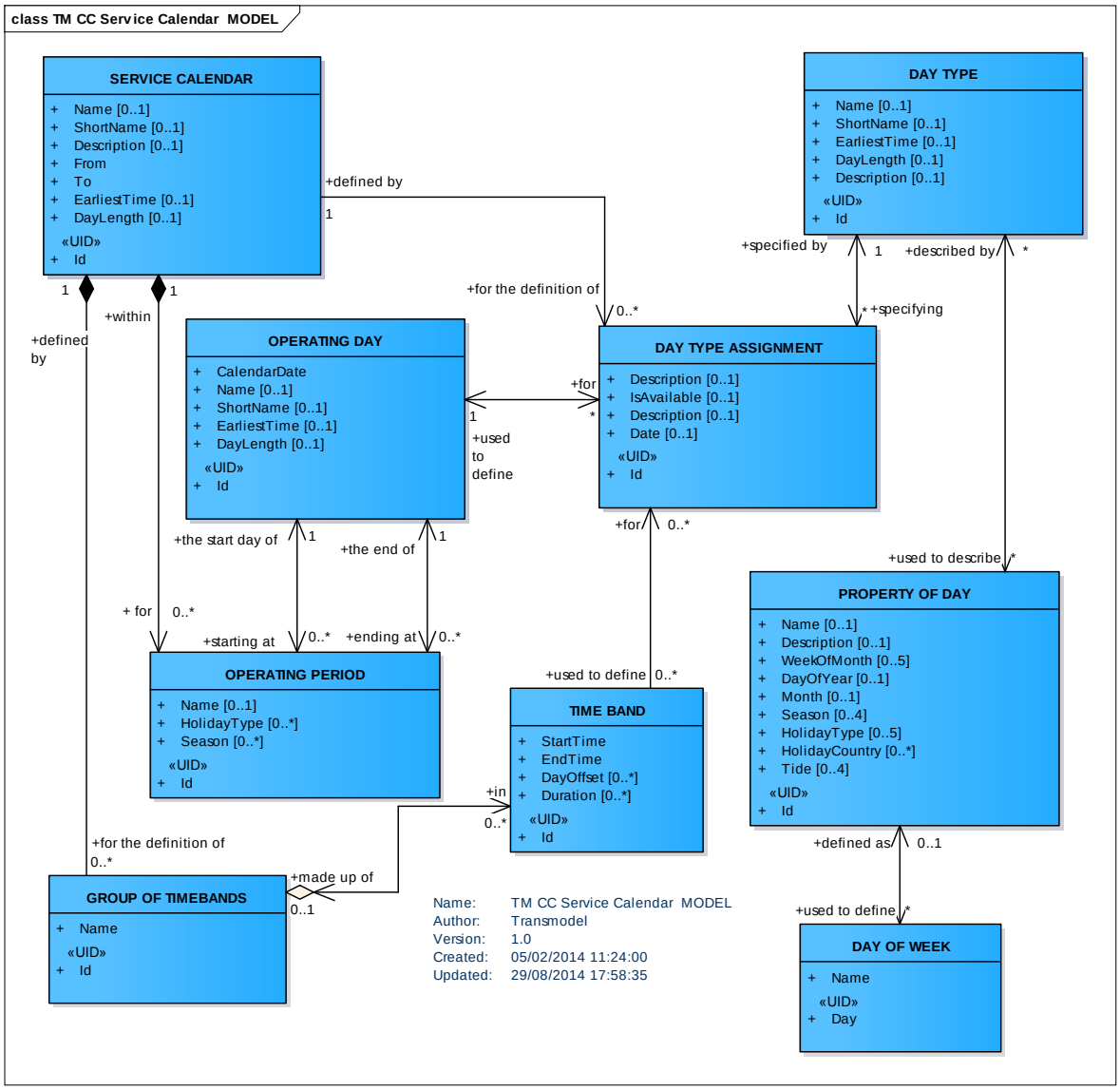

Figure 38 — Service Calendar – Conceptual Model

5.6.5 Availability Condition

5.6.5.1 AVAILABILITY CONDITION – Conceptual Model

AVAILABILITY CONDITION is a specialization of VALIDITY CONDITION to specify precise temporal conditions. For example, an access to a station may be valid (it exists) but not available for some of the time (it is closed between 9 pm and 6 am). Both VALIDITY CONDITIONs and AVAILABILITY CONDITIONs may be associated for the same entity.

An AVAILABILITY CONDITION can be defined by specific DAY TYPEs and/or OPERATING DAYs. It may be further qualified by one or more of TIME BANDs. The DATED AVAILABILITY CONDITION being the instance of VALIDITY CONDITION on a specific CALENDAR DAY.

Examples of use of AVAILABILITY CONDITION include accesses to public transport network, equipment, stopping places, etc.

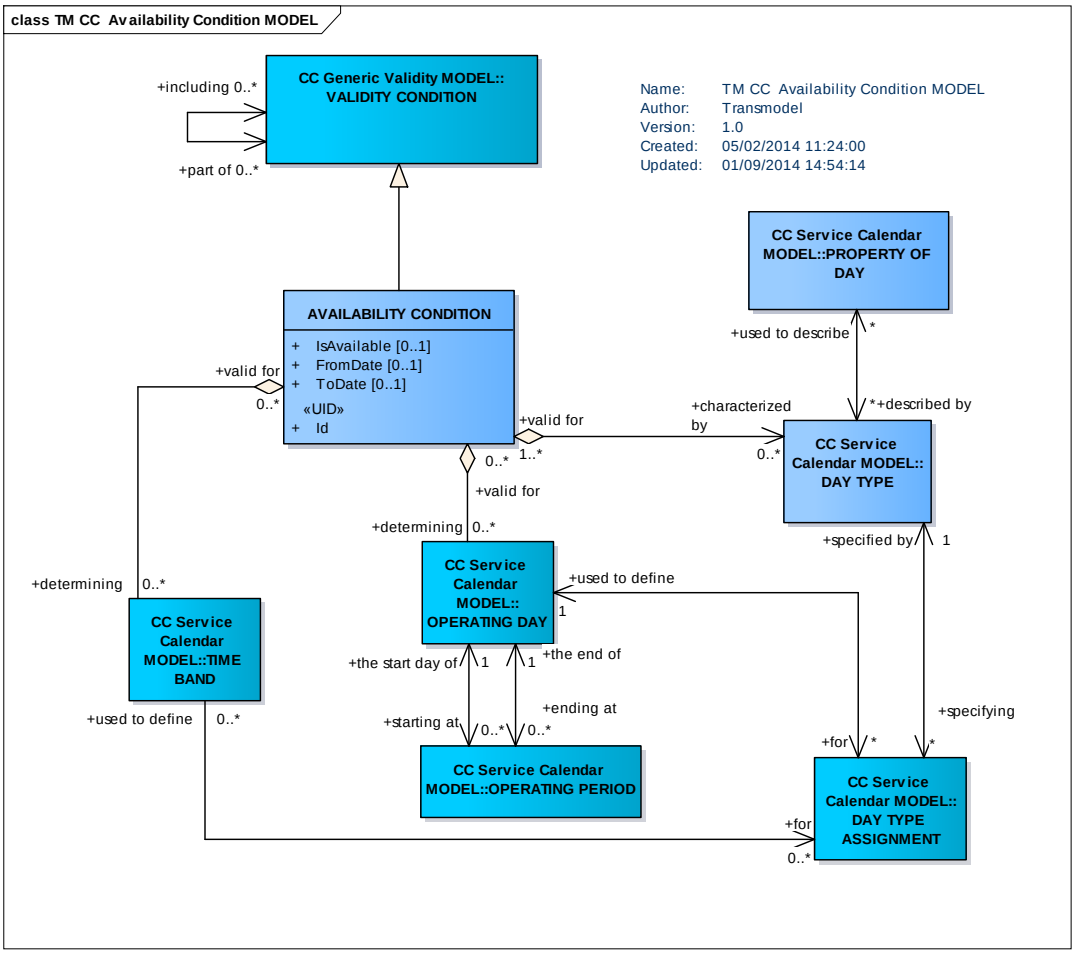

Figure 39 —Availability Condition – Conceptual Model

5.6.6 Topographic Place

5.6.6.1 TOPOGRAPHIC PLACE – Conceptual Model

The TOPOGRAPHIC PLACE model represents the named settlements and other places to which PT data may be related. It also includes a an ADDRESS model, which can be used for stop finding and other purposes.

A TOPOGRAPHIC PLACE may be located within one or more COUNTRies. TOPOGRAPHIC PLACEs may overlap. They may also be contained inside another TOPOGRAPHIC PLACE.

ROAD ADDRESS and POSTAL ADDRESS can also be located within a COUNTRY.

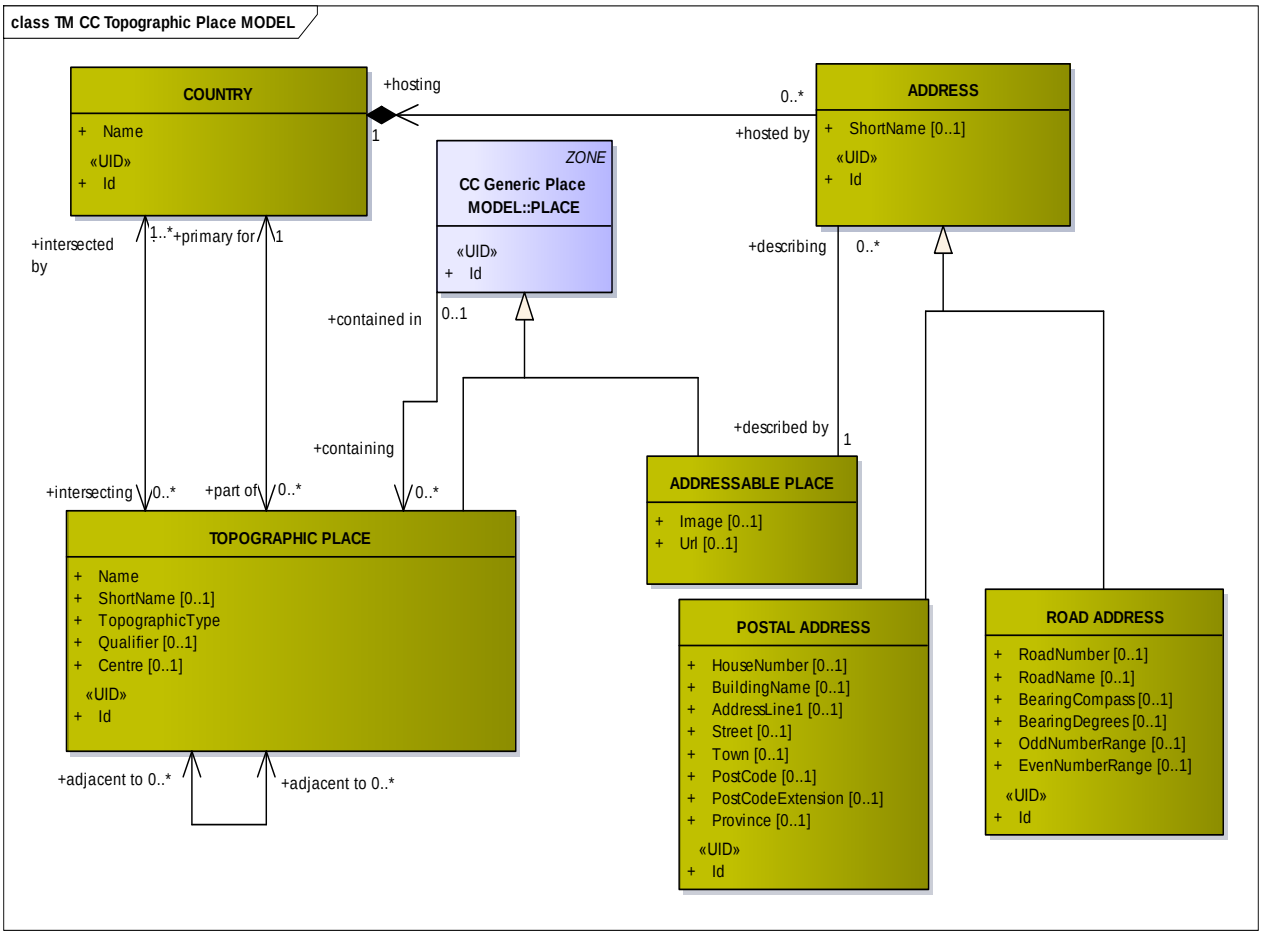

Figure 40 — Topographic Place – Conceptual Model

5.6.7 Transport Organisations

The TRANSPORT ORGANISATION model defines organisations which run Public Transport, specifically OPERATORs of Transport and the AUTHORITY. OPERATORs may be divided into OPERATING DEPARTMENTs.

The generic term OPERATOR expresses a rather general responsibility for the operation of public transport or, if it exists, for a concessionary contract for public transport. The direct operational responsibility for the execution of this contract maybe handed to a specific OPERATING DEPARTMENT of the ORGANISATIONAL UNIT. The OPERATOR acts as an alias for the ORGANISATIONAL UNIT. Part of the contract-execution can be subcontracted to another OPERATOR. Or even the public transport for a whole area can be divided into several contracts, where a GROUP OF OPERATORs are actually the executors of the public transport timetables for a whole area.

5.6.7.1 TRANSPORT ORGANISATIONs – Conceptual Model

An ORGANISATION PART of an ORGANISATION acts as an ORGANISATIONAL UNIT responsible for the determination of the PT Services, that need to be delivered in an OPERATIONAL CONTEXT often defined or limited to one TRANSPORT MODE or even to one VEHICLE MODE or SUBMODE of one of its DEPARTMENTs. This defines the actual involved OPERATING DEPARTMENT that will act as the serving OPERATOR directly in charge of operations, and, when a contractual link to an AUTHORITY exists, for the ordered services by the public transport AUTHORITY. The serving OPERATORs can be combined for executing this service in a GROUP OF OPERATORS.

It is indeed possible to create a GROUP OF OPERATORs for a specific PURPOSE OF GROUPING, required for special functions or processes in public transport, e.g. control of operations, fare collection, passenger information, etc.

A CONTROL CENTRE is an organisational concept for where operational management takes place.

