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Public transport — Reference data model

Part 2: Public transport network

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National foreword

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English Version

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Partie 2: Réseau de transports en commun

Öffentlicher Verkehr - Datenreferenzmodell - Teil 2:
Netzwerk des öffentlichen Verkehrs

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European foreword

This document (EN 12896-2:2016) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2017, and conflicting national standards shall be withdrawn at the latest by March 2017.

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

This document together with documents EN 12896-1:2016 and EN 12896-3:2016 supersedes EN 12896:2006.

The series composed of 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 intends to ease the task of users interested in particular functional domains. Modularisation of Transmodel, undertaken within the NeTEx project, has contributed significantly to this new edition of Transmodel.

In addition to the eight Parts of this European Standard an informative Technical Report (Public Transport – Reference Data Model – Informative Documentation) is also being prepared to provide additional information to help those implementing projects involving the use of Transmodel. It is intended that this Technical Report will be extended and republished as all the eight parts are completed.

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

Introduction

Part 1 of this standard presents the following items:

- rationale for the Transmodel Standard;
- use of the Transmodel Standard;
- applicability of the Transmodel Standard;
- conformance statement;
- transmodel origins ;
- reference to the previous version and other documents.

The data structures represented in Part 1 are generic patterns that are referenced by different other parts. This particular document (Part 2) represents a new edition of EN 12896:2006 of the chapter “description of the network”. Moreover, it incorporates the major part of the IFOPT standard model of stop places and related concepts as updated and harmonized within the NeTEx project.

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 EN 12896 and known as Transmodel V5.1;
- the model for the Identification of Fixed Objects for Public transport, published 2009 as EN 28701 and known as IFOPT;

incorporating the requirements of

- EN 15531-1 to 3 and CEN/TS 15531-4 and CEN/TS 15531-5, *Service interface for real-time information relating to public transport operations (SIRI)*;
- CEN/TS 16614-1 and CEN/TS 16614-2, *Network and Timetable Exchange (NeTEx)*;

in particular the specific needs for long distance train operation.

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

- the data model is described in a modular form in order to facilitate understanding and use of the model;
- the data model is entirely described in UML.

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

- network description: routes, lines, journey patterns, timing patterns, service patterns, scheduled stop points and stop places.
- This part corresponds to the network description as in Transmodel V5.1 extended by the relevant parts of IFOPT.
- Furthermore, the following functional domains are considered:
 - timing information and vehicle scheduling (runtimes, vehicle journeys, day type-related vehicle schedules);
 - passenger information (planned and real-time);
 - operations monitoring and control: operating day-related data, vehicle follow-up, control actions;
 - fare management (fare structure and access rights definition, sales, validation, control);
 - management information and statistics (including data dedicated to service performance indicators);
 - driver management:
 - driver scheduling (day-type related driver schedules);

- rostering (ordering of driver duties into sequences according to some chosen methods);
- driving personnel disposition (assignment of logical drivers to physical drivers and recording of driver performance).

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

1.2 Functional domain description

The different functional domains taken into account in the present Standard and of which the data have been represented as the reference data model are described in “Public transport reference data model - Part 1: Common concepts”.

They are:

- public transport network and stop description;
- timing information and vehicle scheduling;
- passenger information;
- fare management;
- operations monitoring and control;
- management information;
- personnel management: driver scheduling, rostering, personnel disposition.

The aspects of multi-modal operation and multiple operators’ environment are also taken into account.

1.3 Particular Scope of this Document

The present European Standard entitled “Reference data model for Public transport – Part 2: Public transport network” incorporates data structures which form the network topology description of Transmodel V5.1 and the major part of the fixed objects model of IFOPT. It is composed of three data packages:

- network description;
- fixed objects;
- tactical planning components.

The data structures represented in this part form network topology descriptions. They typically reference to structures as described in the “Public transport - Reference data model - Part 1: Common concepts”, such as version frames or generic grouping mechanisms.

This document itself is composed of the following parts:

- Main document (normative) representing the data model for the concepts shared by the different domains covered by Transmodel;
- Annex A (normative), containing the data dictionary, i.e. the list of all the concepts and attribute tables present in the main document together with the definitions;
- Annex B (informative), indicating the data model evolutions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12896-1:2016 apply.

4 Symbols and Abbreviations

DRT	Demand responsive transport
FTS	Flexible transport service
GIS	Geographic information system
IFOPT	Identification of fixed objects in public transport
ISO	International standards organization
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 The Network Topology Domain

5.1 Introduction

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 model delivers also a detailed geographical representation of stopping locations and related concepts, such as equipment, access and navigation paths taken from the IFOPT standard and harmonized with Transmodel within the NeTEx project, including the description of:

- the stops and stations at which transport is accessed together with accessibility characteristics;
- the points of interest from/to which passengers are travelling;
- the detailed navigation paths between the various locations and associated constraints;
- the equipment and services relevant for public transport actors;
- the parking locations relative to both stops and points of interest.

5.2 Model and document structure

The Network Topology models split into three main sub-models.

- a) network description model (ND);
- b) fixed object model (FO);
- c) tactical planning components model (TP).

Network description model: describes infrastructure elements (different types of points and links) and paths (routes and lines) dedicated to (regular and flexible) public transport operation; this description may be considered as a macroscopic view of the network topological aspects of the network. The model splits into:

- network infrastructure model;
- line network model;
- route model;
- flexible network model;
- activation model;
- vehicle and crew point model.

Fixed object model: describes geographical aspects of fixed elements such as stopping locations, or points of interest. It represents, in particular, a detailed view of the stopping places, and associated elements, such as services or equipment, but also concepts enabling the representation of the navigation through or access to the stops. The model splits into:

- site model;
- stop place model;
- flexible stop place model;
- point of interest model;
- equipment description model;

- path and navigation path model;
- check constraint model;
- parking model;
- vehicle stopping model;

Tactical planning components model: describes basic concepts related to the description of the work patterns of public transport vehicles, such as journey patterns and service patterns, useful for planning transport and some related aspects. This part describes the space-related aspects of the vehicle services, whereas the time-related aspects (vehicle journeys, run times, etc) are described in Part 3 – Timing Information and Vehicle Scheduling. The model splits into:

- journey pattern model;
- timing pattern model;
- service connection model;
- service pattern model;
- common section model;
- routing constraint model;
- time demand type model;
- stop assignment model;
- train stop assignment model;
- path assignment model;
- notice assignment model;
- passenger information display assignment model.

Explicit frames model: specific sets of “explicit” VERSION FRAMES that specify sets of data elements appropriate for a particular use case or set of related use cases.

The present document is structured according to the model structure as shown above with some exceptions due to the necessity to introduce some concepts earlier in the document in order to ease the understanding.

5.3 Network description model

5.3.1 Model overview

The network description model describes the basic physical network for transport and is itself divided into a number of separate sub-models covering different aspects of the network:

- network infrastructure model:
 - infrastructure network;
 - network restriction;

- main tactical planning points and links model (from the journey pattern model);
- activation model;
- vehicle and crew point model;
- line and route model;
- line network model;
 - line network;
 - line schematic map;
- flexible network model;
 - flexible link, point and zone;
 - flexible route;
 - flexible line.

For ease of understanding, the sub-models are presented one at a time, each describing only a small set of related concepts.

The sub-models depend on a number of general framework models (for example, generic point and link model, notice model, etc.) described in the part “Public transport - Reference data model – Part 1: Common concepts”.

5.3.2 Infrastructure Network

5.3.2.1 General

The infrastructure network model describes the physical network on which the transport services run; a closely related network restriction model describes the physical restrictions on its use. This part does not concern the service aspects, i.e. vehicle work patterns described separately (e.g. by TIMING PATTERNS, JOURNEY PATTERNS, SERVICE PATTERNS).

5.3.2.2 Infrastructure Network– Conceptual Model

5.3.2.2.1 General

Figure 1 describes the main components of the physical path network (rail, roads, etc.).

This modelling of the infrastructure is, however, very basic and simple and is used here to represent specific operational constraints (restrictions) for public transport operation resulting from the characteristics of the INFRASTRUCTURE POINTs and LINKs and of VEHICLE TYPEs. The spatial detailed organization of the infrastructure itself is described by other models (GDF, Inspire, etc.) and the data are usually provided by GIS data sets.

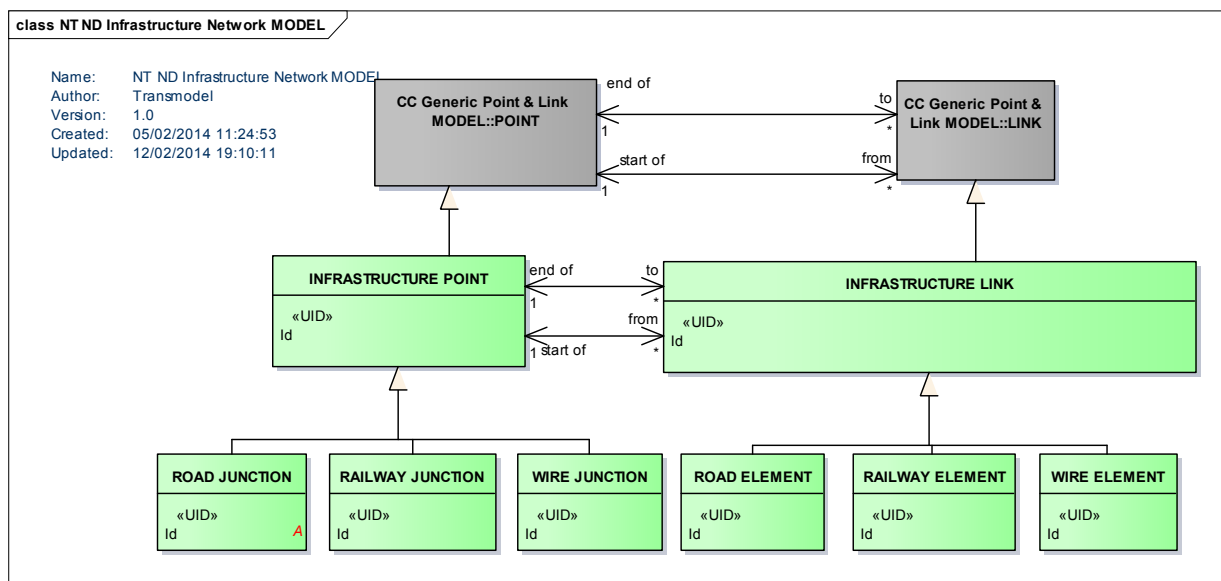


Figure 1 — Infrastructure network – Conceptual model

5.3.2.2.2 Infrastructure points and links

The PT network is described in Transmodel by POINTs and LINKs. This means that separate descriptions of a network either as a set of points or a set of links, or both, are possible and may be kept separately (cf. Generic POINT and LINK – conceptual model from the “Public transport - Reference data model – Part 1: Common concepts”).

The approach of representing the network in terms of generic POINTs and/or LINKs and their specializations (here: INFRASTRUCTURE POINT, INFRASTRUCTURE LINK) is used extensively in Transmodel to describe distinct functional layers as separate graphs.

5.3.2.2.3 Infrastructure network and functional aspects of the network

In Transmodel terms, the infrastructure network builds a LAYER (cf. Layer – Conceptual Model from the “Public transport - Reference data model - Part 1: Common concepts”). A LAYER is a user-defined GROUP OF ENTITIES, specified for a particular functional purpose, associating data referring to a particular LOCATING SYSTEM.