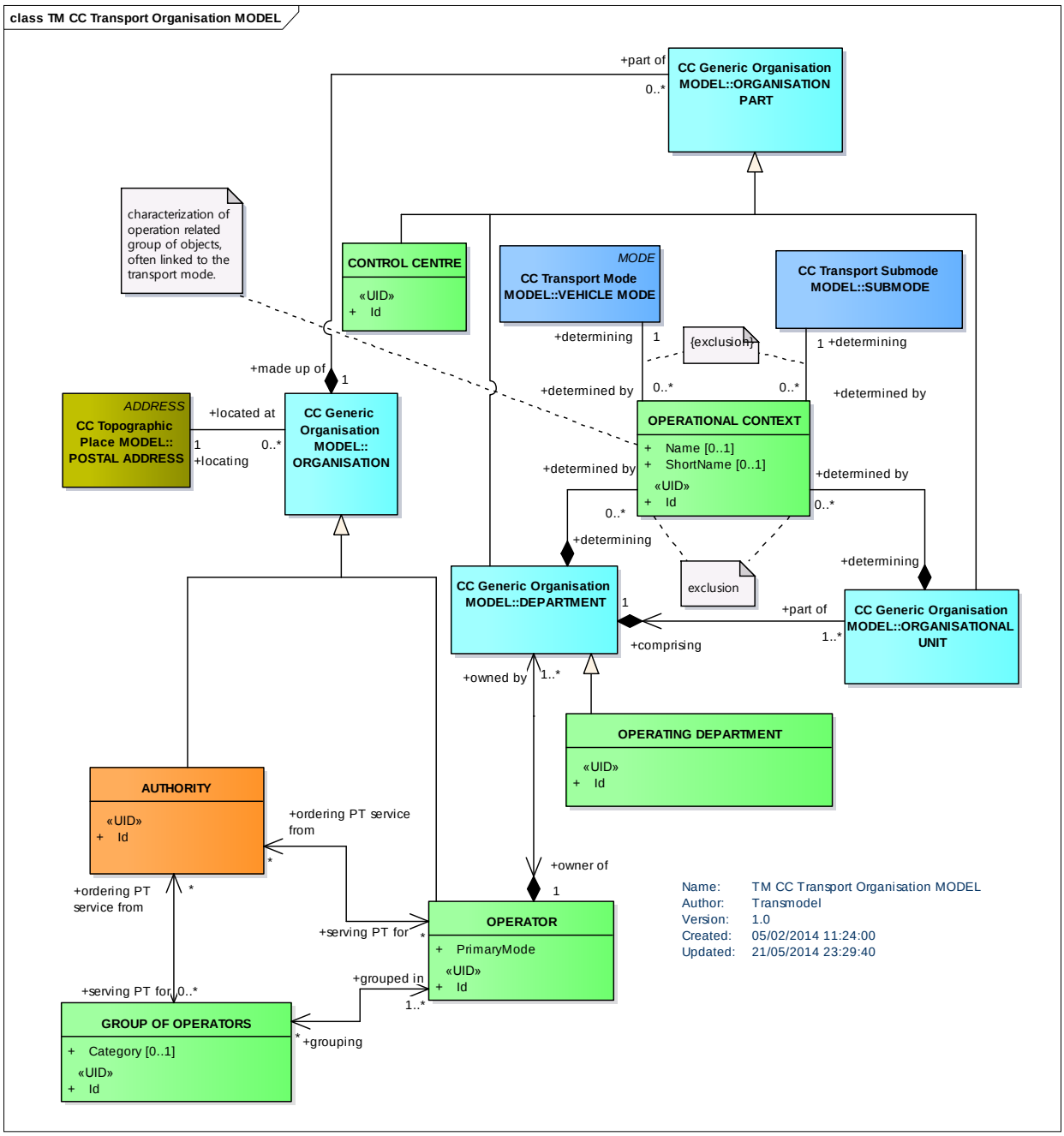

Figure 41 — Transport Organisations – Conceptual Model

5.6.8 Additional Organisations

5.6.8.1 ADDITIONAL ORGANISATIONs – Conceptual Model

The ADDITIONAL ORGANISATION model describes additional ORGANISATION types other than OPERATOR & AUTHORITY, but that are also related to the execution of part of the public transport services.

The model depicts them as different institutions, so with the alias OTHER ORGANISATION it pictures the possible relationships that can be involved in various types of the execution of a public transport contract.

A TRAVEL AGENT takes reservations.

A MANAGEMENT AGENT operates on behalf of another organisation, for example to collect data.

A SERVICED ORGANISATION is an organisation for whom a transport service is provided, for example a school or works and for which the schedule may vary according to whether the organisation is open for business. This is described through the ORGANISATION DAY TYPE (inheriting from DAY TYPE) and SERVICE CALENDAR for a given OPERATNG PERIOD, with DAY TYPE ASSIGNMENT.

An ORGANISATION can be reached at a POSTAL ADDRESS and can be made up of several ORGANISATIONAL PARTs.

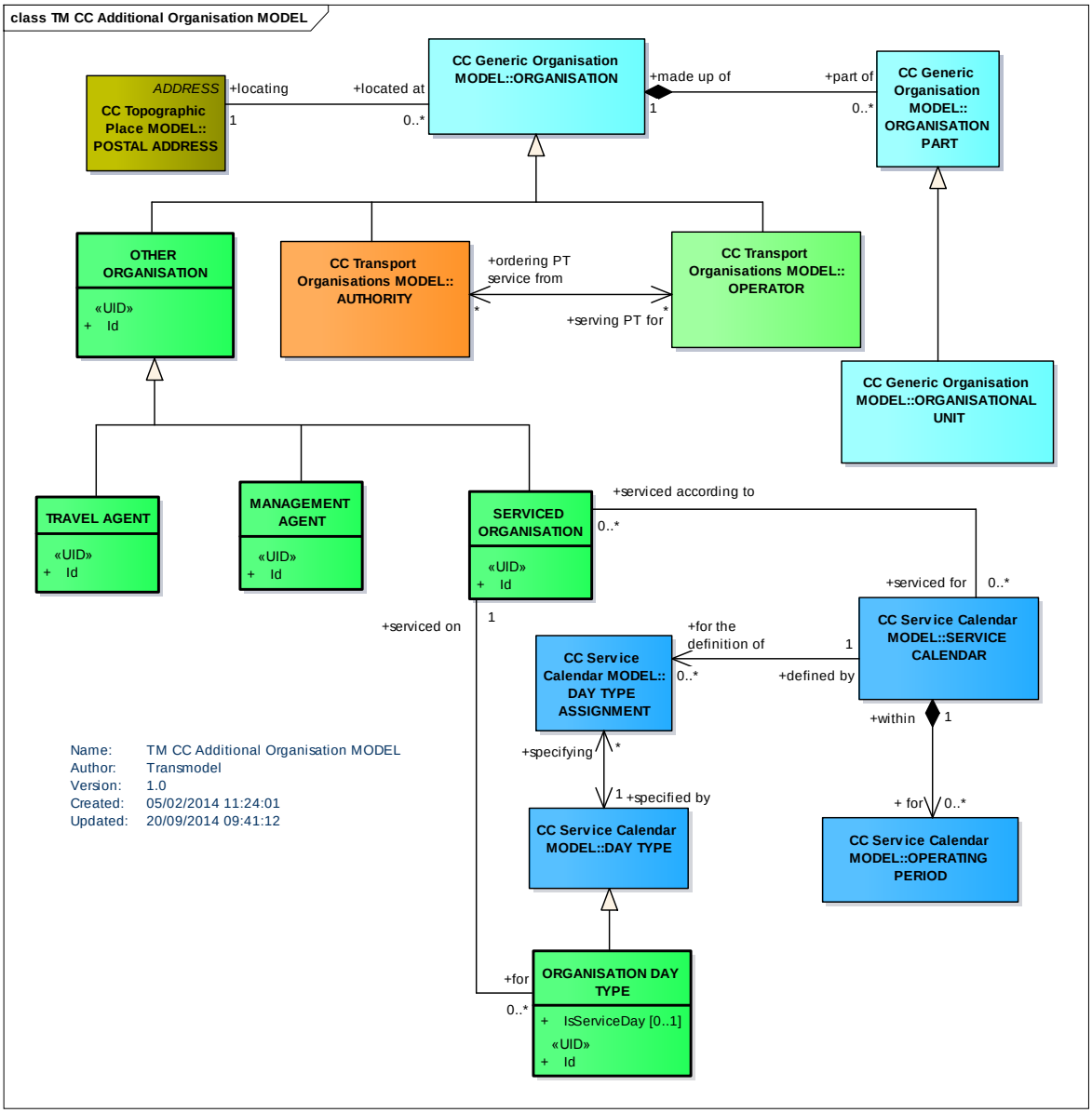

Figure 42 — Additional Organisations – Conceptual Model

5.6.9 Generic Equipment

5.6.9.1 Generic EQUIPMENT – Conceptual Model

The Generic EQUIPMENT Model represents items of equipment which may be located on a vehicle or at a site. There are many different types of EQUIPMENT, each of which may have specific properties. These are classified under two main specializations;

- INSTALLED EQUIPMENT, fixed EQUIPMENT that may be installed on a site, such as a door, lift, gate etc. or on a VEHICLE. This is further characterized into:
    - PLACE EQUIPMENT: equipment which may be located only on a fixed site, such as a barrier, bench, lift and of which the location may be specified by an EQUIPMENT PLACE;
    - ACTUAL VEHICLE EQUIPMENT: an item of equipment of a particular type actually installed on board an individual vehicle;
    - PASSENGER EQUIPMENT: equipment which may be located on either a vehicle or a site, such as a display terminal, ticket validator or WC.
- LOCAL SERVICE: an intangible service that is provided at a site such as selling tickets, porterage, etc.

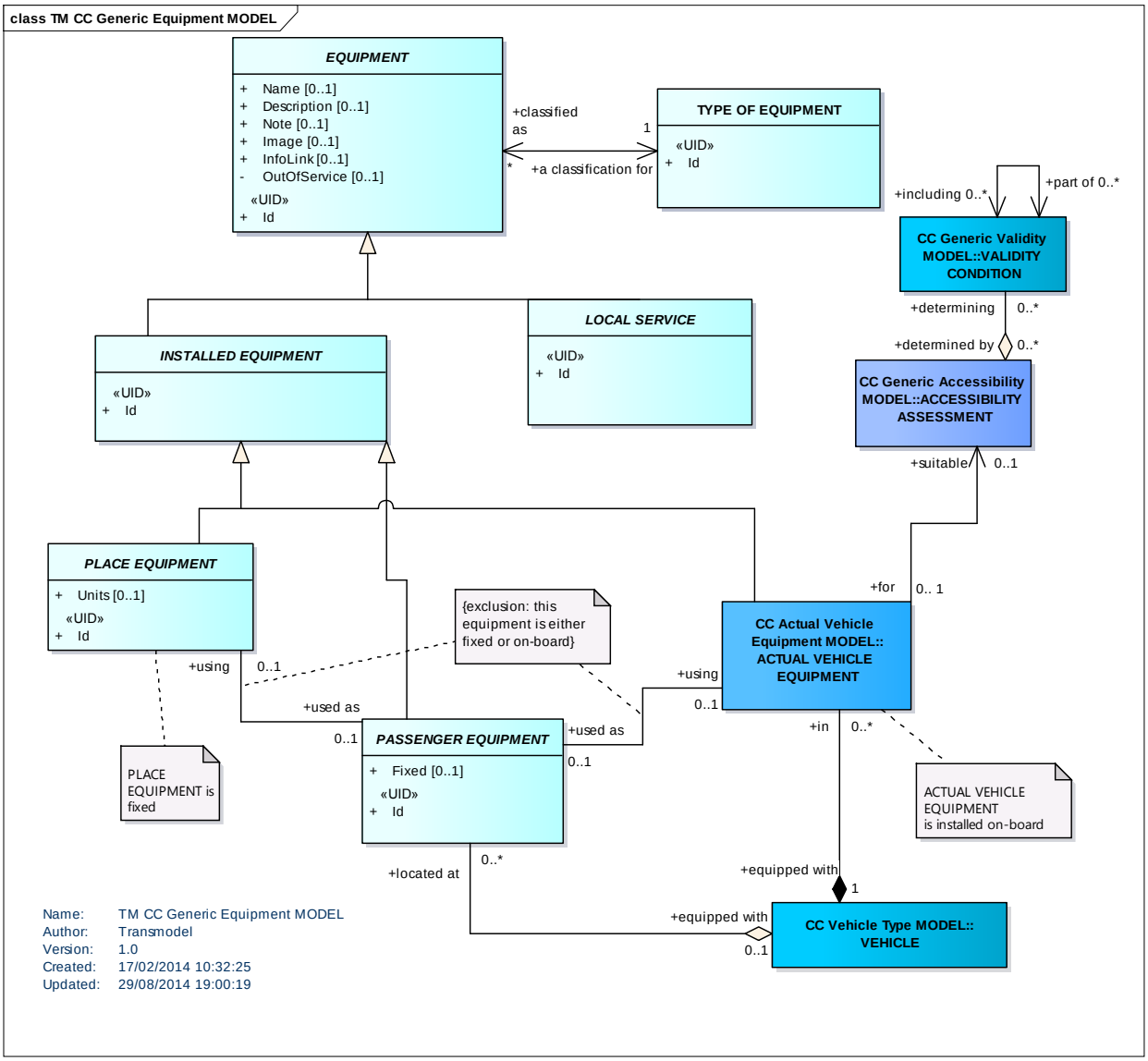

Figure 43 — Generic Equipment – Conceptual Model

5.6.9.2 Vehicle Equipment – Conceptual Model

ACTUAL VEHICLE EQUIPMENT can be used to specify the EQUIPMENT available on a VEHICLE of a specific VEHICLE TYPE.

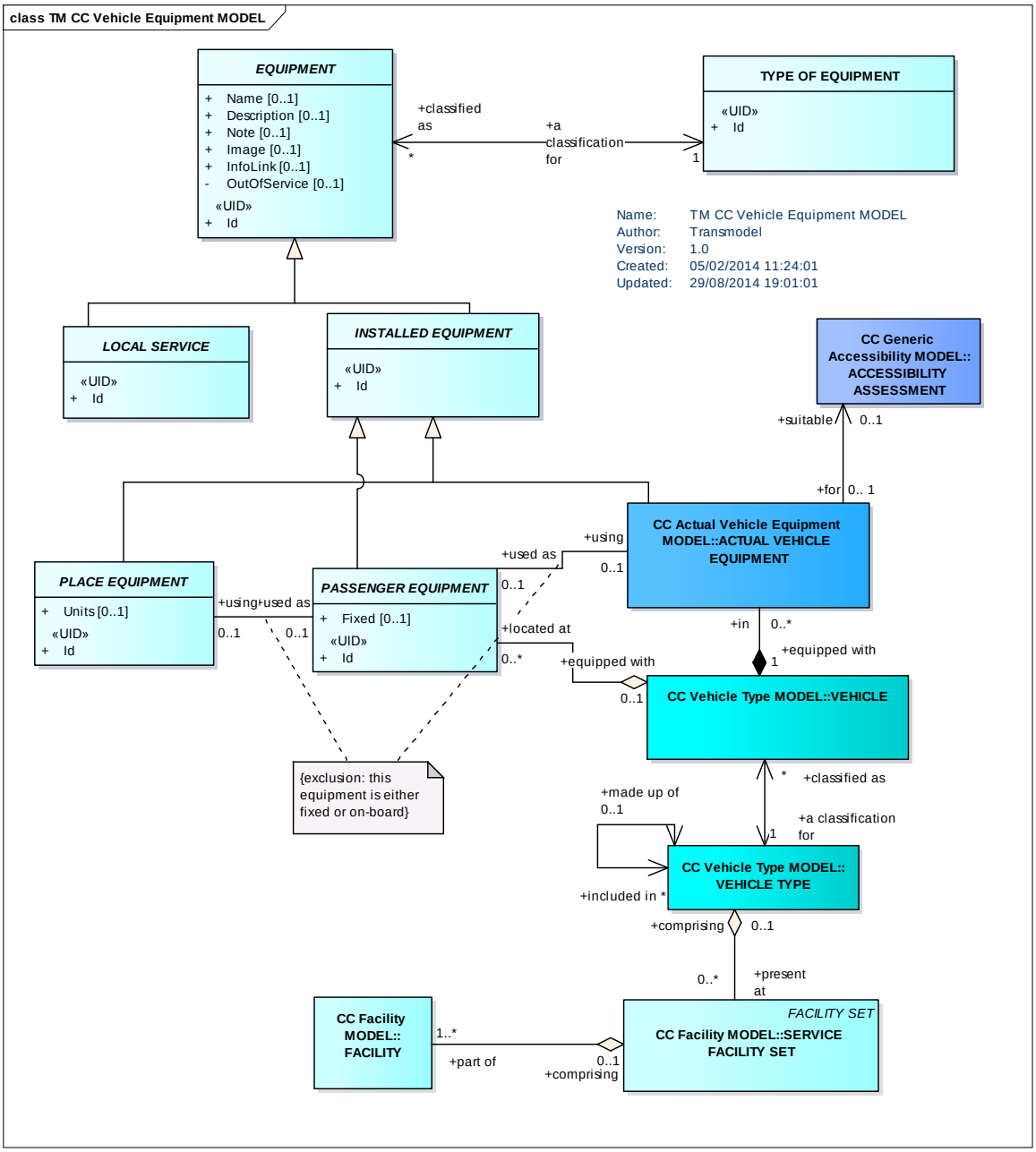

Figure 44 —Vehicle Equipment – Conceptual Model

5.6.10 Vehicle Type

5.6.10.1 VEHICLE TYPE – Conceptual Model

The VEHICLE entity is used to describe the physical public transport vehicles available for short-term planning of operations and daily assignment (in contrast to logical vehicles considered for resource planning). Each VEHICLE must be classified as of a particular VEHICLE TYPE.