Examples of LAYERS (described through concepts introduced later in this document) are: timing pattern layer (defined through TIMING POINTs and TIMING LINKs), and service pattern layer (defined through SCHEDULED STOP POINTs and SERVICE LINKs). Transmodel defines a correspondence mechanism between LAYERS, called PROJECTION (cf. section Generic Projection from part “Public transport - Reference data model Part 1: Common concepts”). It should be noted that the uniqueness of a LOCATING SYSTEM within a LAYER is an important parameter, in particular for the coherence of distances.

Each separate LAYER reflects different concerns and is deliberately kept independent of other LAYERS. Thus for example the modelling of the objects necessary to describe the work patterns of vehicles (JOURNEY PATTERNS) is represented separately in the LAYERS describing the operational planning and not in the infrastructure layer.

The different functional LAYERS may be projected (using the Transmodel projection mechanism) onto the infrastructure layer to represent how they are related to the physical paths represented by sequences of INFRASTRUCTURE LINKs.

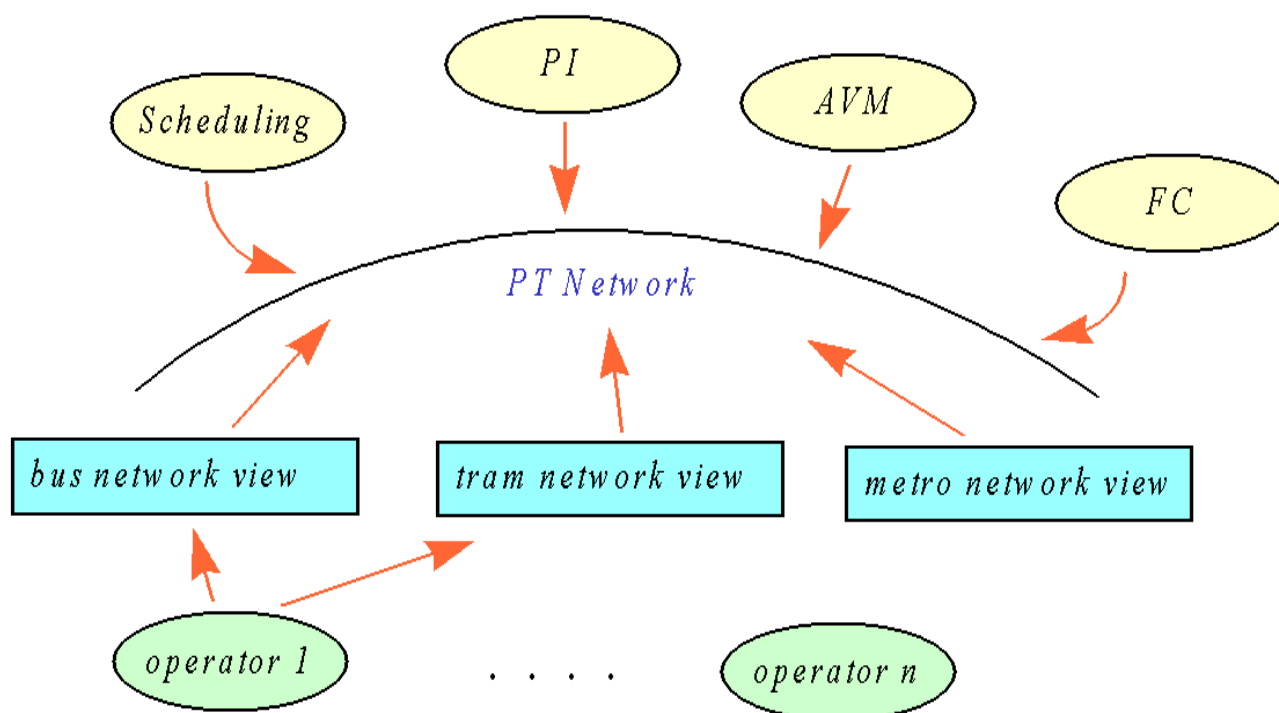


Figure 2 — Examples of layers - Different layers according to the transport mode

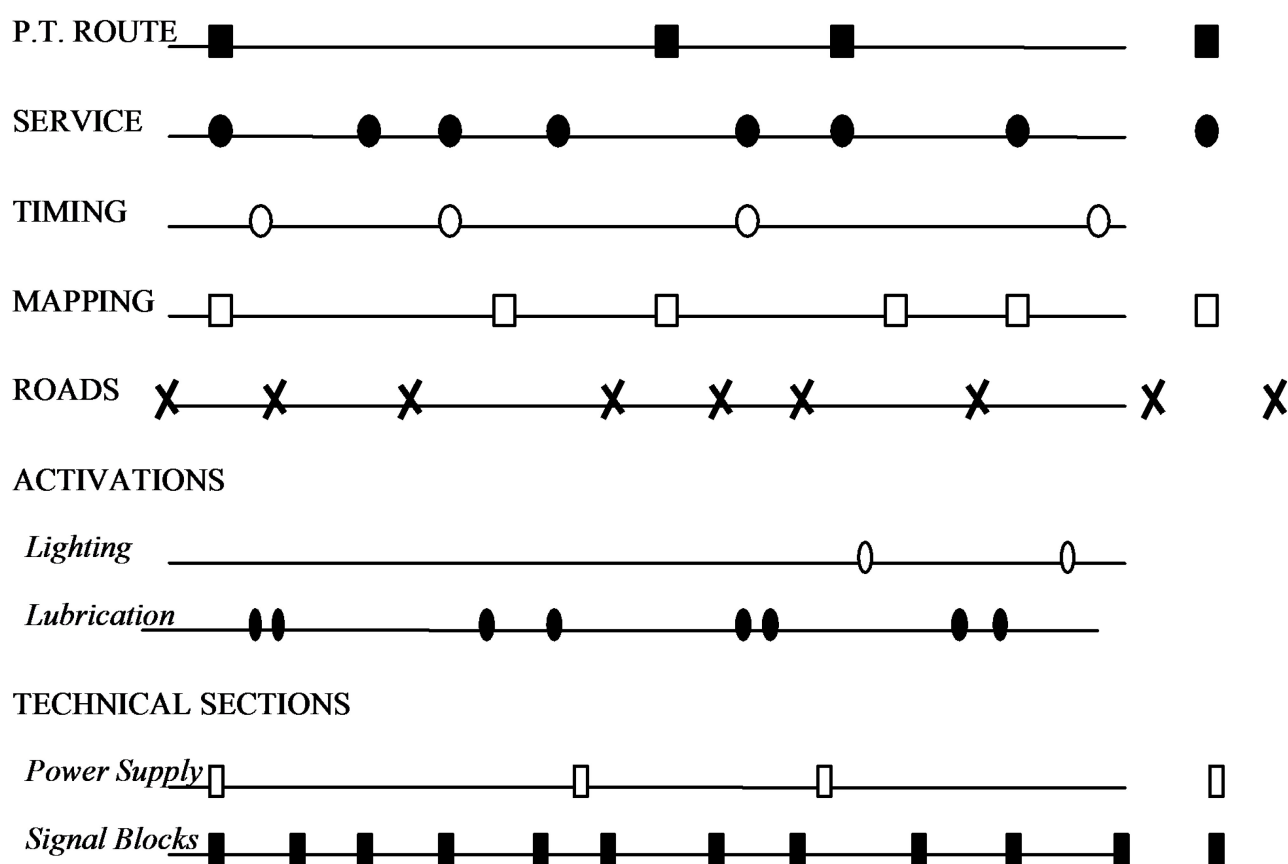


Figure 3 — Examples of layers - Different layers according to an operational need

Any POINT necessary to describe the infrastructure network is defined as an INFRASTRUCTURE POINT, which is a generic entity including several specializations (e.g. ROAD JUNCTION, RAILWAY JUNCTION). Similarly, the necessary LINKs between the POINTs are defined as INFRASTRUCTURE LINKs (e.g. ROAD ELEMENT, RAILWAY ELEMENT).

Any INFRASTRUCTURE LINK shall be bordered by a start and an end INFRASTRUCTURE POINT. This orientation does not necessarily refer to the direction of the traffic flow, but has to be interpreted as an arbitrary orientation (it may be “used” in one way or the other by the objects, like ROUTEs, JOURNEY PATTERNS, etc. referring to it through the PROJECTION mechanism).

5.3.2.2.4 Road network: ROAD JUNCTION and ROAD ELEMENT

The physical road network represents all the carriageways available for buses, into which the bus line network can be embedded.

The corresponding road INFRASTRUCTURE POINTs are defined as ROAD JUNCTIONs, while the corresponding INFRASTRUCTURE LINKs are defined as ROAD ELEMENTs.

5.3.2.2.5 Rail network: RAIL JUNCTION and RAIL ELEMENT

The rail network model represents the track network along which VEHICLES (usually TRAINs) can physically proceed, without taking into account of other operational aspects such as security, regulations or operational conventions followed by the company staff or other authorities. Railway elements are modelled in this data model for reference purposes and not for control functions.

The corresponding rail INFRASTRUCTURE POINTs are defined as RAILWAY JUNCTIONs, while the corresponding INFRASTRUCTURE LINKs are defined as RAILWAY ELEMENTs.

RAILWAY ELEMENTs will always have to be interpreted as non-overlapping parts of the rail network. This means that one railway section between two switches (“points” in English vernacular) or crossings cannot be described alternatively, and in parallel, by two or more different subdivisions into chains of railway elements. Different sequences of railway elements between two switches will principally mean multiple connections, physically separated from each other.

The location where contiguous RAILWAY ELEMENTs are connected is represented by a RAILWAY JUNCTION. The two RAILWAY JUNCTIONs bounding a RAILWAY ELEMENT are specified by two relationships between these entities. The names of the relationship ends suggest a direction, which has to be interpreted as an arbitrary orientation, similar to the orientation of ROAD ELEMENTs described in the previous section.

5.3.2.2.6 Wire network: WIRE JUNCTION and WIRE ELEMENT

The wire network for power supply of trolley buses (or trams) is modelled according to the same principles as applied for the rail network. WIRE ELEMENTs will be defined as the links between WIRE JUNCTIONs, which may be at places where three or more WIRE ELEMENTs are joined, at locations where only two adjacent WIRE ELEMENTs are connected or possibly at intermediate locations.

5.3.2.3 Network infrastructure – Example

In Figure 4, the street network is an example of an infrastructure network, that may be represented (in a GIS for instance) by ROAD JUNCTIONs and ROAD LINKs.