The VEHICLE TYPE Model represents a description of VEHICLES through their properties.

VEHICLES may be classified according to the vehicle scheduling requirements as to model and capacity and on board facilities (e.g. standard bus, double-deck, etc.).

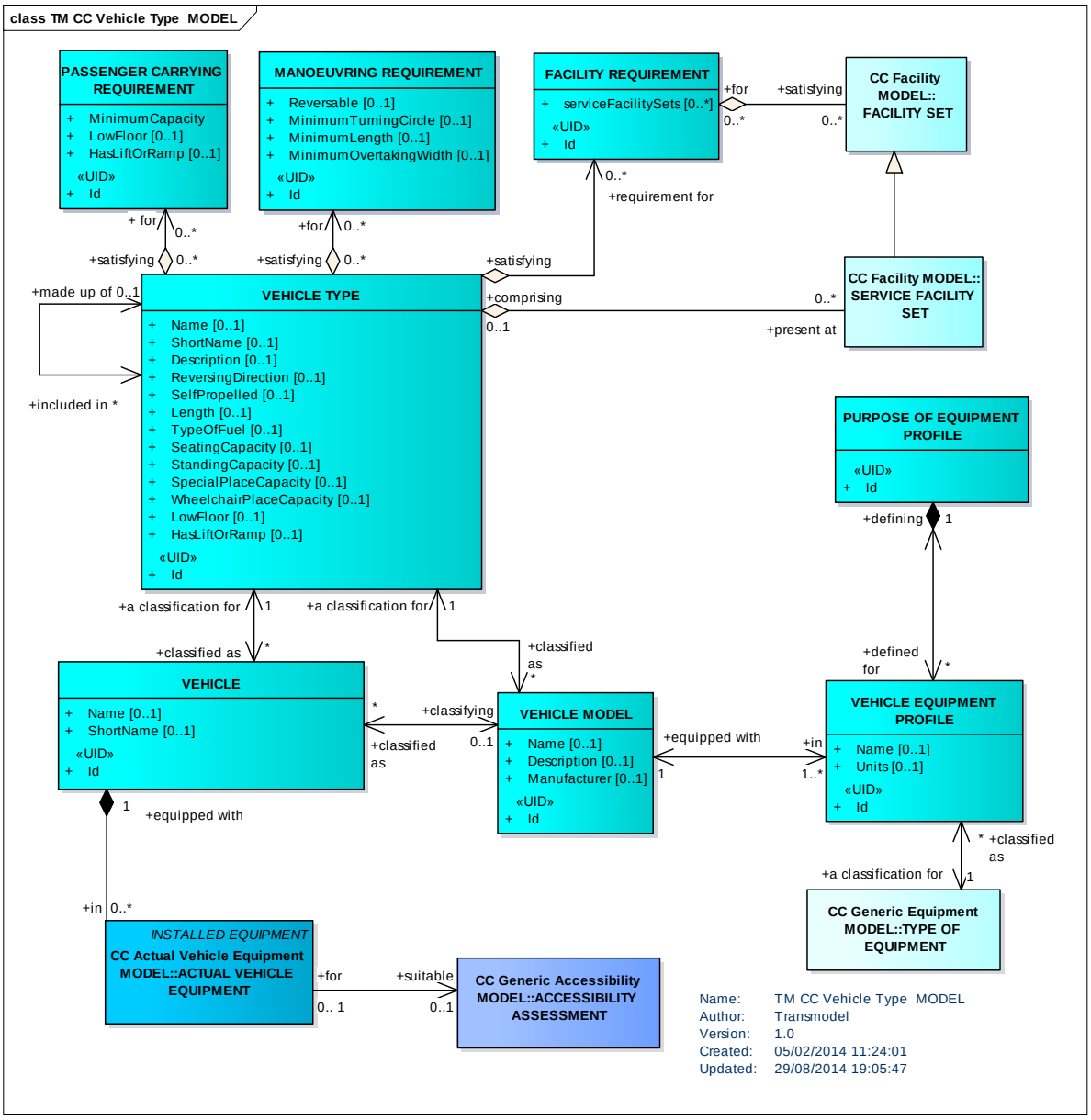

Figure 45 — Vehicle Type – Conceptual Model

5.6.11 Actual Vehicle Equipment

5.6.11.1 ACTUAL VEHICLE EQUIPMENT – Conceptual Model

The ACTUAL VEHICLE EQUIPMENT specifies the type of EQUIPMENT to use in a given VEHICLE.

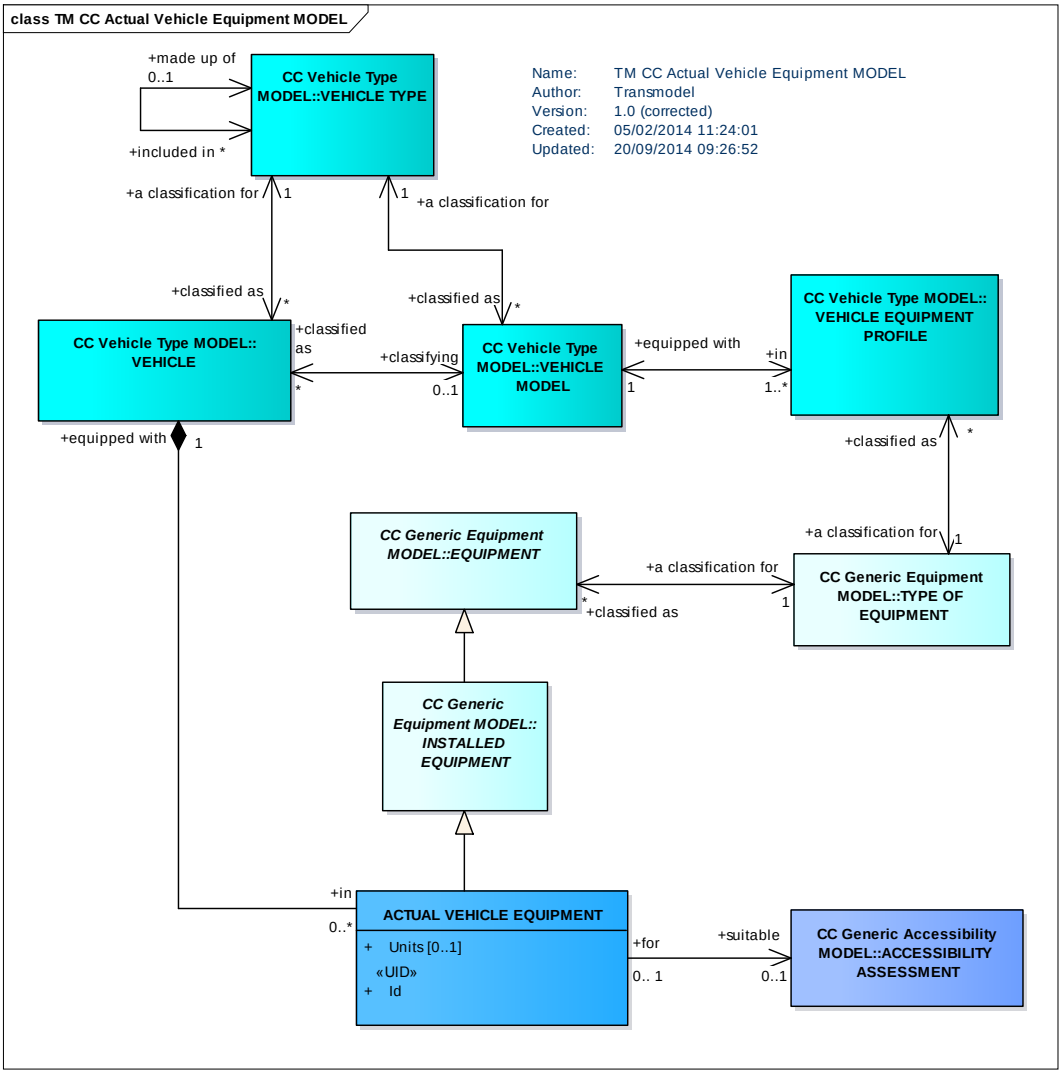

Figure 46 — Actual Vehicle Equipment – Conceptual Model

5.6.12 Vehicle Passenger Equipment

5.6.12.1 Vehicle Passenger Equipment – Conceptual Model

Boarding properties of a VEHICLE are described by two specialisations of the ACTUAL VEHICLE EQUIPMENT:

- WHEELCHAIR VEHICLE EQUIPMENT describes on-board capacity for wheelchairs;

- VEHICLE ACCESS EQUIPMENT describes on-board equipment allowing to access vehicles e.g. low floor, ramp, access area with adapted dimensions, etc.

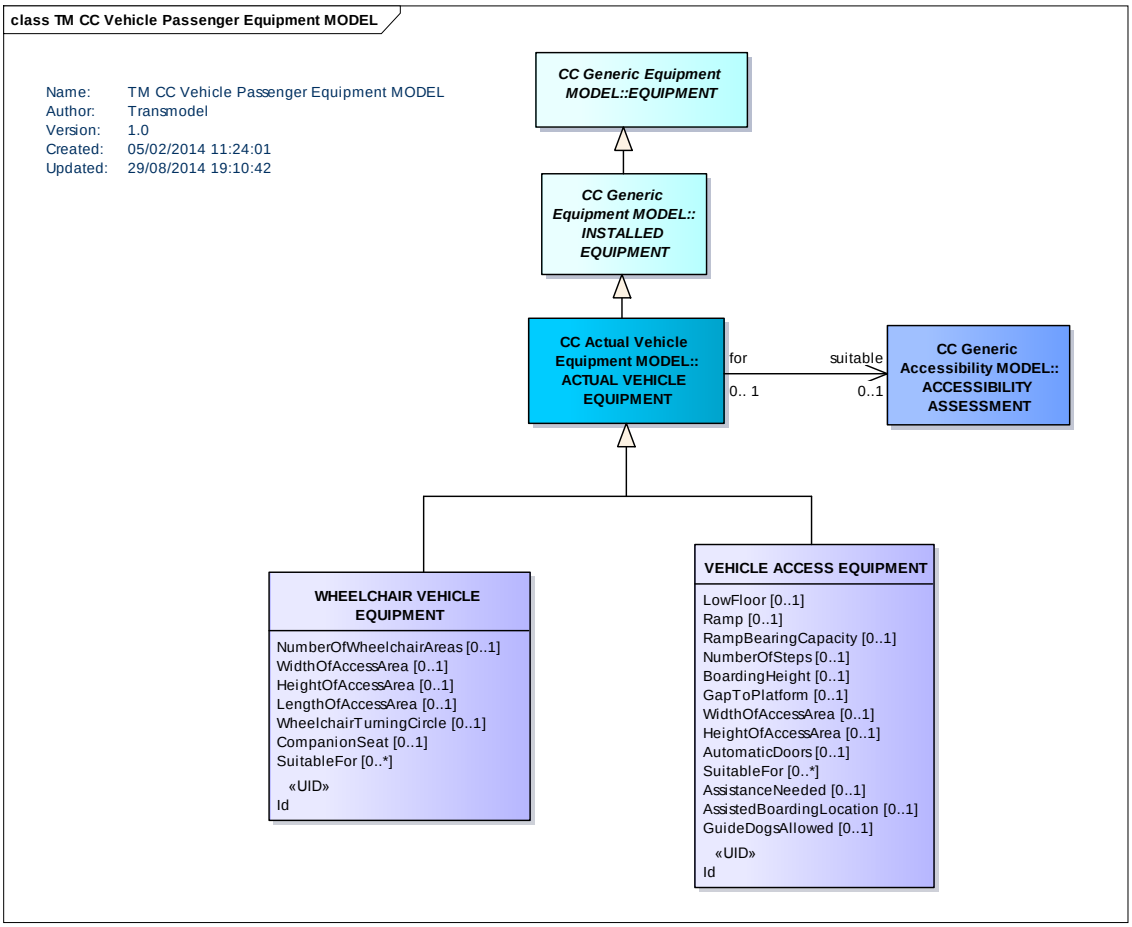

Figure 47 — Vehicle Passenger Equipment – Conceptual Model

5.6.13 Facility

5.6.13.1 FACILITY – Conceptual Model

A FACILITY provides just a simple name of a capability. Detailed properties may be stated for some types of facilities by a corresponding EQUIPMENT type.

FACILITies are combined into FACILITY SETs – reusable standard combinations of facilities.

A SERVICE FACILITY SET describes a set of FACILITIES for use on a service. It can include information about the ACCOMMODATION on board. A SITE FACILITY SET describes a set of FACILITIES available at a fixed place.

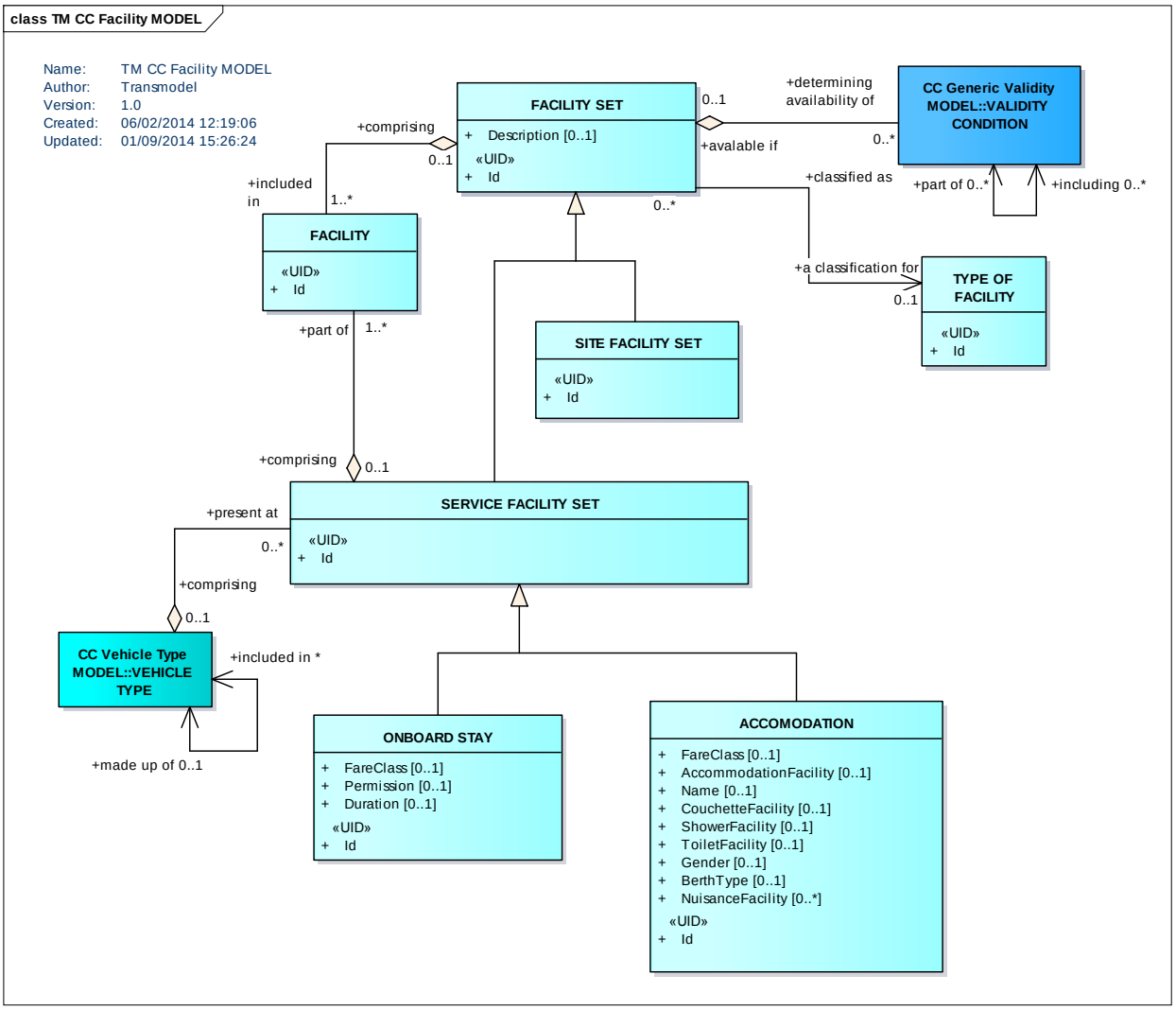

Figure 48 — Facility – Conceptual Model

5.6.14 Train

5.6.14.1 TRAIN – Conceptual Model

The TRAIN Conceptual model represents VEHICLE TYPE properties that are peculiar to TRAINs. A TRAIN may comprise not just a single VEHICLE but a chain of carriages, TRAIN ELEMENTS, assembled as TRAIN COMPONENTs. Groups of carriages may be managed as sections by composing TRAINs into a COMPOUND TRAIN made up of TRAINs IN COMPOUND TRAIN, for example in a Train that joins or splits.

TRAIN ELEMENTS can be classified with a TYPE OF TRAIN.

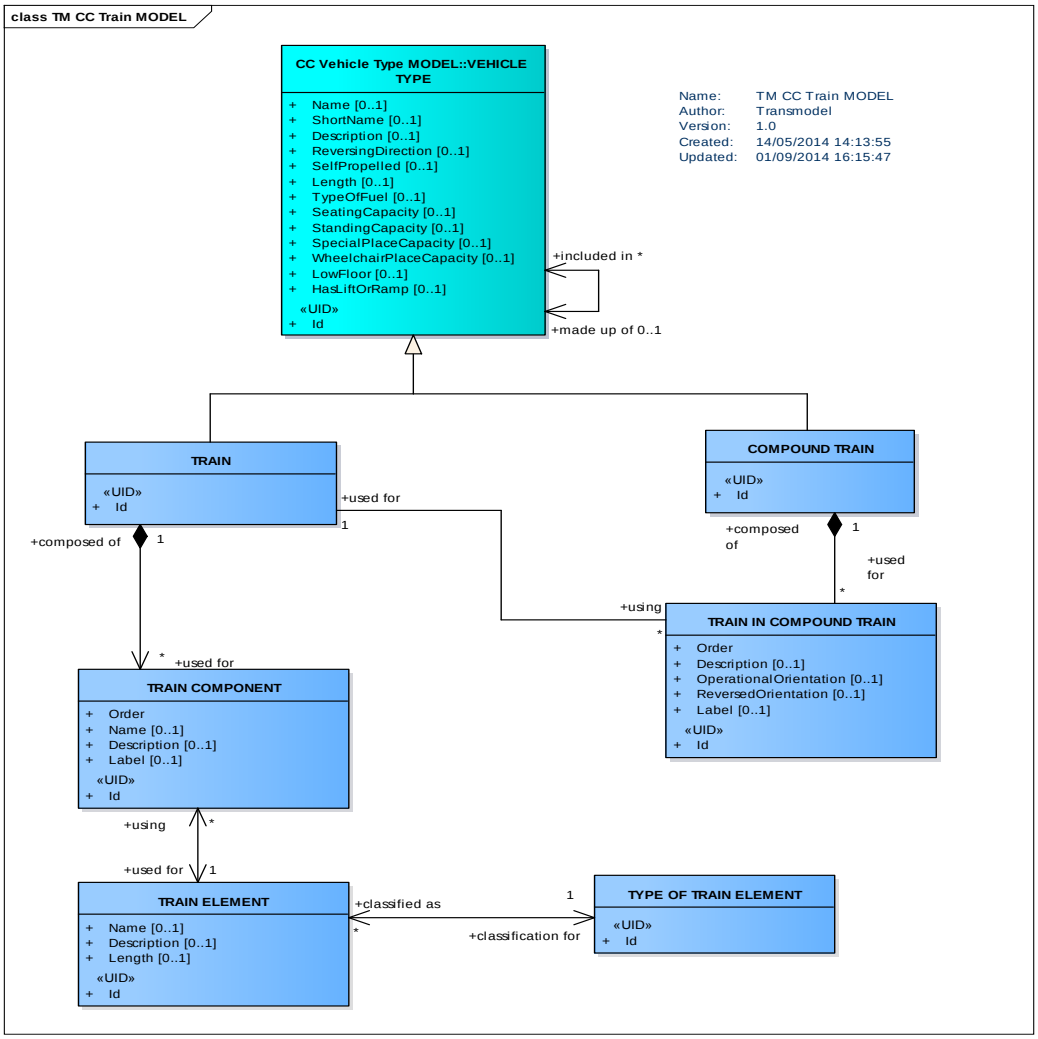

Figure 49 — Train – Conceptual Model

5.6.14.2 Example of a Train

The following figure shows how a train can be represented as an ordered collection of TRAIN COMPONENTs.

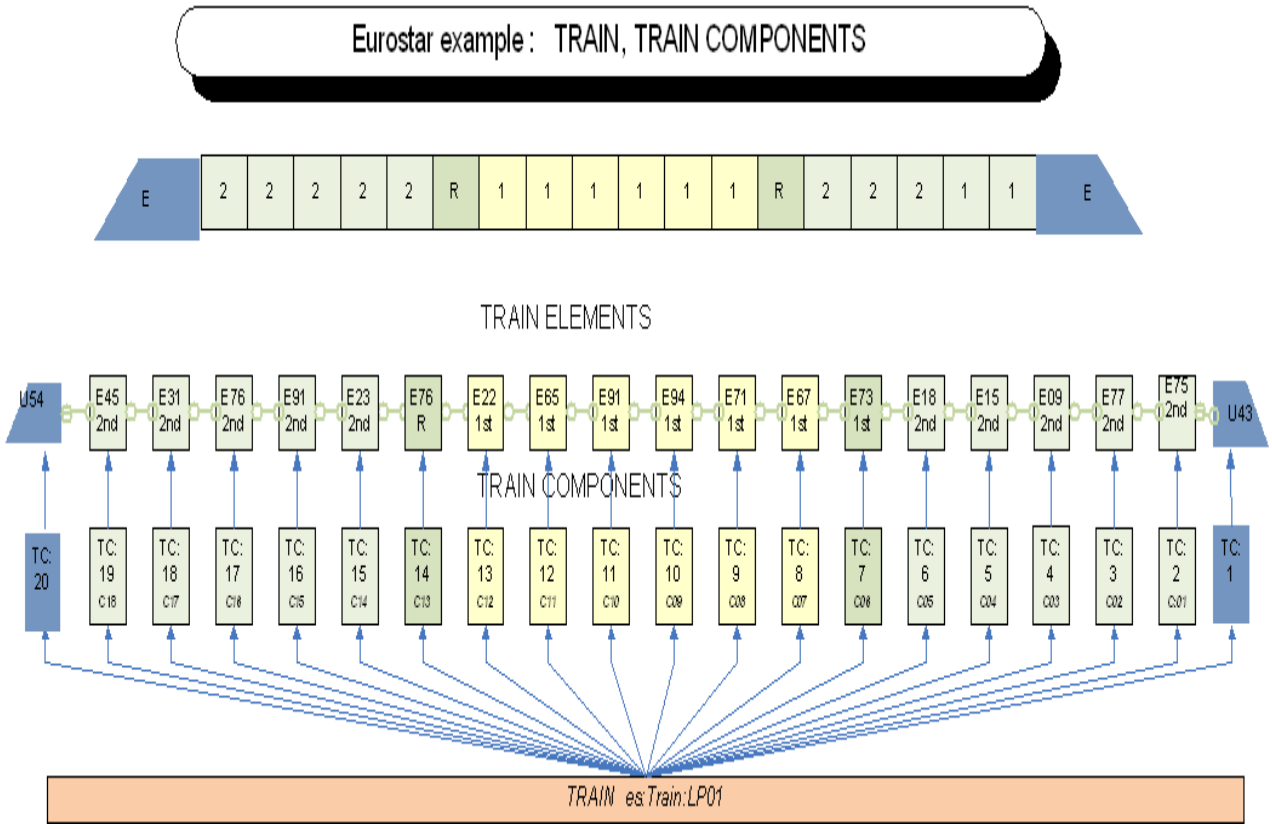

Figure 50 — Train Elements Example (source NeTEx)

The following figure shows a real life example of a Train Makeup.

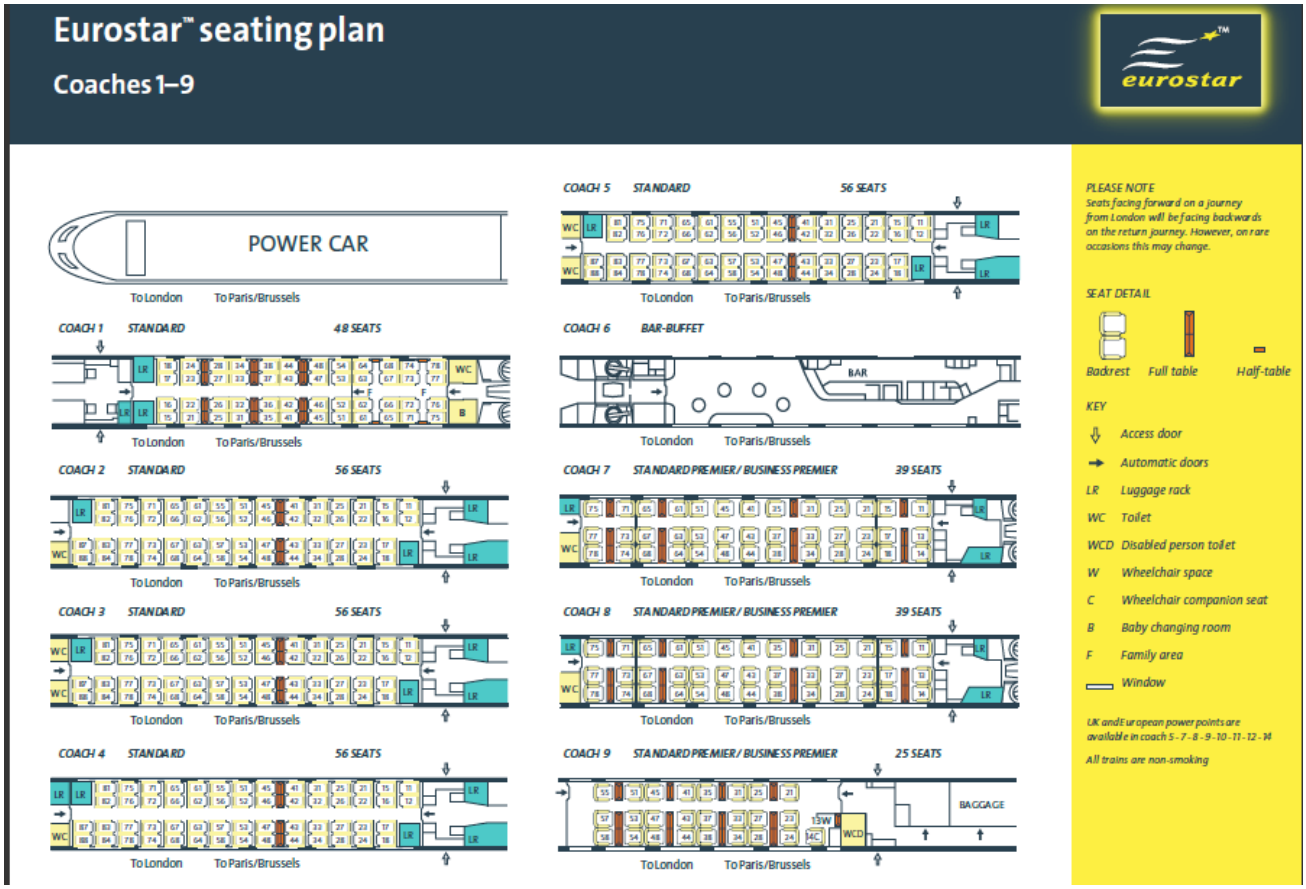

Figure 51 — Eurostar Train Makeup (source NeTEx)

5.6.15 Schematic Map

5.6.15.1 SCHEMATIC MAP – Conceptual Model

The published passenger Information for a complex transport interchange often includes schematic maps to show the relative parts and facilities located within the interchange. In an interactive presentation to passengers using an electronic device, these maps may be linked to other elements, for example, to see the properties of a piece of equipment.

Transmodel includes a generic representation of such a map that may be linked to different Transmodel topological elements as further model parts will show it.