Other layers are represented by coloured graphs: green (timing pattern layer), blue (route layer), red (service pattern layer)

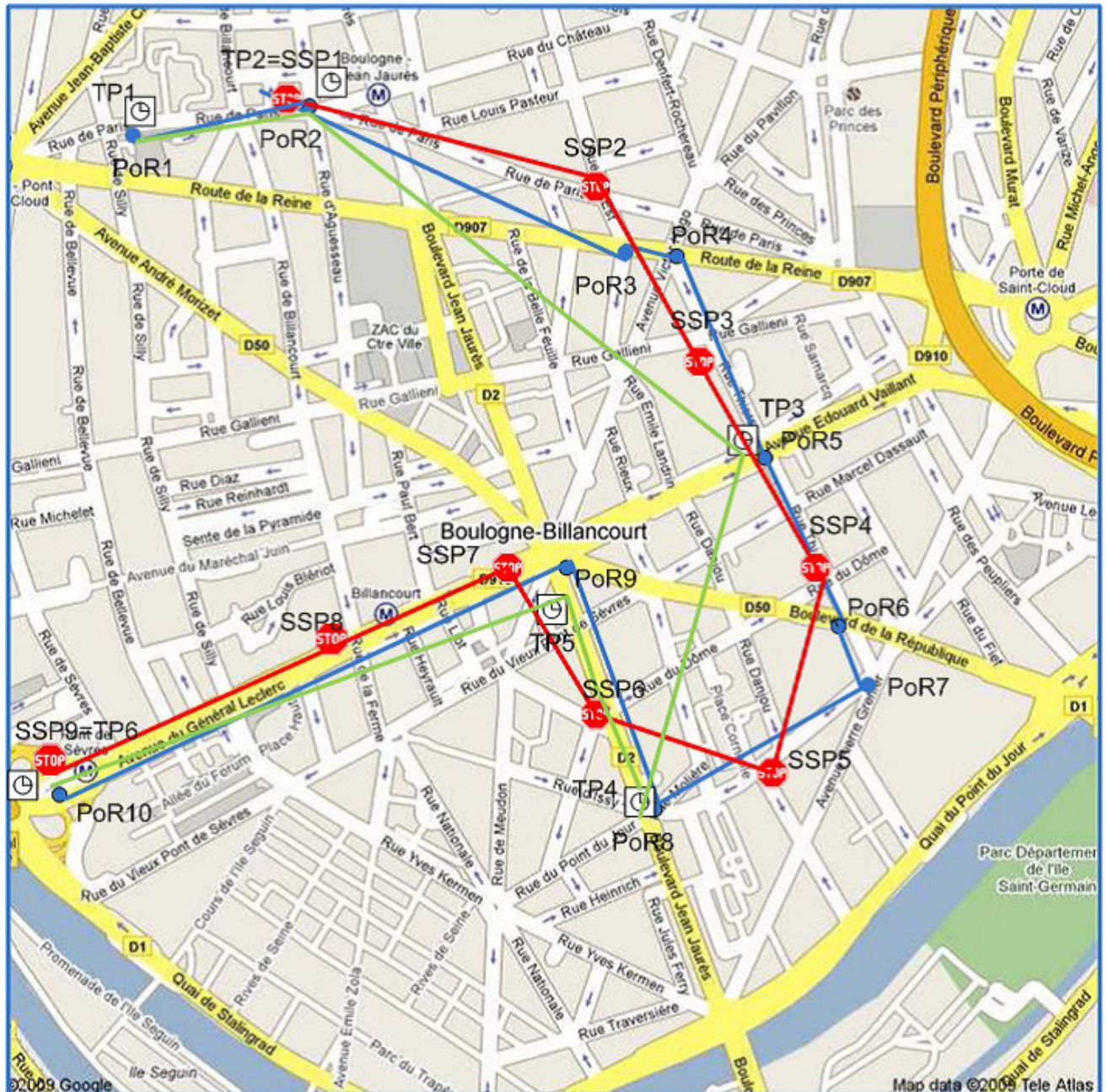


Figure 4 — Network infrastructure example

5.3.3 Network restriction

5.3.3.1 General

Constraints resulting from the physical characteristics of the network are represented in Transmodel by a range of restrictions. The network restriction model represents a number of the most relevant constraints (e.g. the OVERTAKING POSSIBILITY). Transmodel explains the approach as follows: The fact that trains cannot overtake each other or meet each other on the same track is obvious for railway systems, but similar restrictions apply for trolley buses and even conventional buses, under specific circumstances (depending on the number and width of lanes on the street). This type of restriction may be relevant for the scheduling process, because vehicle journeys shall be scheduled in a way to avoid such conflicting events.

5.3.3.2 NETWORK RESTRICTION – Conceptual model

5.3.3.2.1 General

The fact that trains cannot overtake each other or meet each other on the same track is obvious for railway systems, but similar restrictions apply for trolley buses and even conventional diesel buses, under specific circumstances (depending on the number and width of lanes on the street). This type of restriction may be relevant for the scheduling process, because vehicle journeys shall be scheduled in a way to avoid such conflicting events.

The network restriction model is not aimed at describing the management of track or of train movements, for which the concepts to consider are far more complex. It fits with a use case often found in light train operation, which consists of an initial verification of the train movements planned in a schedule, in order to check whether there are situations in which the track constraints makes the schedule impossible to run. This function is usually operated with feedback to the scheduling process.

The model comprises a set of different types of network restriction elements (VEHICLE TYPE AT POINT, OVERTAKING POSSIBILITY, IMPOSSIBLE MANOEUVRE and MEETING RESTRICTION) that apply to specific VEHICLE TYPEs (cf. “Public Transport Reference Data Model - Part 1: Common Concepts”)

Restrictions are explicit: if no NETWORK DESCRIPTION is described, it can be assumed that no limitations apply.

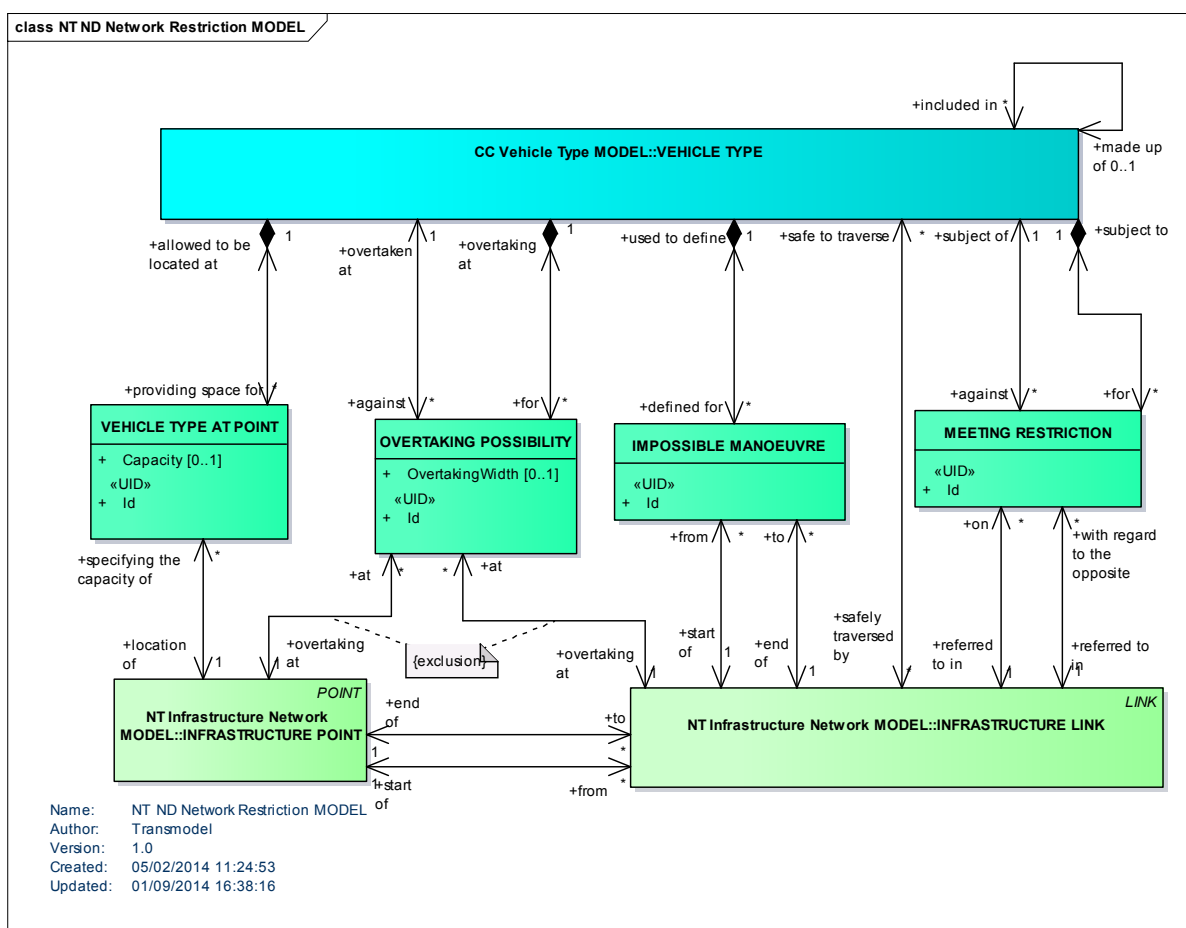


Figure 5 — Network restriction – Conceptual model

5.3.3.2.2 Vehicle types at points

A VEHICLE TYPE characterizes the common properties of a defined class of public transport vehicles (cf. “Public transport - Reference data model - Part 1: Common concepts”). Vehicles of a certain VEHICLE TYPE may not be allowed, or physically not able, to stop for any length of time at particular INFRASTRUCTURE POINTs in the network. The entity VEHICLE TYPE AT POINT may be used to express how many vehicles of each type there is space for at the specified POINT. This usually will be a SCHEDULED STOP POINT. If the number is 0, then vehicles of that VEHICLE TYPE cannot stop at this INFRASTRUCTURE POINT at all. This restriction sometimes may be relevant for checking the timing of overtaking journeys during the scheduling process.

5.3.3.2.3 Availability of links

Vehicles of a certain VEHICLE TYPE may not be able, allowed or safe to cross particular ROUTE LINKs (cf. 5.3.7, lines and routes) in the network. For example, a double-decker bus may not be able to pass under a low bridge. The reference data model expresses this as a positive relationship: a VEHICLE TYPE is safe to traverse a particular ROUTE LINK.

There may be LINKs which are not available at all on certain DAY TYPEs (cf. “Public transport - Reference data model - Part 1: Common concepts”). While these limitations generally depend only on the choice of the public transport company to offer or not to offer particular services, there may be physical restrictions that prevent particular LINKs to be used on a specific DAY TYPE. For instance, a street may be blocked because of a special event (e.g. market day) which occurs regularly on each day of that DAY TYPE. A relationship between the LINK and the DAY TYPE entity may be used to express this kind of limited availability on parts of the public transport network.

5.3.3.2.4 Overtaking possibility

In rail or wire systems, overtaking is only possible if an appropriate overtaking track is available. In bus systems, the situation of two buses regularly planned to overtake each other while operating on the same ROUTE LINK can be practically neglected. Consequently, the places where it is possible to overtake can be described by particular POINTs, as far as the planning domain is concerned. Most often SCHEDULED STOP POINTs will be used for this purpose in operational practice.

The entity OVERTAKING POSSIBILITY is therefore related to, and identified by, the INFRASTRUCTURE POINT which allows a vehicle stopping at this POINT to be overtaken by another vehicle passing by. The OVERTAKING POSSIBILITY specifies that this INFRASTRUCTURE POINT provides means (for instance a bus bay, or an overtaking rail) for one vehicle overtaking the other. This possibility may depend on the characteristics of the VEHICLE TYPEs in question, so the VEHICLE TYPEs of both the overtaking and the overtaken vehicle are associated with the OVERTAKING POSSIBILITY, by means of identifying relationships.

5.3.3.2.5 Meeting restrictions

The entity MEETING RESTRICTION expresses that vehicles of two specified VEHICLE TYPEs are not allowed to meet on a particular pair of INFRASTRUCTURE LINKs (e.g. opposite tracks). In practice, this will probably occur mainly in tram systems, where several generations of tram vehicles are operating on the same rail network, with different vehicle widths leading to conflicting clearance profiles along certain parts of the track network. In metro or light rail systems, such a situation may occur if the network comprises single-track sections.