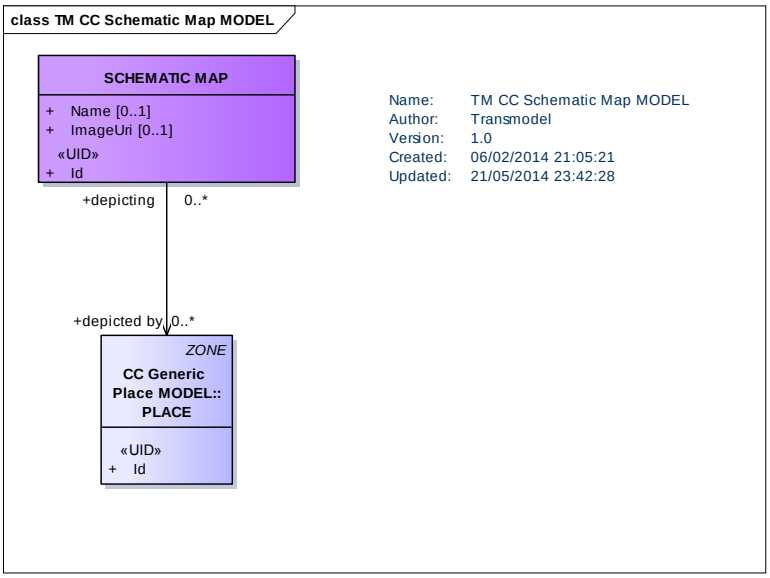

Figure 52 — Schematic Map – Conceptual Model

The following figures show examples of a SCHEMATIC MAP for the PLACE Wimbledon station.

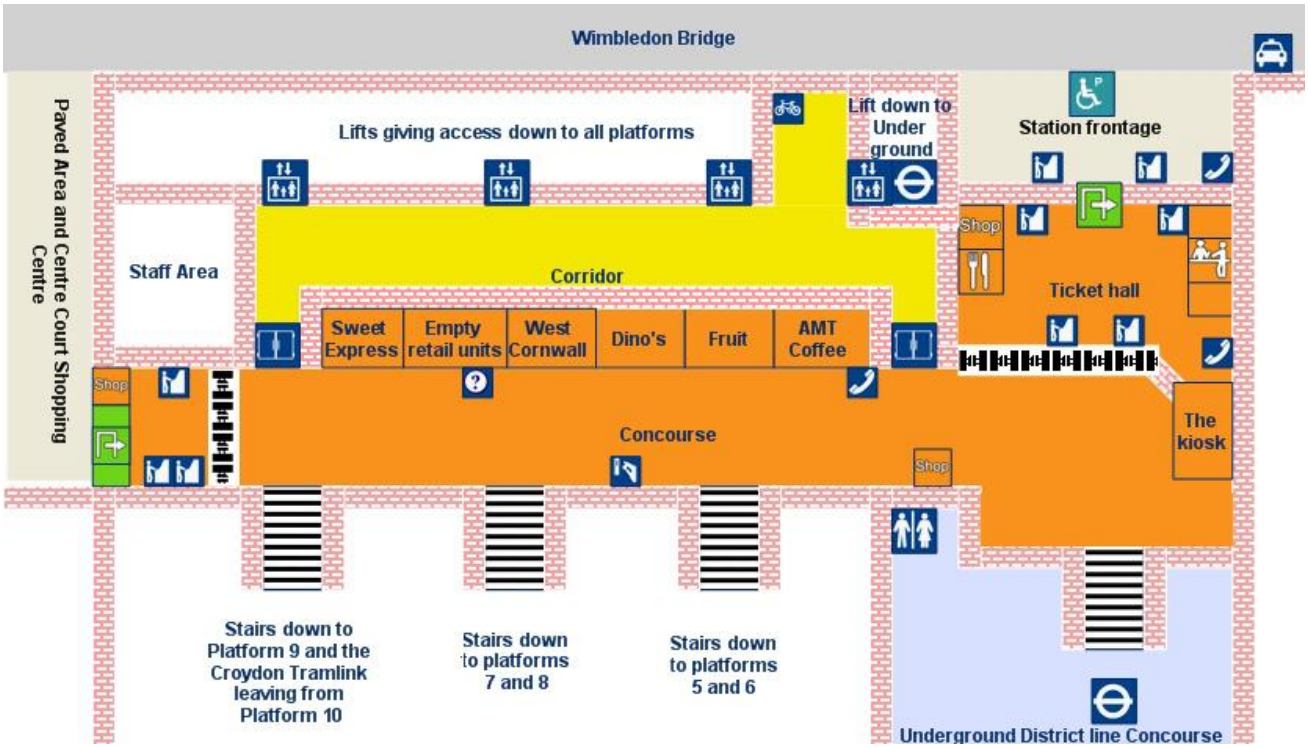

Figure 53 — Wimbledon Station plan: Ground floor (NRE Stations Made Easy) –(source NeTEx)

5.6.16 Notice

5.6.16.1 NOTICE – Conceptual Model

The NOTICE Model defines reusable text note elements that may be attached to timetables as footnotes, used as announcements, etc. NOTICES are associated with other entities using a NOTICE ASSIGNMENT. NOTICES may be classified with a TYPE OF NOTICE.

Each NOTICE may have several alternative formats as specified by a DELIVERY VARIANT.

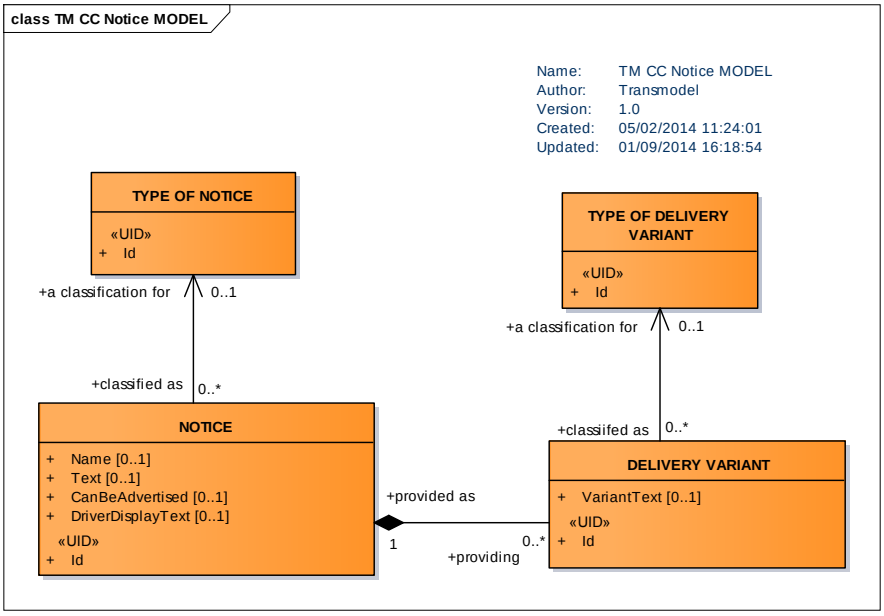

Figure 54 — Notice – Conceptual Model

5.6.17 Service Restriction

5.6.17.1 SERVICE RESTRICTION - Conceptual Model

Figure 55 defines some parameters describing the limitations as regards the use of equipment or service:

- CLASS OF USE represents the fare class e.g. first class, business class, economy class, etc;

- PAYMENT METHOD is the way the service is paid: cash, coin, credit card, cheque, etc

- TYPE OF TICKET may be a standard ticket (without any reduction), a concession, a season ticket, a group ticket, etc

- TICKET SCOPE is the broad geographic validity if the ticket: local, national, international.

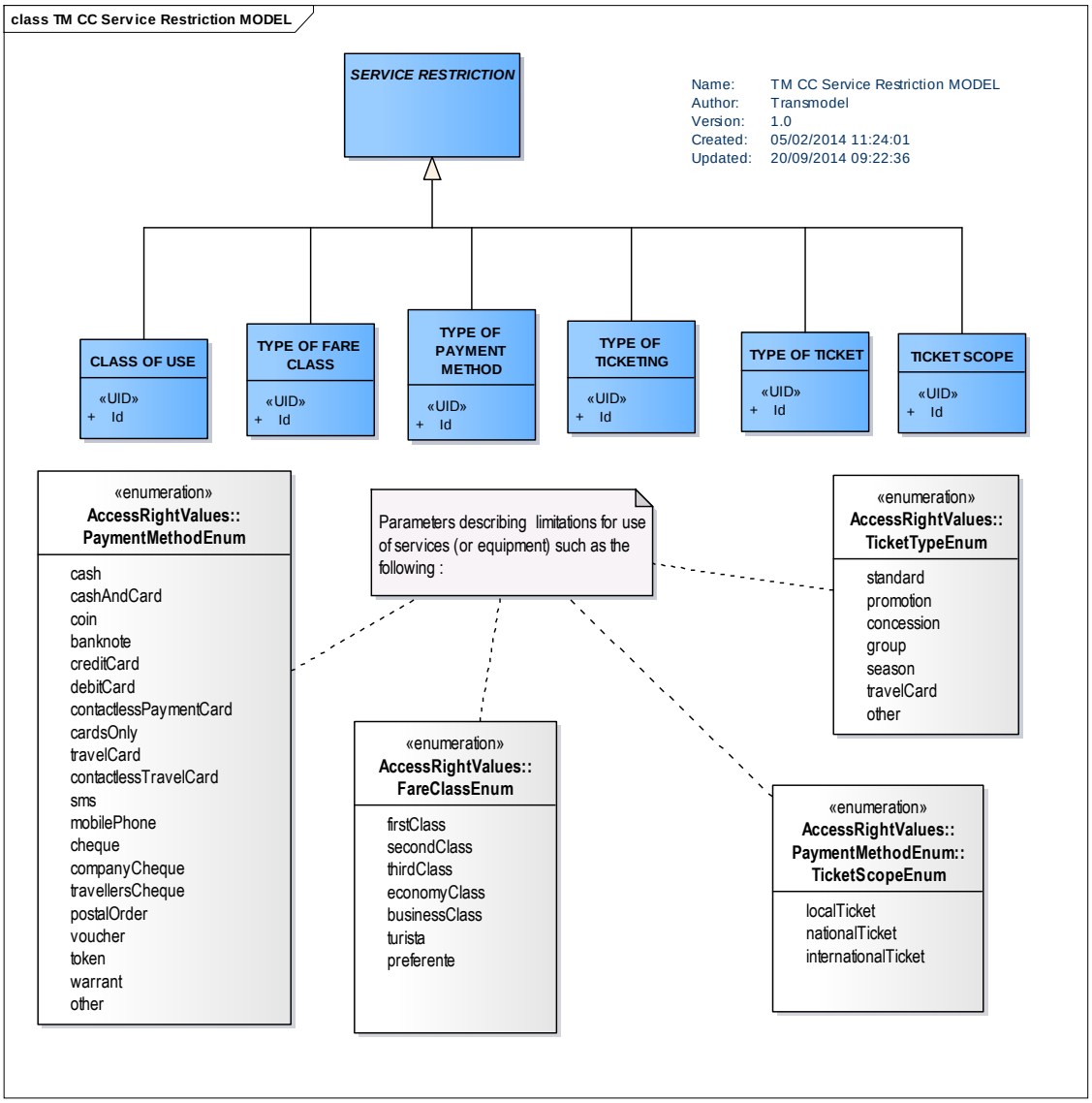

Figure 55— Service Restriction – Conceptual Model

5.6.18 Alternative Name

5.6.18.1 ALTERNATIVE NAME – Conceptual Model

ALTERNATIVE NAME presents a generic mechanism used to provide aliases i.e. alternative names for data elements.

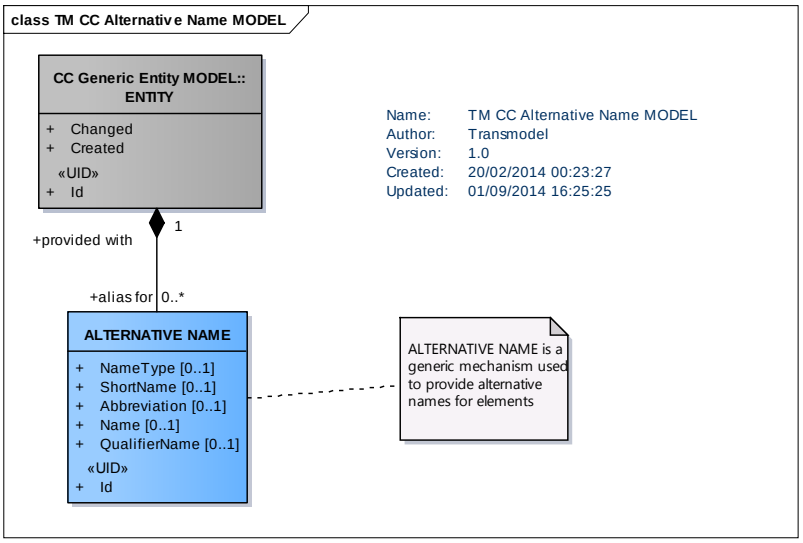

Figure 56 — Alternative Name – Conceptual Model

Appendix A – Data Dictionary

ACCESS_ (CC Generic Place MODEL)

The physical (spatial) possibility for a passenger to access or leave the public transport system. This link may be used during a trip for:- the walking movement of a passenger from a PLACE (origin of the trip) to a SCHEDULED STOP POINT (origin of the PT TRIP), or- the walking movement from a SCHEDULED STOP POINT (destination of the PT TRIP) to a PLACE (destination of the trip).

Inherits from *(empty if no inheritance)*: ***TRANSFER***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

ACCESS END (CC Generic Place MODEL)

Origin or destination end of an ACCESS link. May indicate a POINT and/or PLACE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**

ACCESS MODE (CC Transport Mode MODEL)

A characterisation of the passenger movement according to the means of transport different from public transport (e.g. walk, bicycle, etc)

Inherits from *(empty if no inheritance)*: ***MODE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

ACCESSIBILITY ASSESSMENT (CC Generic Accessibility MODEL)

The accessibility characteristics of an entity used by passengers such as a STOP PLACE, or a STOP PLACE COMPONENT. Described by ACCESSIBILITY LIMITATIONs, and/or a set of SUITABILITies

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	MobilityImpairedAccess	*boolean*	0:1

ACCESSIBILITY LIMITATION (CC Generic Accessibility MODEL)

A categorisation of the accessibility characteristics of a SITE, e.g. a STOP PLACE or a STOP PLACE COMPONENT to indicate its usability by passengers with specific needs, for example, those needing wheelchair access, step-free access or wanting to avoid confined spaces such as lifts. A small number of well-defined categories are used that are chosen to allow the consistent capture of data and the efficient computation of routes for different classes of user.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	WheelchairAccess	*LimitationStatusEnum*	0:1
	StepFreeAccess	*LimitationStatusEnum*	0:1
	EscalatorFreeAccess	*LimitationStatusEnum*	0:1
	LiftFreeAccess	*LimitationStatusEnum*	0:1
	AudibleSignsAvailable	*LimitationStatusEnum*	0:1
	VisualSignsAvailable	*LimitationStatusEnum*	0:1

ACCOMODATION (CC Facility MODEL)

A combination of accommodation characteristics available on a service, e.g. "First Class Couchette with shower and 2 bunks".

Inherits from *(empty if no inheritance)*: ***SERVICE FACILITY SET***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		
	FareClass	*FareClassEnum*	0:1
	AccommodationFacility	*AccommodationFacilityEnum*	0:1
	Name	*MultilingualString*	0:1
	CouchetteFacility	*CouchetteFacilityEnum*	0:1
	ShowerFacility	*SanitaryFacilityEnum*	0:1
	ToiletFacility	*SanitaryFacilityEnum*	0:1
	Gender	*GenderLimitationEnum*	0:1
	BerthType	*BerthTypeEnum*	0:1
	NuisanceFacility	*NuisanceFacilityEnum*	0:*

ACTUAL VEHICLE EQUIPMENT (CC Actual Vehicle Equipment MODEL)

An item of equipment of a particular type in an individual VEHICLE.

Inherits from *(empty if no inheritance)*: ***INSTALLED EQUIPMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Units	*nonNegativeInteger*	0:1

ADDRESS (CC Topographic Place MODEL)

The descriptive data associated with a PLACE that can be used to describe the unique geographical context of a PLACE for the purposes of identifying it. May be refined as either a ROAD ADDRESS, a POSTAL ADDRESS or both.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	ShortName	*MultilingualString*	0:1

ADDRESSABLE PLACE (CC Topographic Place MODEL)

A type of PLACE to which passengers may refer to indicate the origin or a destination of a trip and that is so specific that it has an ADDRESS.

Inherits from *(empty if no inheritance)*: ***PLACE***			
Classifi-cation	**Name**	**Type**	**cardinality**
	Image	*anyUri*	0:1
	Url	*anyUri*	0:1

ADMINISTRATIVE ZONE (CC Generic Organisation MODEL)

The area of a district, a region, a city, a municipality, or other area with which an ORGANIZATION has a RESPONSIBILITY ROLE;

Inherits from *(empty if no inheritance)*: ***ZONE***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***id***		1:1
	ShortName	*MultilingualString*	0:1

ALTERNATIVE NAME (CC Alternative Name MODEL)

Alternative name for the entity.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	NameType	*NameTypeEnum*	0:1
	ShortName	*MultilingualString*	0:1
	Abbreviation	*MultilingualString*	0:1
	Name	*MultilingualString*	0:1
	QualifierName	*MultilingualString*	0:1

AUTHORITY (CC Transport Organisations MODEL)

The organisation under which the responsibility of organising the transport service in a certain area is placed.

Inherits from *(empty if no inheritance)*: ***ORGANISATION***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

AVAILABILITY CONDITION (CC Availability Condition MODEL)

A VALIDITY CONDITION expressed in terms of temporal parameters and referring to DAY TYPEs.

Inherits from *(empty if no inheritance)*: ***VALIDITY CONDITION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	IsAvailable	*boolean*	0:1
	FromDate	*dateTime*	0:1
	ToDate	*dateTime*	0:1

CLASS IN FRAME (CC Generic Version Frame MODEL)

The different CLASSEes IN REPOSITORY which can be relevant for corresponding VERSION FRAMEs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

CLASS IN REPOSITORY (CC Generic Entity MODEL)

Any ENTITY name belonging to the repository. e.g. DAY TYPE, PROPERTY OF DAY, TIME BAND, VEHICLE TYPE, etc, are relevant instances of CLASS IN REPOSITORY in the context of version management.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***	*NameOfClass*	1:1

CLASS OF USE (CC Service Restriction MODEL)

A classification of fare and other service classes by category of user entitled to use them.

Inherits from *(empty if no inheritance)*: ***SERVICE RESTRICTION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

COMPLEX FEATURE (CC Generic Zone and Feature MODEL)

An aggregate of SIMPLE FEATUREs and/or other COMPLEX FEATUREs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

COMPLEX FEATURE PROJECTION (CC Generic Projection MODEL)

An oriented correspondence: from one COMPLEX FEATURE in the source layer, onto an entity in a target layer: e.g. POINT, COMPLEX FEATURE, within a defined TYPE OF PROJECTION.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

COMPOSITE FRAME (CC Composite Frame MODEL)

A set of VERSION FRAMEs to which the same VALIDITY CONDITIONs have been assigned.

Inherits from *(empty if no inheritance)*: ***VERSION FRAME***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

COMPOUND TRAIN (CC Train MODEL)

A VEHICLE TYPE composed of a sequence of more than one vehicles of the type TRAIN.

Inherits from *(empty if no inheritance)*: ***VEHICLE TYPE***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

CONTACT DETAILS (CC Generic Organisation MODEL)

Contact details for ORGANISATION for public use.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	ContactPerson	*normalizedString*	0:1
	Email	*EmailAddressType*	0:1
	Fax	*PhoneNumberType*	0:1
	FurtherDetails	*xsd:string*	0:1
	Phone	*PhoneNumberType*	0:1
	Url	*anyURI*	0:1

CONTROL CENTRE (CC Transport Organisations MODEL)

An ORGANISATION PART for an operational team who are responsible for issuing commands to control the services.

Inherits from *(empty if no inheritance)*: ***ORGANISATION PART***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

COUNTRY (CC Topographic Place MODEL)

A jurisdictional geographic boundary. A COUNTRY normally has a two character IANA identifier.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***	*CountryEnum*	1:1
	Name	*MultilingualString*	1:1

DATA SOURCE (CC Generic Responsibility MODEL)

The DATA SOURCE identifies the system which has produced the data. References to a data source are useful in an interoperated computer system.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Email	*emailType*	0:1

DAY OF WEEK (CC Service Calendar MODEL)

A particular week day (from Monday to Sunday).

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Day***		1:1
	Name	*MultilingualString*	1:1

DAY TYPE (CC Service Calendar MODEL)

A type of day characterised by one or more properties which affect public transport operation. For example: weekday in school holidays.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	EarliestTime	*time*	0:1
	DayLength	*duration*	0:1
	Description	*MultilingualString*	0:1

DAY TYPE ASSIGNMENT (CC Service Calendar MODEL)

The assignment of operational characteristics, expressed by DAY TYPEs, to particular OPERATING DAYs within a SERVICE CALENDAR.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Description	*MultilingualString*	0:1
	IsAvailable	*boolean*	0:1
	Description	*MultilingualString*	0:1
	Date	*date*	0:1

DELIVERY VARIANT (CC Notice MODEL)

A variant text of a NOTICE for use in a specific media or delivery channel (voice, printed material, etc).

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***	*DeliveryIdVariantType*	1:1
	VariantText	*MultilingualString*	0:1

DELTA (CC Generic Delta MODEL)

A record of the detailed changes of a given ENTITY IN VERSION from one VERSION to the next one. A DELTA contains pairs of attributes' old values - new values.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	DeltaValue		1:1

DEPARTMENT (CC Generic Organisation MODEL)

An ORGANIZATION PART specific to a purpose and/or organisational structure.

Inherits from *(empty if no inheritance)*: ***ORGANISATION PART***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	1:1

ENCUMBRANCE NEED (CC Generic Accessibility MODEL)

A specific USER NEED, i.e. a requirement of a passenger travelling with luggage, animal or any other object requiring special arrangements to access public transport.

Inherits from *(empty if no inheritance)*: ***TYPE OF USER NEED***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Need	*EncumbranceNeedEnum*	1:1

ENTITY (CC Generic Entity MODEL)

Any data instance to be managed in an operational Version Management System. When several data sources coexist (multimodality and/or interoperability), an ENTITY has to be related to a given DATA SOURCE in which it is defined.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Changed	*dateTime*	1:1
	Created	*dateTime*	1:1

ENTITY IN VERSION (CC Generic Version MODEL)

The ENTITY associated to a given VERSION.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Modification	*ModificationEnum*	0:1

EQUIPMENT (CC Generic Equipment MODEL)

An item of equipment installed either fixed (PLACE EQUIPMENT) or on-board vehicles (VEHICLE EQUIPMENT). A service (LOCAL SERVICE such as LEFT LUGGAGE, TICKETING SERVICE) is considered as immaterial equipment as well.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	Note	*MultilingualString*	0:1
	Image	*anyURI*	0:1
	InfoLink	*InfoLink*	0:1
	OutOfService	*boolean*	0:1

FACILITY (CC Facility MODEL)

A named amenity available to the public at a SITE or on a SERVICE. A facility has no further properties other than a name. An EQUIPMENT or LOCAL SERVICE is used to describe the further properties provided as part of particular facility.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

FACILITY REQUIREMENT (CC Vehicle Type MODEL)

A classification of public transport vehicles according to the facilities available on the vehicle.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	serviceFacilitySets	*ServiceFacilitySet*	0:*

FACILITY SET (CC Facility MODEL)

Set of FACILITies available for a SERVICE JOURNEY or a JOURNEY PART. The set may be available only for a specific VEHICLE TYPE within the SERVICE (e.g. carriage equipped with low floor).

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Description	*MultilingualString*	0:1

GENERAL FRAME (CC General Frame MODEL)

Set of data containing information, to which the same VALIDITY CONDITIONs have been assigned.

Inherits from *(empty if no inheritance)*: ***VERSION FRAME***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

GROUP OF ENTITIES (CC Generic Grouping MODEL)

A set of ENTITies grouped together according to a PURPOSE OF GROUPING, e.g. grouping of stops known to the public by a common name.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1

GROUP OF LINK SEQUENCES (CC Generic Point & Link Sequence MODEL)

A grouping of LINK SEQUENCEs.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

GROUP OF LINKS (CC Generic Point & Link MODEL)

A grouping of LINKs. e.g. one GROUP OF LINKs may be managed by a same AUTHORITY.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

GROUP OF OPERATORS (CC Transport Organisations MODEL)

A group of OPERATORs having for instance common schemes for fare collection or passenger information.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Category	*normalizedString*	0:1

GROUP OF POINTS (CC Generic Point & Link MODEL)

A grouping of POINTs of a certain TYPE OF POINT and dedicated to a FUNCTIONAL PURPOSE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

GROUP OF TIMEBANDS (CC Service Calendar MODEL)

A grouping of TIME BANDs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		1:1

INSTALLED EQUIPMENT (CC Generic Equipment MODEL)

An item of equipment either fixed (PLACE EQUIPMENT) or on board i.e. associated with vehicles. This equipment is materialised as opposed to a service (LOCAL SERVICE) considered as an immaterial equipment.

Inherits from *(empty if no inheritance)*: ***EQUIPMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

LAYER (CC Generic Layer MODEL)

A user-defined GROUP OF ENTITies, specified for a particular functional purpose, associating data referring to a particular LOCATING SYSTEM.

Inherits from *(empty if no inheritance)*: ***GROUP OF ENTITIES***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

LINE SHAPE (CC Generic Projection MODEL)

The graphical shape of a LINK obtained from a formula or other means, using the LOCATION of its limiting POINTs and depending on the LOCATING SYSTEM used for the graphical representation.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Formula	*Name*	1:1
	Name	*normalizedString*	0:1

LINK (CC Generic Point & Link MODEL)

An oriented spatial object of dimension 1 with view to the overall description of a network, describing a connection between two POINTs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Distance	*DistanceType*	0:1

LINK IN LINK SEQUENCE (CC Generic Point & Link Sequence MODEL)

The order of a LINK in a LINK SEQUENCE to which it belongs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Order	*positiveInteger*	1:1

LINK PROJECTION (CC Generic Projection MODEL)

An oriented correspondence from one LINK of a source layer, onto an entity in a target layer: e.g. LINK SEQUENCE, COMPLEX FEATURE, within a defined TYPE OF PROJECTION.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

LINK SEQUENCE (CC Generic Point & Link Sequence MODEL)

An ordered sequence either of POINTs or of LINKs, defining a path through the network.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	Distance	*DistanceType*	0:1

LOCAL SERVICE (CC Generic Equipment MODEL)

A named service relating to the use of the SITE or transport services at a particular location, for example porterage, assistance for disabled users, booking offices etc. The service may have a VALIDITY CONDITION associated with it. A LOCAL SERVICE is treated as a form of immaterial EQUIPMENT.

Inherits from *(empty if no inheritance)*: ***EQUIPMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

LOCATING SYSTEM (CC Generic Location MODEL)

The system used as reference for location and graphical representation of the network and other spatial objects.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	LocatingSystemName	*LocatingSystemNameType*	1:1

LOCATION (CC Generic Location MODEL)

The position of a POINT with a reference to a given LOCATING SYSTEM (e. g. coordinates).

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Coordinates	*CordinateString*	0:1
	Latitude	*LatitudeType*	0:1
	Longitude	*LongitudeType*	0:1
	Altitude	*LengthType*	0:1
	Precision	*decimal*	0:1

MANAGEMENT AGENT (CC Additional Organisation MODEL)

Specialisation of ORGANISATION for MANAGEMENT AGENTs.

Inherits from *(empty if no inheritance)*: ***OTHER ORGANISATION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

MANOEUVRING REQUIREMENT (CC Vehicle Type MODEL)

A classification of requirements for a public transport VEHICLE according to the Maneuvering capabilities of the vehicle.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Reversable	*boolean*	0:1
	MinimumTurningCircle	*LengthType*	0:1
	MinimumLength	*LengthType*	0:1
	MinimumOvertakingWidth	*LengthType*	0:1

MEDICAL NEED (CC Generic Accessibility MODEL)

A specific USER NEED, i.e. a requirement of a passenger as regards medical constraint (e.g. allergy) to access public transport .

Inherits from *(empty if no inheritance)*: ***TYPE OF USER NEED***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Need	*MedicalNeedEnum*	1:1

MOBILITY NEED (CC Generic Accessibility MODEL)

A specific USER NEED, i.e. a constraint of a passenger as regards his mobility, e.g. wheelchair, assisted wheelchair, etc.

Inherits from *(empty if no inheritance)*: ***TYPE OF USER NEED***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Need	*MobilityNeedEnum*	1:1

MODE (CC Transport Mode MODEL)

Any means of transport.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1

NOTICE (CC Notice MODEL)

A text for informational purposes on exceptions in a LINE, a JOURNEY PATTERN, etc. The information may be usable for passenger or driver information.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Text	*MultilingualString*	0:1
	CanBeAdvertised	*boolean*	0:1
	DriverDisplayText	*MultilingualString*	0:1

ONBOARD STAY (CC Facility MODEL)

Permission to board early before the journey or stay on board after the journey.

Inherits from *(empty if no inheritance)*: ***SERVICE FACILITY SET***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	FareClass	*FareClassEnum*	0:1
	Permission	*BoardingPermisssionEnum*	0:1
	Duration	*duration*	0:1

OPERATING DAY (CC Service Calendar MODEL)

A day of public transport operation of which the characteristics are defined within in a specific SERVICE CALENDAR. An OPERATING DAY may last more than 24 hours.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	CalendarDate	*date*	1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	EarliestTime	*time*	0:1
	DayLength	*duration*	0:1

OPERATING DEPARTMENT (CC Transport Organisations MODEL)

A specific DEPARTMENT which administers certain LINEs.

Inherits from *(empty if no inheritance)*: ***DEPARTMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

OPERATING PERIOD (CC Service Calendar MODEL)

A continuous interval of time between two OPERATING DAYs which will be used to define validities.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	HolidayType	*HolidayTypeEnum*	0:*
	Season	*SeasonEnum*	0:*

OPERATIONAL CONTEXT (CC Transport Organisations MODEL)

Characterization of a set of operational objects, such as timing or links determined either by a DEPARTMENT or by an ORGANISATIONAL UNIT.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*normalizedString*	0:1
	ShortName	*MultilingualString*	0:1

OPERATOR (CC Transport Organisations MODEL)

A company providing public transport services.