5.3.3.2.6 Impossible manoeuvre

A particular characteristic of railway networks (in contrast to road networks) is the fact that the railway geometry does not always allow vehicle movement between two adjacent railway elements, for instance in the case of switches or crossings. Railway elements may not be suitable to be passed through in any arbitrary sequence and some successions may physically be impossible. This kind of

restrictions is expressed by the entity IMPOSSIBLE MANOEUVRE, specifying from which INFRASTRUCTURE LINK to which other (adjacent) element a rail vehicle cannot proceed because of physical restrictions. Additional information can be attached, for example the VEHICLE TYPES for which an IMPOSSIBLEMANOEUVRE would apply (for instance, bi-directional rail vehicles may be able to perform a certain manoeuvre whereas one-directional vehicles are not capable of it).

5.3.3.3 Network restriction – Example

Figure 6 provides an example of a meeting restriction: two vehicles run their journeys on opposite tracks, but due to the narrowing of the track, they are not able to meet on the two opposite red links.

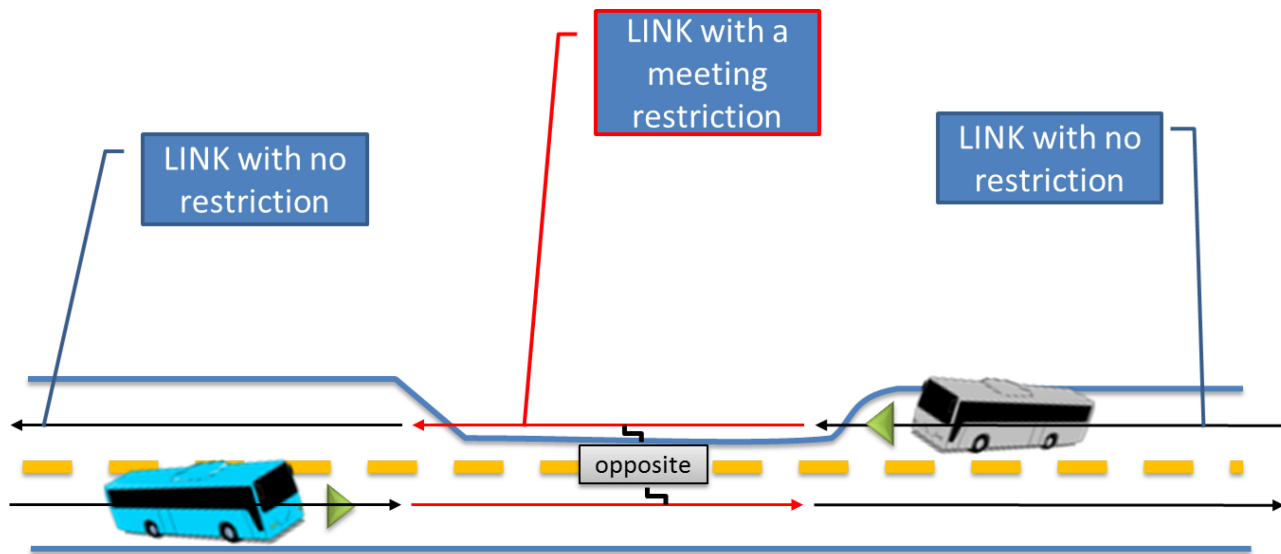


Figure 6 — Network infrastructure example (source NeTEx – Part 1)

5.3.4 Main tactical planning points and links

The generic point and link model (cf. “Public transport - Reference data model - Part 1: Common concepts”) presents the generic objects composing a network (points, links and zones). Specific roles are assigned to these simple objects according to the functional purpose. Figure 7 presents the network points and links, dedicated in particular to the tactical planning of operations.

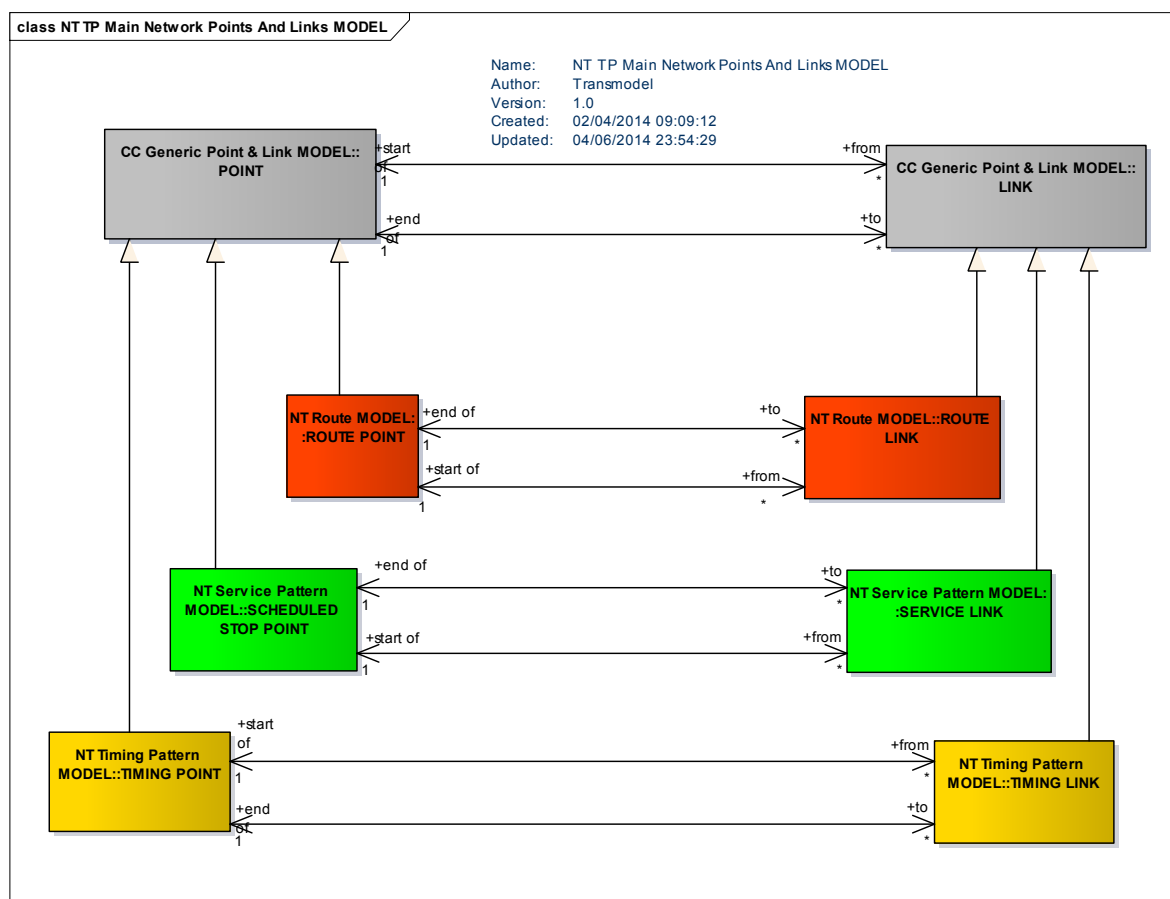


Figure 7 — Main network points and links – Conceptual model

A SCHEDULED STOP POINT is the location of a bus stop where passengers can board or alight from vehicles. This may be restricted to boarding only or alighting only. A SCHEDULED STOP POINT is a conventional representation of such a stopping place, as used to build the schedules or to provide broad traveller information. More detailed stopping positions may be necessary for dynamic platform management and the corresponding traveller information (see 5.5.9 and 5.5.10).

Any pair of SCHEDULED STOP POINTs may be related by a SERVICE LINK, which expresses the possibility for a service to run from one of these SCHEDULED STOP POINTs to the other.

A TIMING POINT is a location for which timing information necessary to build schedules may be recorded. A classical way of using TIMING POINTs is to relate them by a LINK. Such a TIMING LINK, relating a start TIMING POINT to an end TIMING POINT, may be used to store standard run times against it.

In some cases, it is necessary to store standard waiting times at some selected TIMING POINTs. A flag attribute 'waiting point' allows such points to be specified.

Some operators may want to define run times between any pair of SCHEDULED STOP POINTs related by a SERVICE LINK. In such a case, probably all SCHEDULED STOP POINTs of the network will also be classified as TIMING POINTs. Other companies will define run times only for a selection of SCHEDULED STOP POINTs. The times related to the rest of the stops would then be derived by process (e.g. interpolation). In addition, some POINTs that are not SCHEDULED STOP POINTs are classified as TIMING POINTs. It is often the case for garage entry or exit points (cf. section below).

The path to be followed by services is described thanks to ROUTE POINTs, related by ROUTE LINKs. A ROUTE POINT may be an end point of a route (“terminus”) or a point chosen to express that a route is passing “via” this ROUTE POINT. If there are several possible paths between two ROUTE POINTs, the most common practice is to create such “via” ROUTE POINTs, in order to distinguish the various paths (cf. section referring to the route model).

5.3.5 Activation

5.3.5.1 General

The ACTIVATION Model relates the points in the network at which monitoring equipment may interact with vehicles - possibly with on-board equipment. Such equipment may be relevant for real-time control. Uses of ACTIVATED EQUIPMENT can include:

- detectors for vehicle locating systems;
- traffic light priority systems;
- sign clear-down: the use of vehicle to infrastructure wireless communication to trigger sign content update based on proximity (providing a faster and more reliable link than a hub based signal).

5.3.5.2 ACTIVATION – Conceptual model

Figure 8 describes the relationship between ACTIVATION POINTs, ACTIVATION LINKs, TRAFFIC CONTROL POINTs and the ACTIVATED EQUIPMENT using ACTIVATION ASSIGNMENTS.

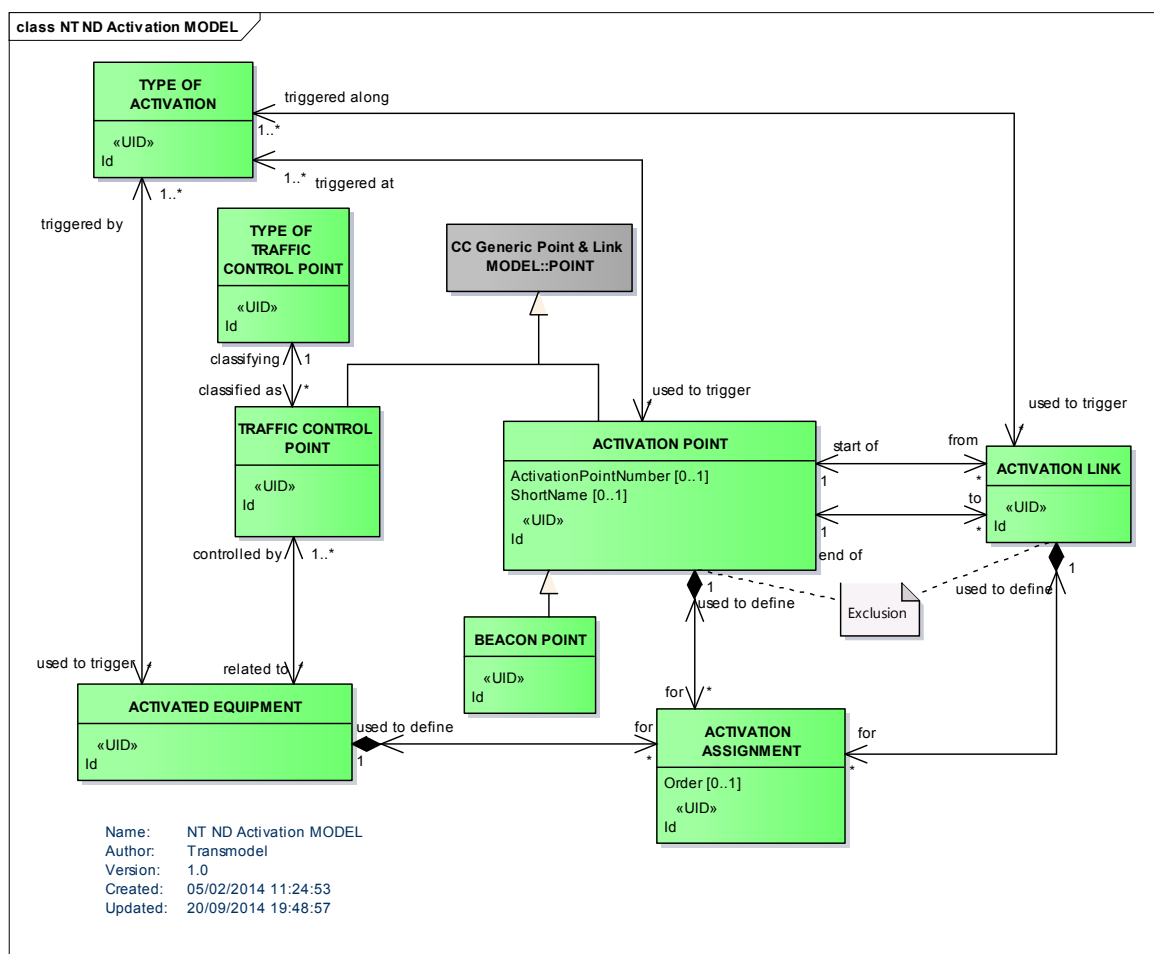


Figure 8 — Activation – Conceptual model

An ACTIVATION POINT represents a POINT in the network that is used to activate some device when a vehicle passes it. Similarly, an ACTIVATION LINK represents a LINK used for such a function. The event of passing by may be recognized by a particular piece of equipment (e.g. beacon), or may be calculated (e.g. by an AVM system). The appropriate control process, or other action, hence will be triggered.

A particular subtype of ACTIVATION POINT is the BEACON POINT. Infrared or electronic beacons are installed at particular locations along the tracks or at stops, for instance. They send out a specific 'code' (permanently or after having been activated by a vehicle passing by) to be used by a vehicle location system to identify the actual location of vehicles.

Any device to be activated will be identified as ACTIVATED EQUIPMENT. ACTIVATION ASSIGNMENT is used to specify which ACTIVATED EQUIPMENT is alerted when a vehicle passes either by an ACTIVATION POINT or an ACTIVATION LINK. The actions triggered by ACTIVATED EQUIPMENT are classified according to a TYPE OF ACTIVATION (traffic light priority or barrier opening request, interior lighting of vehicles in tunnels, etc.). In some systems the activation process consists of several messages. The first message triggers the activation once a vehicle passes a first point, whereas the activation will be cancelled as soon as the vehicle passes the second point. In addition, some systems need to refer to a certain approaching section for a pre-announcement (e.g. in traffic light priorities). Such processes are differentiated by distinct TYPES OF ACTIVATION.

An important case of activation is the process of priority requests sent to TRAFFIC CONTROL POINTS. This entity represents a POINT in the network where a traffic light (or another device used to influence the traffic flow) is located. The traffic lights installed at a TRAFFIC CONTROL POINT will be controlled by one or more traffic light controllers, specified as ACTIVATED EQUIPMENT. Such a controller may

control more than one traffic light, all of which may be at the same road junction, or may be distributed over several consecutive road junctions. TRAFFIC CONTROL POINTs are classified according to a TYPE OF TRAFFIC CONTROL POINT.

5.3.6 Vehicle and crew point

5.3.6.1 General

The vehicle and crew point model describes the location of the garages and crew changeover points that are referenced by vehicle and duty schedules.

5.3.6.2 VEHICLE and CREW POINT – Conceptual model

Figure 9 shows the conceptual model for VEHICLE and CREW POINTs. There are three types of POINT: RELIEF POINT, PARKING POINT and GARAGE POINT at which VEHICLES may be located. These may be associated with organization entities for staff – CREW BASE – and for vehicle scheduling – GARAGE.

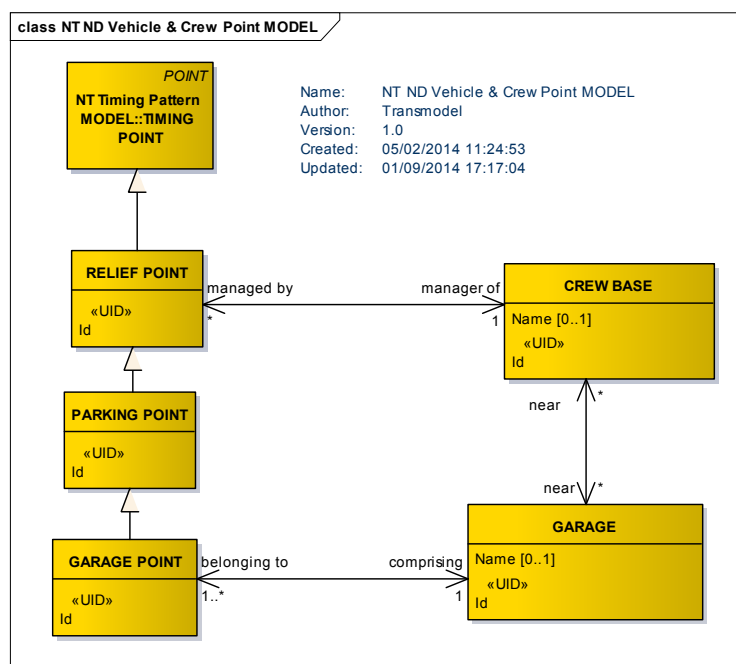


Figure 9 — Vehicle and crew point – Conceptual model

The GARAGES where public transport vehicles are usually parked are considered to be part of the basic network definition. They are the source and destination places where vehicles start and end their operation, and thus are part of the basic infrastructure.

Within a GARAGE, it is often necessary to distinguish several GARAGE POINTs. Such points are not aimed at describing any precise parking place for vehicles, but to specify conventional places where timing information, necessary for planning, may be different. Therefore, different GARAGE POINTs may represent different parking areas, or different entry or exit points.

PARKING POINT represents any POINT where a public transport vehicle may be parked for a while. It includes GARAGE POINTs located within a GARAGE, as a subtype. Other PARKING POINTs located at other places may be defined. For instance, in bus operation, PARKING POINTs often exist in central places of the network; buses may be parked there at off-peak hours, or as tactical reserves.

Operating employees of a PT operator, in particular the drivers, are managed at a CREW BASE, where they report, sign on or off, stock up with tickets, etc. A CREW BASE and a GARAGE may be near each other (or even in the same “depot”).

The driver planning process defines in advance the points where the drivers will start or stop driving vehicles. Such POINTs are qualified as RELIEF POINTs. They are managed by a CREW BASE. RELIEF POINT has an extended meaning, as it includes any point where a driver may pick up an unattended vehicle or park it. Therefore, PARKING POINT (including GARAGE POINT) is a specialization of RELIEF POINT.

As the start or the end of a driving spell are at fixed times, RELIEF POINT is a subtype of TIMING POINT. PARKING POINT and GARAGE POINT are hence specializations of TIMING POINT as well.

5.3.7 Lines and routes

5.3.7.1 ROUTE – Conceptual model

The ROUTE entity represents a conventional way of describing a path through the network, to be used by regular PT services. A ROUTE is a linear feature composed of points and links specifically defined for that purpose. This sequence of points and links shall be built in a way that identifies a path without any ambiguity.

The ROUTE entity represents an abstract concept that has in itself no real operational meaning. Its purpose is to describe a path *independently* of both the *infrastructure pattern* (e.g. ROAD ELEMENTs or RAILWAY ELEMENTs) and the *operational pattern* (e.g. sequence of SCHEDULED STOP POINTs presented in a further section). ROUTE is classically used as an interfacing object between operational planning and infrastructure description. The independence of the ROUTE definition serves to separate the concerns of the different layers allowing a modular consideration of network topology data.

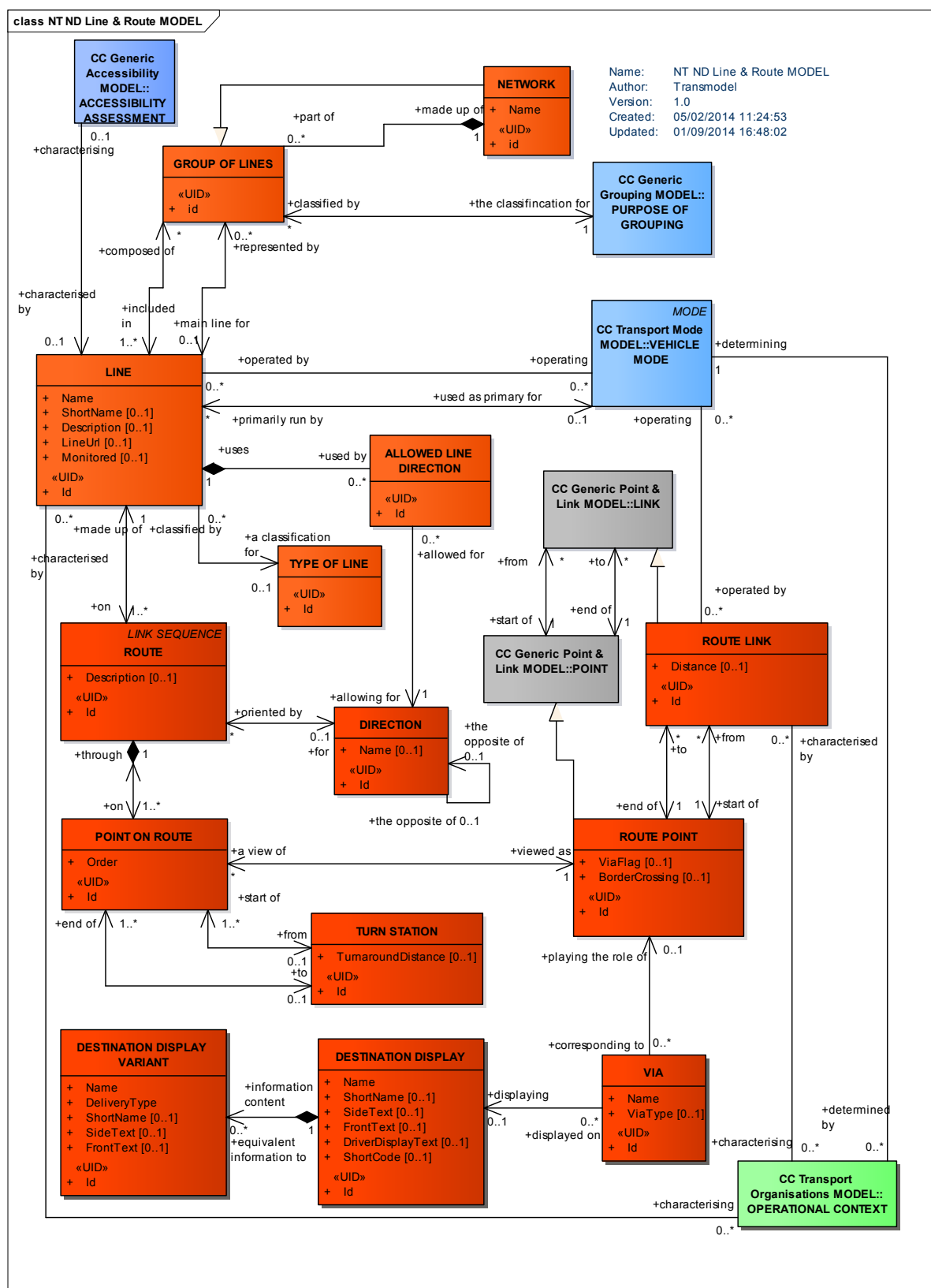


Figure 10 — Line and route - Conceptual model

A ROUTE is made up of ROUTE LINKs, which are LINKs defined between two ROUTE POINTs. A ROUTE LINK is restricted to be identifiable by its end ROUTE POINTs, which means that there cannot normally

be any alternative ROUTE LINK between the same pair of ROUTE POINTs. This restriction corresponds to most practices, but if necessary can be qualified by the use of an OPERATIONAL CONTEXT (See TRANSPORT ORGANIZATION model), which allows separate links for separate designated purposes.