Inherits from *(empty if no inheritance)*: ***ORGANISATION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	PrimaryMode	*VehicleModeEnum*	1:1

ORGANISATION (CC Generic Organisation MODEL)

A legally incorporated body associated with any aspect of the transport system.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Description	*MultilingualString*	0:1
	LegalName	*MultilingualString*	0:1
	Name	*normalizedString*	1:1
	Remarks	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	TradingName	*MultilingualString*	0:1
	Status	*boolean*	0:1
	ValidFromDate	*date*	0:1
	ValidToDate	*date*	0:1

ORGANISATION DAY TYPE (CC Additional Organisation MODEL)

DAY TYPE that is defined in terms of operation or not operation of a referenced SERVICED ORGANISATION.

Inherits from *(empty if no inheritance)*: ***DAY TYPE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	IsServiceDay	*boolean*	0:1

ORGANISATION PART (CC Generic Organisation MODEL)

A part of an ORGANISATION to which specific responsibilities upon the data and data management may be assigned.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1

ORGANISATIONAL UNIT (CC Generic Organisation MODEL)

An ORGANISATION PART to which a set of responsibilities in a public transport company for planning and control is assigned.

Inherits from *(empty if no inheritance)*: ***ORGANISATION PART***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

OTHER ORGANISATION (CC Additional Organisation MODEL)

Generic ORGANISATION being neither an AUTHORITY, neither a public transport OPERATOR (TRAVEL AGENT, MANAGEMENT AGENT, etc.).

Inherits from *(empty if no inheritance)*: ***ORGANISATION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

PASSENGER ACCESSIBILITY NEED (CC Generic Accessibility MODEL)

A passenger's requirement for accessibility, comprising one or more USER NEEDs. For example, that he is unable to navigate stairs, or lifts, or has visual or auditory impairments. PASSENGER ACCESSIBILITY NEEDS can be used to derive an accessibility constraint for the passenger, allowing the computation of paths for passengers with specifically constrained mobility. Example: Wheelchair, No Lifts, No Stairs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Carer	*boolean*	1:1

PASSENGER CARRYING REQUIREMENT (CC Vehicle Type MODEL)

A classification of requirements for a public transport vehicle according to the passenger carrying capabilities of the vehicle.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	MinimumCapacity	*PassengerCapacity*	1:1
	LowFloor	*boolean*	0:1
	HasLiftOrRamp	*boolean*	0:1

PASSENGER EQUIPMENT (CC Generic Equipment MODEL)

An item of equipment of a particular type actually available at a location within a PLACE or a VEHICLE.

Inherits from *(empty if no inheritance)*: ***INSTALLED EQUIPMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Fixed	*boolean*	0:1

PLACE (CC Generic Place MODEL)

A geographic place of any type which may be specified as the origin or destination of a trip. A PLACE may be represented as a POINT (dimension 0) , a road section (dimension 1) or a ZONE (dimension 2).

Inherits from *(empty if no inheritance)*: ***ZONE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

PLACE EQUIPMENT (CC Generic Equipment MODEL)

An item of equipment of a particular type actually available at a location within a PLACE.

Inherits from *(empty if no inheritance)*: ***INSTALLED EQUIPMENT***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Units	*nonNegativeInteger*	0:1

POINT (CC Generic Point & Link MODEL)

A 0-dimensional node of the network used for the spatial description of the network. POINTs may be located by a LOCATION in a given LOCATING SYSTEM.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1

POINT IN LINK SEQUENCE (CC Generic Point & Link Sequence MODEL)

A POINT in a LINK SEQUENCE indicating its order in that particular LINK SEQUENCE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Order	*positiveInteger*	1:1

POINT ON LINK (CC Generic Point & Link MODEL)

A POINT on a LINK which is not needed for LINK definition, but may be used for other purposes, e.g. for purposes of automatic vehicle monitoring, passenger information or for driver information.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Order	*Integer*	1:1
	DistanceFromStart	*Distance*	0:1

POINT PROJECTION (CC Generic Projection MODEL)

An oriented correspondence from one POINT of a source layer, onto a entity in a target layer: e.g. POINT, LINK, LINK SEQUENCE, COMPLEX FEATURE, within a defined TYPE OF PROJECTION.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Distance	*DistanceType*	0:1

POSTAL ADDRESS (CC Topographic Place MODEL)

A specification of ADDRESS refining it by using the attributes used for conventional identification for mail. Comprises variously a building Identifier, Street name, Post code and other descriptors.

Inherits from *(empty if no inheritance)*: ***ADDRESS***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	HouseNumber	*normalizedString*	0:1
	BuildingName	*normalizedString*	0:1
	AddressLine1	*normalizedString*	0:1
	Street	*normalizedString*	0:1
	Town	*normalizedString*	0:1
	PostCode	*PostCodeType*	0:1
	PostCodeExtension	*normalizedString*	0:1
	Province	*normalizedString*	0:1

PROPERTY OF DAY (CC Service Calendar MODEL)

A property which a day may possess, such as school holiday, weekday, summer, winter etc.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	WeekOfMonth	*WeekOfMonthEnum*	0:5
	DayOfYear	*monthDay*	0:1
	Month	*month*	0:1
	Season	*SeasonEnum*	0:4
	HolidayType	*HolidayTypeEnum*	0:5
	HolidayCountry	*CountryEnum*	0:*
	Tide	*TideEnum*	0:4

PSYCHOSENSORY NEED (CC Generic Accessibility MODEL)

A specific USER NEED, i.e. a constraint of a passenger as regards his psycho-sensory impairments, such as visual impairment, auditory impairment, averse to confined spaces, etc.

Inherits from *(empty if no inheritance)*: ***TYPE OF USER NEED***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Need	*PsychosensoryNeedEnum*	1:1

PURPOSE OF EQUIPMENT PROFILE (CC Vehicle Type MODEL)

A functional purpose which requires a certain set of equipment of different types put together in a VEHICLE EQUIPMENT PROFILE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

PURPOSE OF GROUPING (CC Generic Grouping MODEL)

Functional purpose for which GROUPs of elements are defined. The PURPOSE OF GROUPING may be restricted to one or more types of the given object.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

RESOURCE FRAME (CC Resource Frame MODEL)

A set of resource data to which the same VALIDITY CONDITIONs have been assigned.

Inherits from (empty if no inheritance): ***VERSION FRAME***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

RESPONSIBILITY ROLE (CC Responsibility Role MODEL)

A particular role an ORGANISATION or an ORGANISATION PART is playing as regards certain data, for example data origination, data augmentation, data aggregation, data distribution, planning, operation, control, ownership etc).

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

RESPONSIBILITY ROLE ASSIGNMENT (CC Responsibility Role MODEL)

The assignment of one or more roles to an ORGANISATION or an ORGANISATION PART as regards the responsibility it will have as regards specific data (e.g. ownership, planning, etc.) and the management of this data (e.g. distribution, updates, etc.).

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

RESPONSIBILITY SET (CC Responsibility Role MODEL)

A list of possible responsibilities over one or more ENTITies IN VERSION., resulting from the process of the assignment of RESPONSIBILITY ROLEs (such as data origination, ownership, etc) on specific data (instances) to ORGANISATIONs or ORGANISATION PARTs.

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

ROAD ADDRESS (CC Topographic Place MODEL)

Specialization of ADDRESS refining it by using the characteristics such as road number, and name used for conventional identification of along a road.

Inherits from (empty if no inheritance): ***ADDRESS***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	RoadNumber	*normalizedString*	0:1
	RoadName	*normalizedString*	0:1
	BearingCompass	*CompassEnum*	0:1
	BearingDegrees	*integer*	0:1
	OddNumberRange	*normalizedString*	0:1
	EvenNumberRange	*normalizedString*	0:1

SCHEMATIC MAP (CC Schematic Map MODEL)

A map representing schematically the layout of the topographic structure of PLACEs (e.g. a set of SITEs) or the public transport network (a set of LINEs). It can include a pixel projection of a set of ENTITies onto a bitmap image so as to support hyperlinked interactions.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Name	*MultilingualString*	0:1
	ImageUri	*anyURI*	0:1

SERVICE CALENDAR (CC Service Calendar MODEL)

A collection of DAY TYPE ASSIGNMENTs.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	From	*date*	1:1
	To	*date*	1:1
	EarliestTime	*time*	0:1
	DayLength	*duration*	0:1

SERVICE CALENDAR FRAME (CC Service Calendar Frame MODEL)

A coherent set of assignments of OPERATING DAYS to DAY TYPES.

Inherits from (empty if no inheritance): ***VERSION FRAME***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

SERVICE FACILITY SET (CC Facility MODEL)

Set of FACILITies available for a specific VEHICLE TYPE (e.g. carriage equipped with low floor) possibly only for a service (or for a SERVICE JOURNEY or a JOURNEY).

Inherits from (empty if no inheritance): ***FACILITY SET***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

SERVICE RESTRICTION **(CC Service Restriction MODEL)**

Parameters describing the limitations as regards the use of equipment or service.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**

SERVICED ORGANISATION (CC Additional Organisation MODEL)

A public or private organisation for which public transport services are provided on specific days, e.g. a school, university or works.

Inherits from (empty if no inheritance): ***OTHER ORGANISATION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

SIMPLE FEATURE (CC Generic Zone and Feature MODEL)

An abstract representation of elementary objects related to the spatial representation of the network. POINTs (0-dimensional objects), LINKs (1-dimensional objects) and ZONEs (2-dimensional objects) may be viewed as SIMPLE FEATUREs.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**	*SimpleFeatureIdType*	1:1

SITE FACILITY SET (CC Facility MODEL)

Set of FACILITies available for a SITE ELEMENT .

Inherits from (empty if no inheritance): ***FACILITY SET***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

SUBMODE (CC Transport Submode MODEL)

A variant of a MODE, as for instance international or domestic rail (rail being the MODE).

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

SUITABILITY (CC Generic Accessibility MODEL)

A statement of whether a particular USER NEED can be met. It can be used to state whether a SITE can be accessed by a passenger with a particular USER NEED.

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Suitable	*SuitableEnum*	1:1

TARIFF ZONE (CC Generic Zone and Feature MODEL)

A ZONE used to define a zonal fare structure in a zone-counting or zone-matrix system.

Inherits from (empty if no inheritance): ***ZONE***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

TICKET SCOPE (CC Service Restriction MODEL)

Scope of ticket.

Inherits from (empty if no inheritance): ***SERVICE RESTRICTION***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

TIME BAND (CC Service Calendar MODEL)

A period in a day, significant for some aspect of public transport, e.g. similar traffic conditions or fare category.

Inherits from (empty if no inheritance):			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	StartTime	*time*	1:1
	EndTime	*time*	1:1
	DayOffset	*integer*	0:*
	Duration	*duration*	0:*

TOPOGRAPHIC PLACE (CC Topographic Place MODEL)

A type of PLACE providing the topographical context when searching for or presenting travel information, for example as the origin or destination of a trip. It may be of any size (e.g. County,City, Town, Village) and of different specificity (e.g. Greater London, London, West End, Westminster, St James's).

Inherits from (empty if no inheritance): ***PLACE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Name	*MultilingualString*	1:1
	ShortName	*MultilingualString*	0:1
	TopographicType	*TopographicTypeEnum*	1:1
	Qualifier	*MultilingualString*	0:1
	Centre	*boolean*	0:1

TRACE (CC Generic Delta MODEL)

A way to record the context of the changes occurred in a given ENTITY instance, as regards the authors, the causes of the changes, etc., possibly accompanied by a descriptive text.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	ChangedAt	*dateTime*	1:1
	ChangedBy	*normalizedString*	0:1
	Description	*normalizedString*	0:1

TRAIN (CC Train MODEL)

A VEHICLE TYPE composed of TRAIN ELEMENTs in a certain order, i.e. of wagons assembled together and generally propelled by a locomotive or one of the wagons.

Inherits from (empty if no inheritance): ***VEHICLE TYPE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

TRAIN COMPONENT (CC Train MODEL)

A specification of the order of TRAIN ELEMENTs in a TRAIN.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Order	*positiveInteger*	1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	Label	*MultilingualString*	0:1

TRAIN ELEMENT (CC Train MODEL)

An elementary component of a TRAIN (e.g. wagon, locomotive).

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	Length	*LengthType*	0:1

TRAIN IN COMPOUND TRAIN (CC Train MODEL)

The specification of the order of TRAINs in a COMPOUND TRAIN.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Order	*positiveInteger*	1:1
	Description	*MultilingualString*	0:1
	OperationalOrientation	*VehicleOrientationEnum*	0:1
	ReversedOrientation		0:1
	Label	*MultilingualString*	0:1

TRANSFER (CC Generic Place MODEL)

A couple of POINTs located sufficiently near that it may represent for a passenger a possibility to reach one of these POINTs when starting at the other one in a timescale which is realistic when carrying out a trip, e.g. ACCESS.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	Distance	*LenthType*	0:1
	BothWays	*boolean*	0:1
	DefaultDuration	*duration*	1:1
	FrequentTravellerDuration	*duration*	0:1
	OccasionalTravellerDuration	*duration*	0:1
	MobilityRestrictedTravellerDuration	*duration*	0:1

TRANSFER END (CC Generic Place MODEL)

End point of a TRANSFER.

Inherits from (empty if no inheritance):			
Classification	**Name**	**Type**	**cardinality**
«UID»	**Id**		1:1

TRAVEL AGENT (CC Additional Organisation MODEL)

Specialisation of ORGANISATION for TRAVEL AGENT

Inherits from *(empty if no inheritance)*: ***OTHER ORGANISATION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF ACCESSIBILITY LIMITATION (CC Generic Accessibility MODEL)

A classification for ACCESSIBILITY LIMITATIONs, e.g. audio, visual, step free, etc.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF DELIVERY VARIANT (CC Notice MODEL)

A classification of a DELIVERY VARIANT. The way of delivering a NOTICE: by vocal announcement, by visual display, issuing printed material

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF ENTITY (CC Generic Entity MODEL)

Classification of ENTITies, for instance according to the domain in which they are defined or used.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF EQUIPMENT (CC Generic Equipment MODEL)

A classification of equipment items to be installed at stop points or onboard vehicles, for instance.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF FACILITY (CC Facility MODEL)

A classification of a FACILITY or a FACILITY SET.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF FARE CLASS (CC Service Restriction MODEL)

A classification for fare classes (e.g. first class, second class, business class, etc).

Inherits from *(empty if no inheritance)*: ***SERVICE RESTRICTION***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF FRAME (CC Generic Version Frame MODEL)

A classification of VERSION FRAMEs according to a common purpose. e.g. line descriptions for line versions, vehicle schedules, operating costs. A TYPE OF FRAME is ruled by a unique TYPE OF VALIDITY.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Periodicity	*duration*	0:1
	Nature	*DataNatureEnum*	0:1
	ModificationSet	*ModificationSetEnum*	0:1
	Versioning	*VersioningEnum*	0:1

TYPE OF LINK (CC Generic Point & Link MODEL)

A classification of LINKs to express the different functional roles of a LINK.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		0:1

TYPE OF LINK SEQUENCE (CC Generic Point & Link Sequence MODEL)

A classification of LINK SEQUENCEs used to define the different functions a LINK SEQUENCE may be used for. e.g. ROUTE, road, border line etc.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		0:1

TYPE OF NOTICE (CC Notice MODEL)

A classification for a NOTICE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF OPERATION (CC Generic Organisation MODEL)

A classification of OPERATIONs to express the different functional roles of a DEPARTMENT.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF ORGANISATION (CC Generic Organisation MODEL)

A classification for the ORGANISATIONs according to their activity, e.g. a public transport company, an IT company, etc).