A ROUTE is thus a LINK SEQUENCE, defined by an ordered sequence of (two or more) POINTs ON ROUTE. A ROUTE may pass through the same ROUTE POINT more than once, as in the case of a loop. The POINT ON ROUTE entity is accordingly used to describe the ordered list of ROUTE POINTs defining the path of a ROUTE, with an attribute 'order' as identifier.

It should be noted that a ROUTE – as a single path through a network in one direction – corresponds to only one of the possible senses of 'route' in colloquial English. In particular the wider sense of a set of paths including branches and conditional variants given a common name for marketing to the public, is represented by the concept of a LINE,

The LINE and ROUTE model above gives an overview on all the relevant concepts in this context. They will be explained in the following sections.

5.3.7.2 Route topologies

A number of different geometries for routes are typically found in transport networks, all of which may be described using POINT and LINK representations.

- **Linear:** A simple linear path from an origin stop to a destination stop. It may be exactly symmetric i.e. be traversed to matching stop pairs in the outbound and inbound direction. Or asymmetric – with differences in the stop sequences in each direction.
- **Circular:** A path that returns to the origin stop as the destination. It then may continue round repeatedly. There may be symmetric or asymmetric services in the clockwise or anticlockwise direction. The destinations shown for such routes may vary along the way.
- **Lollipop:** A path that goes round a loop one way at the outbound destination end and then returns past the same stops on the inbound path.
- **Cloverleaf:** A path that returns repeatedly to the same stop.
- **Branching:** Alternate paths that go one or other alternative way at either end of the journey.
- **Eye:** Alternate paths that go one or other alternative way round an intermediate section of the route.

There shall be a valid ROUTE LINK between each pair of consecutive POINTs ON ROUTE.

The general orientation of a ROUTE (a ROUTE is of course oriented) may be described by an expression like "outwards", "backwards" etc., often referring approximately to the city centre. This classification may lead to the definition of arbitrarily chosen DIRECTIONS, which may be used for passenger information, but may also be relevant for scheduling or fare management. Two DIRECTIONS may be defined as being opposite to each other.

5.3.7.3 Route – Example

Figure 11 shows a ROUTE described through a sequence of POINTs ON ROUTE. It should clarify in particular, the difference between the infrastructure network (streets) and the schematic representation of the physical path for vehicles: the ROUTE.

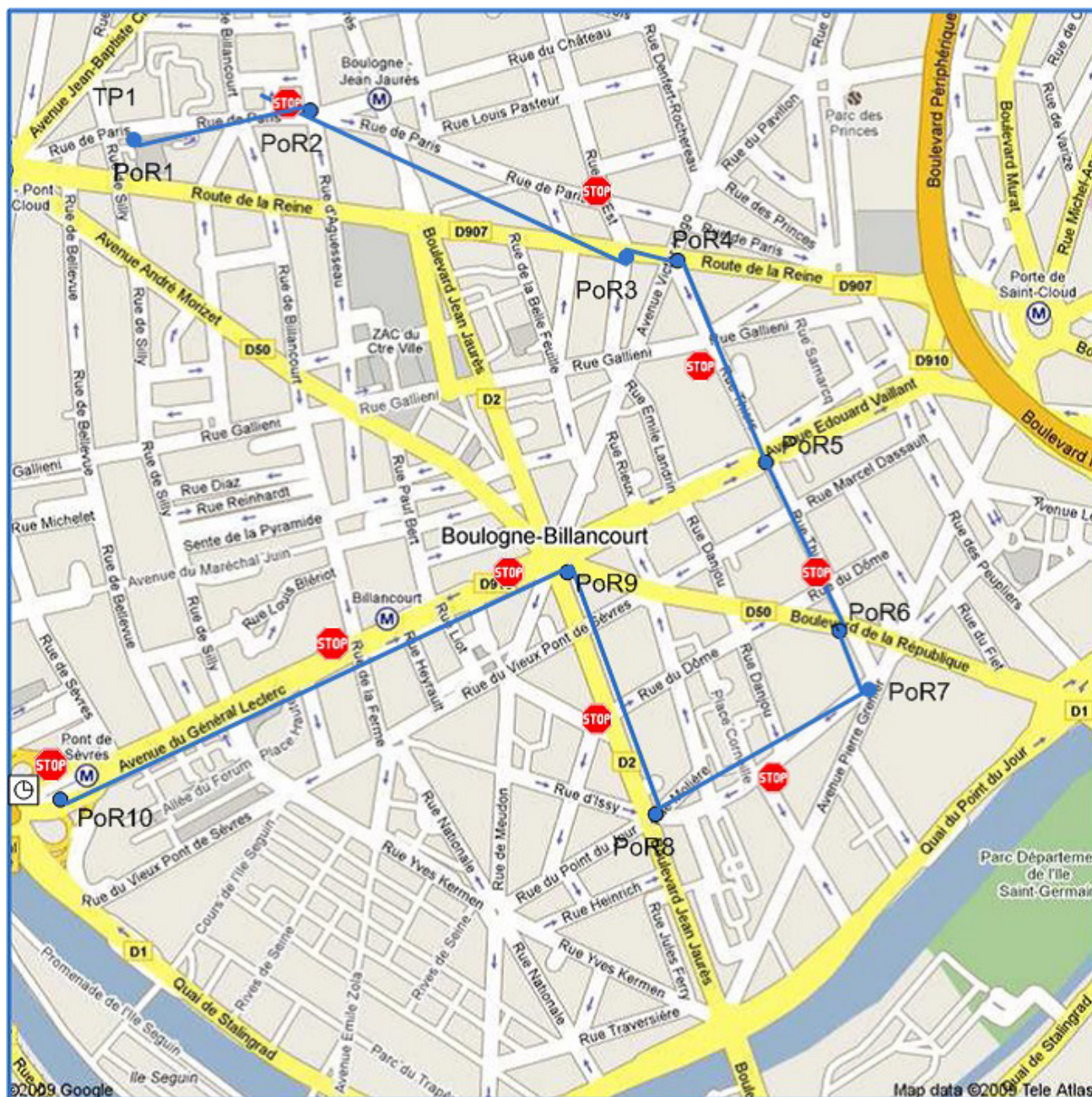


Figure 11 — Route point and point on route - Example (NeTEx - Part 1)

Figure 12 shows an example of ROUTE POINTs used by two ROUTEs, with ROUTE 1 (the green one) passing the same ROUTE POINT several times. Each time the ROUTE passes through a ROUTE POINT, it “creates” a new POINT ON ROUTE.

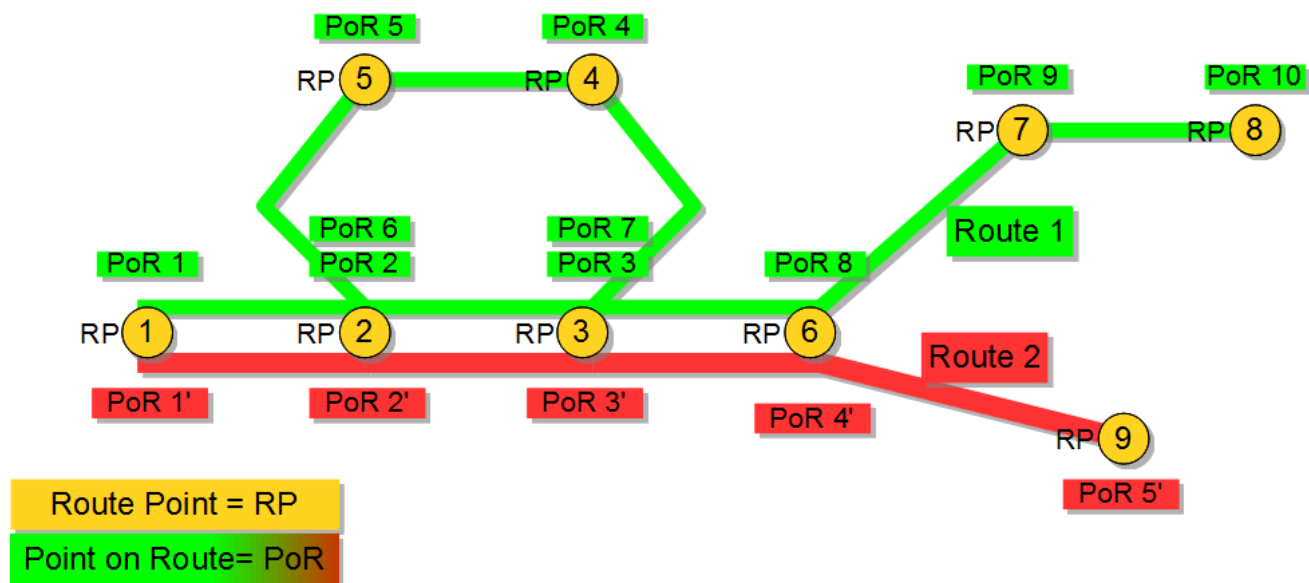


Figure 12 — Route point and point on route – Example (NeTEx – Part 1)

5.3.7.4 LINE – Conceptual model

Figure 13 incorporates the line model. Transmodel defines a LINE as a grouping of ROUTEs that is generally known to the public by a similar name or number. These ROUTEs are usually very similar to each other from the topological point of view, being variants of a core route with some deviations only on certain parts. Often the vehicle journeys on these ROUTEs are scheduled jointly with tight synchronisation, in order to provide a regular service on this specific LINE. They are often grouped together for presentation of the timetable to the public.

Two ROUTEs using the same infrastructure path (or parallel tracks), but with opposite DIRECTIONS, will generally belong to the same LINE.

LINEs may be grouped into GROUPs OF LINEs for particular purposes, such as fare harmonization, day type assignment, or to group some kind of service categories (night buses, etc.). Grouping can also be used to define several kinds of PT networks and sub-networks: what is usually called 'public transport network' is in fact only a specific GROUP OF LINEs and a LINE may belong to several of them. For example in Ile de France, a LINE may belong to the STIF network (the all Ile-de-France Network), but also to the Nocilien network (night buses) and the PHEBUS network (Versailles' town bus network).

Each GROUP OF LINEs shall be defined for only one purpose, which is expressed by a PURPOSE OF GROUPING. A LINE may be in different groups for different purposes, and may also belong to more than one GROUP OF LINEs for one single purpose. It is the responsibility of users to ensure consistent groupings, suitable for the specific purpose in question (cf. "Public transport - Reference data model - Part 1: Common concepts").

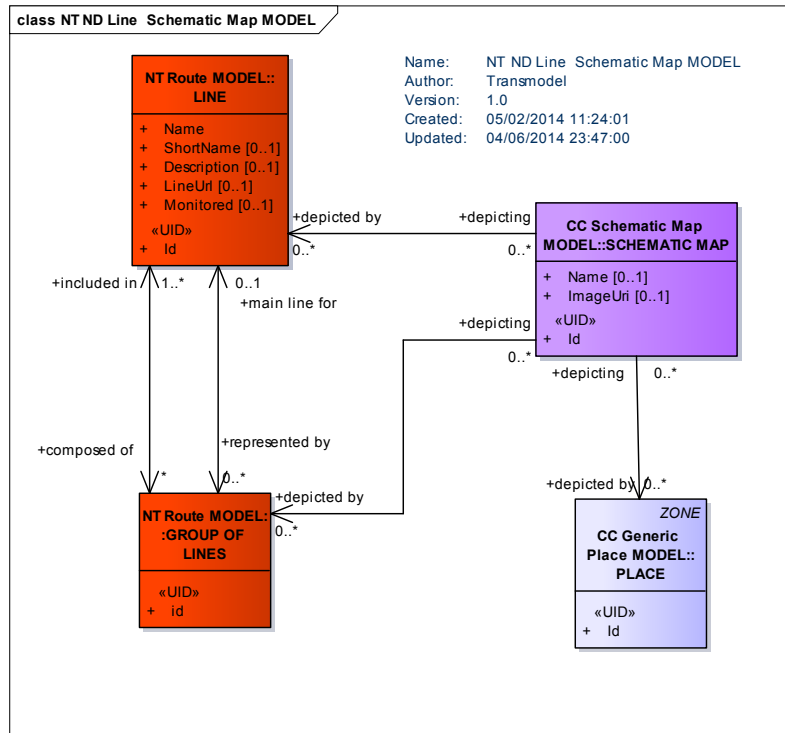


Figure 13 — Line schematic map – Conceptual model

Figure 13 expresses the fact that a SCHEMATIC MAP may be representing schematically the layout of the topographic structure of a LINE or a GROUP OF LINES.

5.3.8 Line Network

5.3.8.1 General

The Line Network model provides a means of describing the overall topology of a route - or rather all the ROUTES of a LINE - including branches and alternatives etc. This is in contrast to ROUTES, SERVICE PATTERNS, JOURNEY PATTERNS, etc., which show a single path though the network for a single journey.

The grouping of patterns into a LINE NETWORK has uses for visualizations (for example a schematic map of a network) and for relating situations to affected parts of the network.

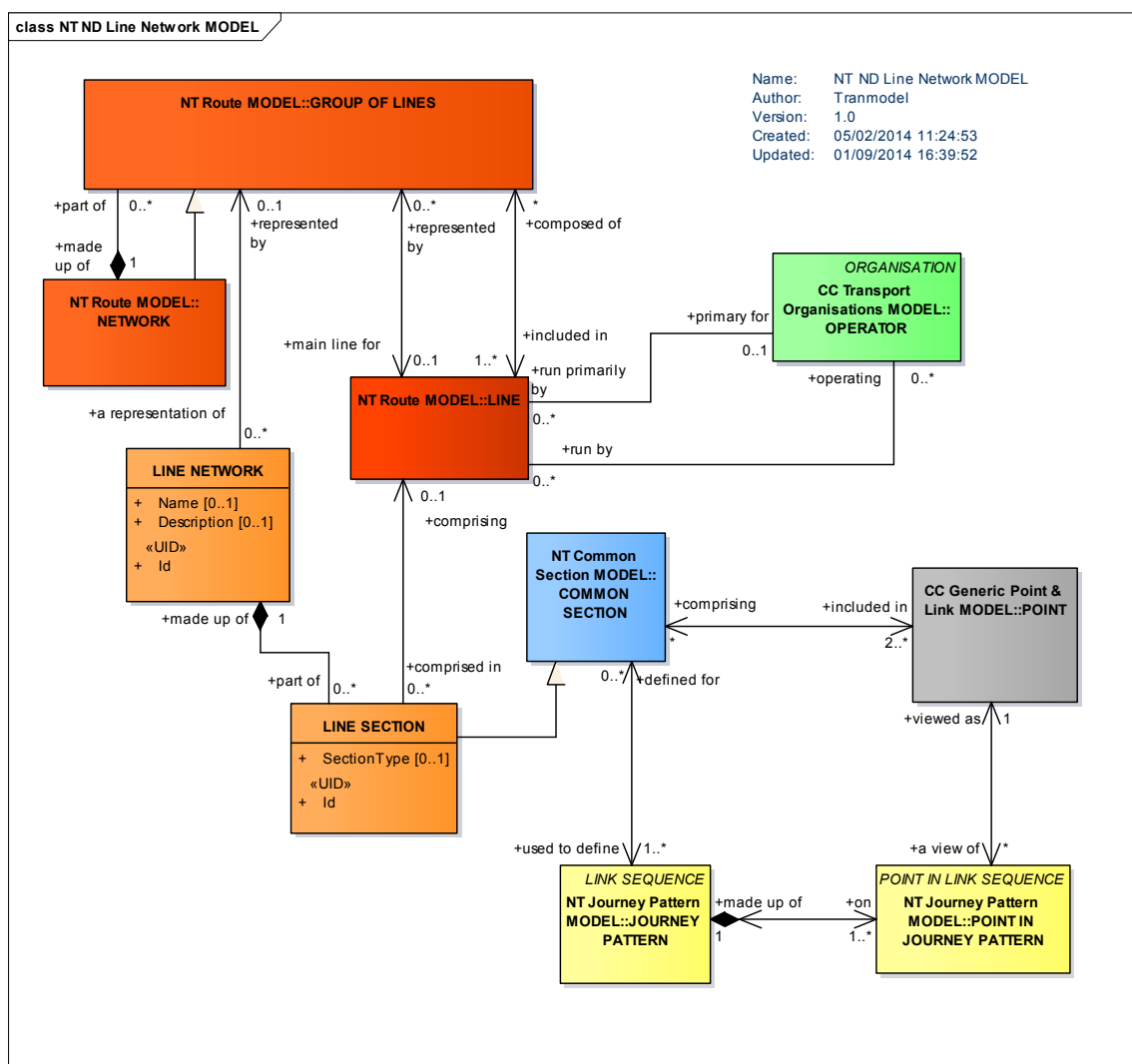


Figure 14 — Line network – Conceptual model

5.3.8.2 LINE NETWORK – Conceptual model

A LINE NETWORK represents the network topology as a named set of LINE SECTIONS. Each LINK SECTION is a sequence of SCHEDULED STOP POINTs and/or SERVICE LINKs.

5.3.8.3 Line network – Example

Figure 15 shows an example of a LINE NETWORK for the Northern line of the London Underground. It includes a number of branches and covers both direction of the line.

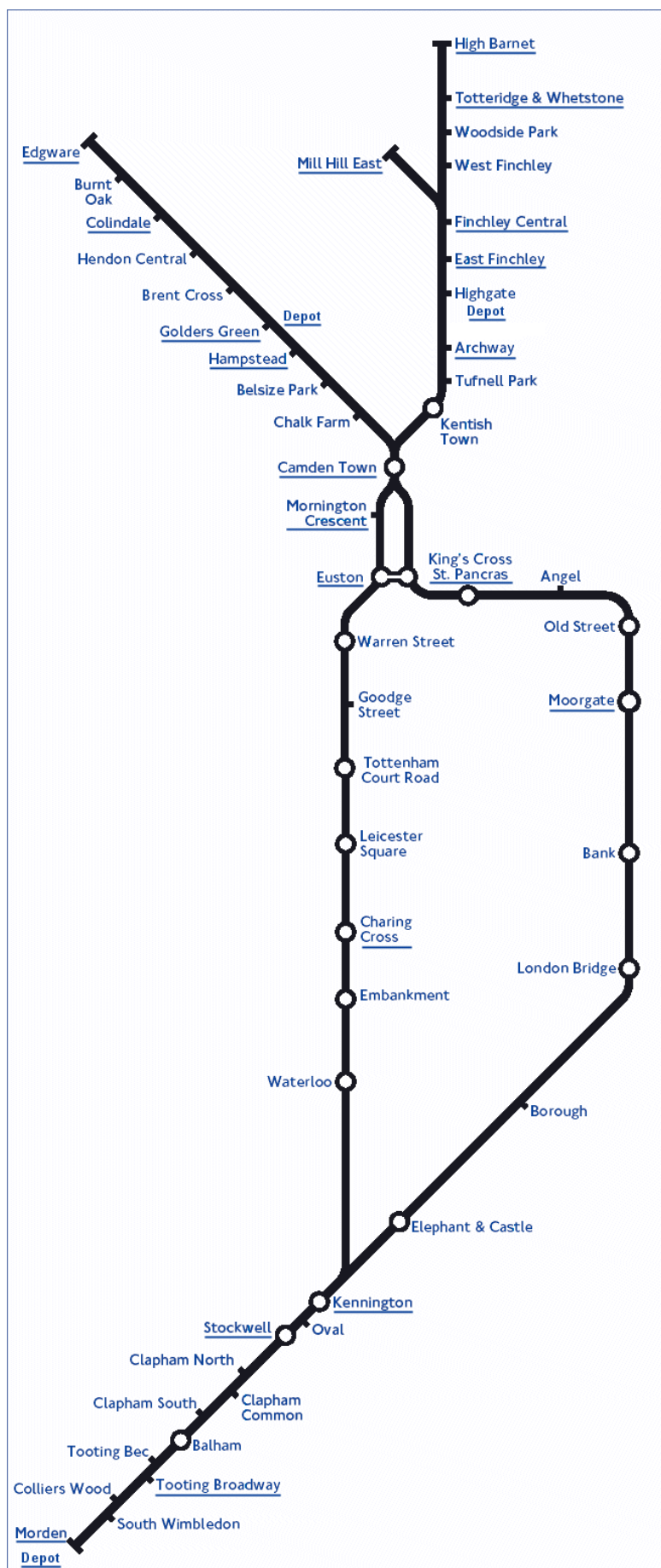


Figure 15 — Example of a schematic representation of a LINE (Line Network LUL Northern line - source NeTEx - Part 1)

5.3.9 Flexible network

5.3.9.1 General

Transmodel is designed to support FTS (flexible transport service) and DRT (demand responsive transport). DRT and FTS often cover similar services; FTS being more generic since flexibility may not be directly linked to the demand, but may be related to some operating needs or cost optimisations. The term 'FTS' will be used in the following text to cover both concepts.

5.3.9.2 Flexible network introduction

Transmodel does not have a separate FTS specific model, but has extra properties that can be used to describe FTS systems.