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF PAYMENT METHOD (CC Service Restriction MODEL)

A classification for payment method (e.g. cash, credit card, debit card, travel card, contactless travel card, mobile phone, token, etc.).

Inherits from *(empty if no inheritance)*: ***SERVICE RESTRICTION***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF PLACE (CC Generic Place MODEL)

A classification for PLACEs.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF POINT (CC Generic Point & Link MODEL)

A classification of POINTs according to their functional purpose.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		0:1

TYPE OF PROJECTION (CC Generic Projection MODEL)

A classification of the projections according to their functional purpose, the source and target layers.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		0:1

TYPE OF RESPONSIBILITY ROLE (CC Responsibility Role MODEL)

A classification of RESPONSIBILITY ROLEs, e.g. data ownership.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF SUITABILITY (CC Generic Accessibility MODEL)

A classification for SUITABILITY, i.e. assessments as regards a possible SUITABILITY of access according to USER NEEDS.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF TICKET (CC Service Restriction MODEL)

A classification for tickets available at a TICKETING EQUIPMENT (e.g. standard, concession, promotion, group, season, travel card, etc.)

Inherits from *(empty if no inheritance)*: ***SERVICE RESTRICTION***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF TICKETING (CC Service Restriction MODEL)

A classification for ticketing available at a TICKETING EQUIPMENT (e.g. purchase, collection, card top up, reservations).

Inherits from *(empty if no inheritance)*: ***SERVICE RESTRICTION***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF TRAIN ELEMENT (CC Train MODEL)

A classification of TRAIN ELEMENTs.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF TRANSFER (CC Generic Place MODEL)

A classification for TRANSFER.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF USER NEED (CC Generic Accessibility MODEL)

A classification of USER NEEDS.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF VALIDITY (CC Generic Version Frame MODEL)

A classification of the validity of TYPEs OF FRAME. e.g. frames for schedules designed for DAY TYPEs, for specific OPERATING DAYs.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF VERSION (CC Generic Version MODEL)

A classification of VERSIONs. E.g shareability of ENTITies between several versions.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

TYPE OF ZONE (CC Generic Zone and Feature MODEL)

A classification of ZONEs. e.g. TARIFF ZONE, ADMINISTRATIVE ZONE.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

USER NEED (CC Generic Accessibility MODEL)

A user's need for a particular SUITABILITY.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Excluded	*boolean*	1:1
	NeedRanking	*integer.*	0:1

VALIDITY CONDITION (CC Generic Validity MODEL)

Condition used in order to characterise a given VERSION of a VERSION FRAME. A VALIDITY CONDITION consists of a parameter (e.g. date, triggering event, etc.) and its type of application (e.g. for, from, until, etc.).

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Description	*MultilingualString*	0:1
	Name	*MultilingualString*	0:1

VALIDITY RULE PARAMETER (CC Generic Validity MODEL)

A user defined VALIDITY CONDITION used by a rule for selecting versions. e.g. river level > 1.5 m and bad weather.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	AttributeName	*normalisedString*	0:1
	AttributeValue	*any*	0:1
	ComparisonOperator	*OperatorEnum*	0:1
	IsValid	*boolean*	0:1
	Method	*normalizedString*	0:1

VALIDITY TRIGGER (CC Generic Validity MODEL)

External event defining a VALIDITY CONDITION. E.g exceptional flow of a river, bad weather, road closure for works.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	PrivateCode	*PrivateCodeType*	0:1

VEHICLE (CC Vehicle Type MODEL)

A public transport vehicle used for carrying passengers.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1

VEHICLE ACCESS EQUIPMENT (CC Vehicle Passenger Equipment MODEL)

Specialisation of VEHICLE EQUIPMENT dedicated to access vehicles providing information such as low floor, ramp, access area dimensions, etc.

Inherits from *(empty if no inheritance)*: ***ACTUAL VEHICLE EQUIPMENT***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	LowFloor	*boolean*	0:1
	Ramp	*boolean*	0:1
	RampBearingCapacity	*Weight*	0:1
	NumberOfSteps	*integer*	0:1
	BoardingHeight	*LengthType*	0:1
	GapToPlatform	*LengthType*	0:1
	WidthOfAccessArea	*LengthType*	0:1
	HeightOfAccessArea	*LengthType*	0:1
	AutomaticDoors	*boolean*	0:1
	SuitableFor	*MobilityNeed*	0:*
	AssistanceNeeded	*AssistanceNeededEnum*	0:1
	AssistedBoardingLocation	*AssistedBoardingLocationEnum*	0:1
	GuideDogsAllowed	*boolean*	0:1

VEHICLE EQUIPMENT PROFILE (CC Vehicle Type MODEL)

Each instantiation of this entity gives the number of items of one TYPE OF EQUIPMENT a VEHICLE MODEL should contain for a given PURPOSE OF EQUIPMENT PROFILE. The set of instantiations for one VEHICLE MODEL and one purpose gives one complete 'profile'.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Units	*nonNegativeInteger*	0:1

VEHICLE MODE (CC Transport Mode MODEL)

A characterisation of the public transport operation according to the means of transport (bus, tram, metro, train, ferry, ship).

Inherits from *(empty if no inheritance)*: ***MODE***			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

VEHICLE MODEL (CC Vehicle Type MODEL)

A classification of public transport vehicles of the same VEHICLE TYPE, e.g. according to equipment specifications or model generation.

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	Manufacturer	*normalizedString*	0:1

VEHICLE TYPE (CC Vehicle Type MODEL)

A classification of public transport vehicles according to the vehicle scheduling requirements in mode and capacity (e.g. standard bus, double-deck, ...).

Inherits from *(empty if no inheritance)*:			
Classification	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	ShortName	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1
	ReversingDirection	*boolean*	0:1
	SelfPropelled	*boolean*	0:1
	Length	*LengthType*	0:1
	TypeOfFuel	*TypeOfFuelEnum*	0:1
	SeatingCapacity	*NumberOfPassengers*	0:1
	StandingCapacity	*NumberOfPassengers*	0:1
	SpecialPlaceCapacity	*NumberOfPassengers*	0:1
	WheelchairPlaceCapacity	*NumberOfPassengers*	0:1
	LowFloor	*boolean*	0:1
	HasLiftOrRamp	*boolean*	0:1

VERSION (CC Generic Version MODEL)

A group of operational data instances which share the same VALIDITY CONDITIONs. A version belongs to a unique VERSION FRAME and is characterised by a unique TYPE OF VERSION.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Description	*MultilingualString*	0:1
	EndDate	*dateTime*	0:1
	Name	*MultilingualString*	0:1
	StartDate	*dateTime*	0:1
	Status	*VersionStatusEnum*	0:1

VERSION FRAME (CC Generic Version Frame MODEL)

A set of VERSIONS referring to a same DATA SOURCE and belonging to the same TYPE OF FRAME. A FRAME may be restricted by VALIDITY CONDITIONs.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name	*MultilingualString*	0:1
	Description	*MultilingualString*	0:1

WHEELCHAIR VEHICLE EQUIPMENT (CC Vehicle Passenger Equipment MODEL)

Specialisation of VEHICLE EQUIPMENT for wheel chair accessibility on board a VEHICLE providing information such as the number of wheel chair areas and the access dimensions.

Inherits from *(empty if no inheritance)*: ***ACTUAL VEHICLE EQUIPMENT***			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	NumberOfWheelchairAreas	*integer*	0:1
	WidthOfAccessArea	*LengthType*	0:1
	HeightOfAccessArea	*LengthType*	0:1
	LengthOfAccessArea	*LengthType*	0:1
	WheelchairTurningCircle	*LengthType*	0:1
	CompanionSeat	*boolean*	0:1
	SuitableFor	*MobilityNeed*	0:*

ZONE (CC Generic Zone and Feature MODEL)

A two-dimensional PLACE within the service area of a public transport operator (administrative zone, TARIFF ZONE, ACCESS ZONE, etc.).

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1
	Name		0:1
	Description		0:1

ZONE PROJECTION (CC Generic Projection MODEL)

An oriented correspondence: from one ZONE in a source layer, onto a target entity : e.g. POINT, COMPLEX FEATURE, within a defined TYPE OF PROJECTION.

Inherits from *(empty if no inheritance)*:			
Classifi-cation	**Name**	**Type**	**cardinality**
«UID»	***Id***		1:1

Additional definitions from [7]:

SCHEDULED STOP POINT : A POINT where passengers can board or alight from vehicles.

SITE ELEMENT: A type of ADDRESSABLE PLACE specifying common properties of a SITE or a SITE COMPONENT to describe it, including accessibility.

SITE : A well known PLACE to which passengers may refer to indicate the origin or a destination of a trip.

SITE COMPONENT: An element of a SITE describing a part of its structure. SITE COMPONENTs share common properties for data management, accessibility and other features.

LINE: A group of ROUTEs which is generally known to the public by a similar name or number.

ROUTE: An ordered list of located POINTs defining one single path through the road (or rail) network. A ROUTE may pass through the same POINT more than once.

Additional definitions from [1]:

PT TRIP : A part of a trip starting from the first boarding of a public transport vehicle to the last alighting from a public transport vehicle.

Appendix B : Status of the Textual Descriptions & Model Evolution

In order to allow the reader familiar with Transmodel V5.1 (marked TM) to appraise the changes each numbered (level 3) section indicates the source of the text:

TM: text incorporating either simple reformulations or taken over from TM;

TM and NeTEx: text based on TM with additions by NeTEx;

IFOPT and NeTEx: text based on IFOPT with additions by NeTEx;

NeTEx: text incorporating significant enhancements or a totally new text compared to Transmodel V5.1. Some of them take over explanations referring to IFOPT.

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Table 8 : Sources of text in Common Concepts Domain

Section	*Topic*	*Source*
5.1	**Introduction to the Common Concepts**	NeTEx
5.2	**Versions & Validity**	
5.2.1	Introduction	NeTEx
5.2.2	Version & Validity – Model Overview	NeTEx
5.2.3	Generic Entity	TM and NeTEx
5.2.4	Generic Version	TM and NeTEx
5.2.5	Generic Version Frame	TM and NeTEx
5.2.6	Generic Validity	TM
5.2.7	Generic Delta Model	TM
5.3	**Responsibility**	
5.3.1	Introduction	NeTEx
5.3.2	Responsibility – Model Overview	NeTEx
5.3.3	Generic Responsibility	NeTEx
5.3.4	Responsibility Role	NeTEx
5.3.5	Generic Organisation	TM and NeTEx
5.4	**Explicit Frames**	
5.4.1	Composite Frame	NeTEx
5.4.2	General Frame	NeTEx
5.4.3	Resource Frame	NeTEx
5.4.4	Service Calendar Frame	NeTEx
5.4.5	Other Explicit Frames	NeTEx
5.5	**Generic Framework Model**	

5.5.1	Generic Framework – Model overview	NeTEx
5.5.2	Location Model	TM and NeTEx
5.5.3	Generic Grouping	NeTEx
5.5.4	Generic Point & Link	TM
5.5.5	Generic Point & Link Sequence	TM
5.5.6	Generic Zone and Feature	TM
5.5.7	Generic Projection	TM
5.5.8	Generic Place	NeTEx
5.5.9	Accessibility	NeTEx
5.6	**Reusable Components**	
5.6.1	Reusable Components – Model Overview	NeTEx
5.6.2	Transport Mode	TM
5.6.3	Transport SubMode	NeTEx
5.6.4	Service Calendar	TM and NeTEx
5.6.5	Availability Condition	NeTEx
5.6.6	Topographic Place	NeTEx
5.6.7	Transport Organisations	TM
5.6.8	Additional Organisations	NeTEx
5.6.9	Generic Equipment	NeTEx
5.6.10	Vehicle Type	TM and NeTEx
5.6.11	Actual Vehicle Equipment	TM and NeTEx
5.6.12	Vehicle Passenger Equipment	NeTEx
5.6.13	Facility	NeTEx
5.6.14	Train	TM and NeTEx
5.6.15	Schematic Map	NeTEx
5.6.16	Notice	NeTEx
5.6.17	Service Restriction	NeTEx
5.6.18	Alternative Name	NeTEx

Table 9 : Status of diagrams & figures compared to NeTEx

Part 1 figure	**Main Package**	**Part 1 diagram/figure title**	**status compared to NeTEx**
1		*Transmodel hierarchy of packages*	
2		*Package Content Example*	
3	**Methodology**	*Complex Diagram Example*	*added*
4		*Class Example*	*added*
5		*Simple Diagram Example*	*added*
6		*Reflexive Association Example*	*added*
7		*Aggregation Example*	*added*
8		*Generalisation Example*	*added*
9		*Parent Class Example*	*added*

10	**Versions & Validity**	Generic Entity Model	corrected
11		Generic Version Model	corrected
12		Generic Version Frame Model	modified
13		Generic Validity Model	modified
14		Generic Delta Model	corrected
15	**Responsibility**	Responsibility Model	corrected
16		Responsibility Role Model	corrected
17		Generic Organisation Model	corrected
18	**Explicit Frames**	Composite Frame Model	copied
19		General Frame Model	copied
20		Resource Frame Model	copied
21		Service Calendar Frame Model	copied
22	**Generic Framework**	Location Model	corrected
23		Generic Grouping Model	copied
24		Explicit Grouping Possibilities Model	copied
25		Generic Point & Link Model	corrected
26		Generic Point & Link Sequence Model	corrected
27		Generic Zone Model	modified
28		Generic Feature Model	added
29		Generic Layer Model	new
30		Generic Projection Model	corrected
31		Point Projection Model	copied
32		Link Projection Model	copied
33		Shape of Linear Objects Model	corrected
34		Generic Place Model	modified
35		Accessibility Model	corrected
36	**Reusable Components**	Reusable Transport Mode Model	corrected
37		Submode Model	added
38		Service Calendar Model	corrected
39		Availability Condition Model	corrected
40		Topographic Place Model	modified
41		Transport Organisation Model	corrected
42		Additional Organisation Model	corrected
43		Generic Equipment Model	modified
44		Vehicle Equipment Model	modified
45		Vehicle Type Model	corrected
46		Actual Vehicle Equipment Model	corrected
47		Vehicle Passenger Equipment Model	corrected
48		Facility Model	added
49		Train Model	modified
50		*Train Elements Example (source NeTEx)*	*copied*
51		*Eurostar Train Makeup (source NeTEx)*	*copied*
52		Schematic Map Model	modified
53		*Wimbledon Station plan*	*copied*

54		Notice Model	corrected
55		Service Restriction Model	corrected
56		Alternative Name Model	modified

Copied: means "copied from NeTEx" with no change except layout, and adaptation of the stereotype PK --> UID.

Corrected: means "corrected from NeTEx" where the correction refers to the type of association (composition <--> aggregation), cardinality, scope of ID (private-->public), label naming.

Modified: means "modified from NeTEx" if it includes any change other than the above ones.

Added means “added compared to NeTEx” with possible substantial changes.

New: means “not considered within NeTEx” (but considered in Transmodel).