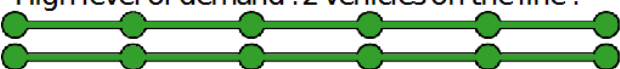
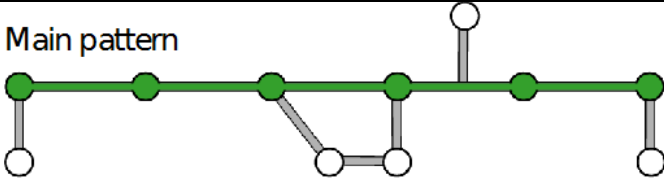
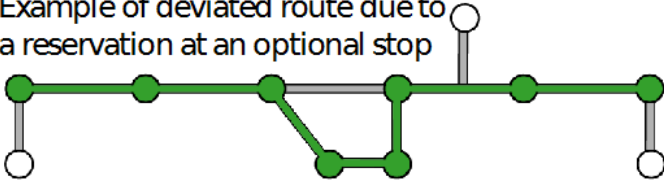
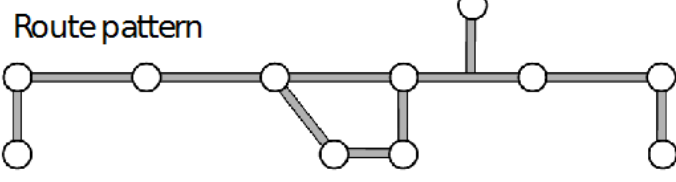
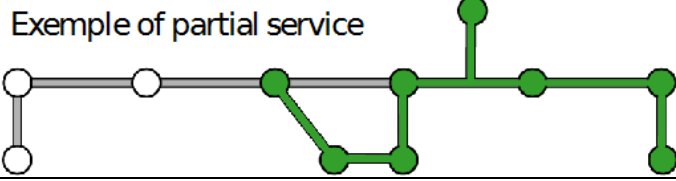
For network topology, the main FTS aspect considered is the FTS line structure.

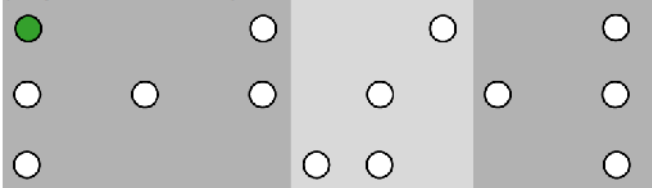
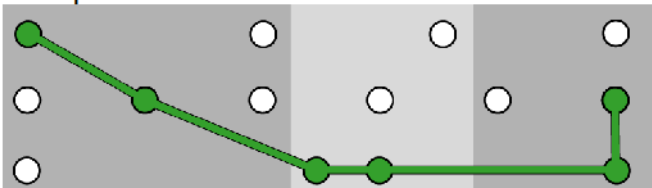
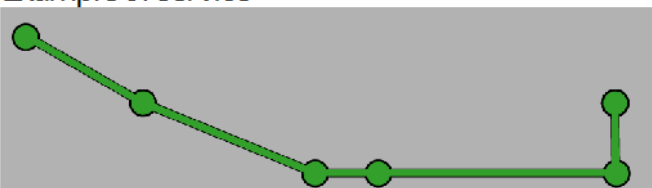
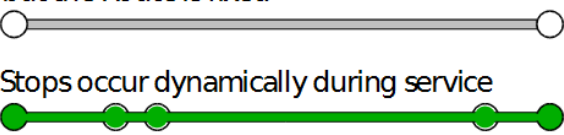
Different types of FTS are considered in the present document. The FTS type considered are defined on JOURNEY PATTERN level (or POINT IN JOURNEY PATTERN, in the case when only a part of the JOURNEY PATTERN is flexible) or on ROUTE level. This allows for:

- virtual line service;
- flexible service with main route;
- corridor service (flexible service without main route);
- fixed stop area-wide flexible service;
- free area-wide flexible service;
- mixed types of flexible service (not at point level).

Table 1 summarizes the FTS LINE topologies taken into account in Transmodel.

Table 1 — FTS typology (source NeTEx)

Name	Description	Figure
Virtual Line	This case is very similar to fixed line operation: journey patterns are defined as usual, but stops are served only if there is a passenger booking for it. Several vehicles may be allocated to the same journey when high level of demand occurs. Virtual line can be operated with fixed or dynamic passing times.	Journey pattern :  Partial service :  High level of demand : 2 vehicles on the line : 
Flexible line with main route	A minimal list and order of stops are defined determining a “main and minimal” journey pattern. Possible additional stops are defined but will be served only in case of passenger reservation. A range of journey patterns is determined through a stop list and order defined dynamically according to the passenger reservations and “around” the “main and minimal” journey pattern..	Main pattern  Example of deviated route due to a reservation at an optional stop 
Flexible line without main route	The possible stops of the journey pattern are known, and the possible stop sequences are also defined and the real stop list and order are defined dynamically according to the passenger reservations without any reference to a main pattern.	Route pattern  Exemple of partial service 

Name	Description	Figure
Flexible zone with fixed stops	The service is defined by one or several zones (in sequence). Each zone is defined by a set of possible stops. Stops served, and stop order are defined for each vehicle journey according to the reservations. Passing times (entry and exit time) are usually defined for each zone. They may also be defined for each stop.	"Route" pattern (may contain some stops served without reservation)  Example of service 
Flexible zone without fixed stops	The service is defined by one or several zones (in sequence). A stop can occur anywhere in each Zone. Stops served, and stop order will be defined for each vehicle journey according to the reservations. Passing times may be defined for each zone (entry and exit time), or for each stop.	No route pattern, no schedules...  Example of service 
Hail and Ride	The route is defined, but the Journey Pattern only has a start and an end. Boarding or alighting is obtained by signalling the driver that one wishes to board/alight, and can occur anywhere along the Route. It also sometimes happens that boarding may occur at fixed stops, and only alighting can occur on demand anywhere along the Route.	No stops are defined on the Journey Pattern, but the Route is fixed  Stops occur dynamically during service
Combination of any of the previous FTS structure	A lot of FTS services are defined as a sequence of the described previously FTS types.	

5.3.9.3 FLEXIBLE NETWORK – Conceptual model

5.3.9.3.1 General

Figure 16 shows that there is no major difference between FTS and fixed route points, links and zones. The main difference resides in the way the model and the typology are used.

- FTS often needs to refer to a ZONE of operation instead of specific SCHEDULED STOP POINTs. As shown by the diagram, a POINT may represent the functional centroid of a ZONE (i.e. not necessarily the geometric centre of the ZONE). Therefore Transmodel uses the convention that if the POINT (a SCHEDULED STOP POINT, a TIMING POINT or a ROUTE POINT) is the centroid of a ZONE, this means that this POINT (SCHEDULED STOP, TIMING or ROUTE POINT) is *representing* a ZONE, to be used for FTS as a flexible ZONE. In order to specify the nature of the flexibility, the additional FLEXIBLE POINT PROPERTIES element is available.
- The ZONE itself may contain a set of POINTs through the 'including' relation (it is then possible to define all the SCHEDULED STOP POINTs of a flexible zone with fixed stops, for example). A ZONE may include other ZONES. According to the typology of FTS chosen, a constraint is formulated requiring that a ZONE may contain POINTs or ZONES, but not both.
- The FLEXIBLE LINK PROPERTIES are available for LINKs, making it possible to describe hail and ride LINKs or a LINE structure combining different kind of FTS. The LINK with FLEXIBLE LINK PROPERTIES can have some generic VALIDITY CONDITIONS in order to be able to describe situations likes LINKs being hail and ride only between 9 pm and 7 am

Note that in order to make coverage by flexible services visible to journey planners, FLEXIBLE STOP PLACES, FLEXIBLE AREAs and HAIL AND RIDE AREAs can be defined. See section on FLEXIBLE STOP PLACE model.

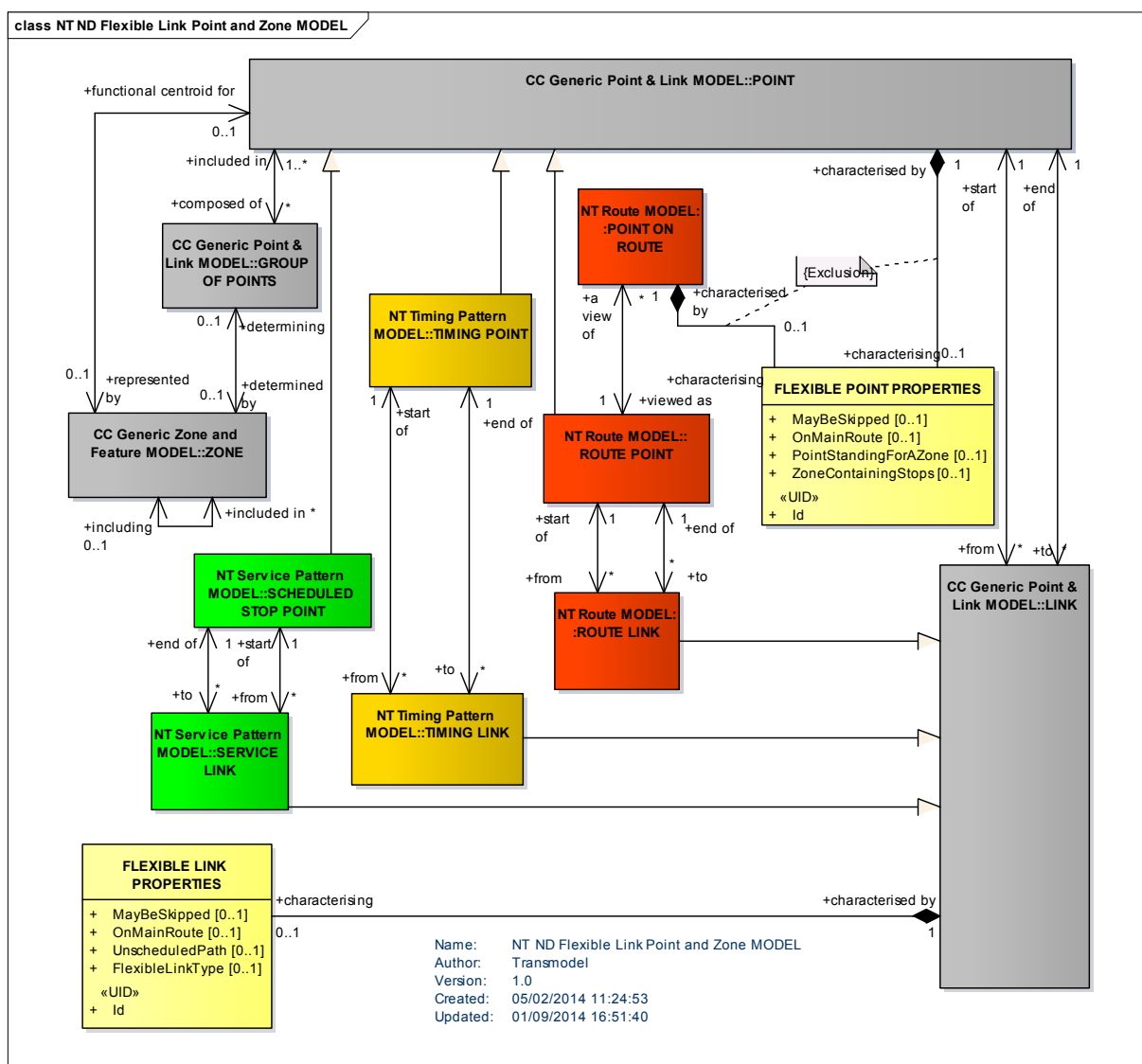


Figure 16 — Flexible link, point and zone – Conceptual model

5.3.9.3.2 Flexible routes

A FLEXIBLE ROUTE is a specialization of ROUTE allowing flexible behaviour, the type of flexibility being described by its attribute.

As shown above, ROUTE POINTs and ROUTE LINKs may have flexible properties (FLEXIBLE POINT and LINK PROPERTIES have already been described with the previous schema). This modelling also applies to POINTs ON ROUTE in order to describe FLEXIBLE ROUTES.

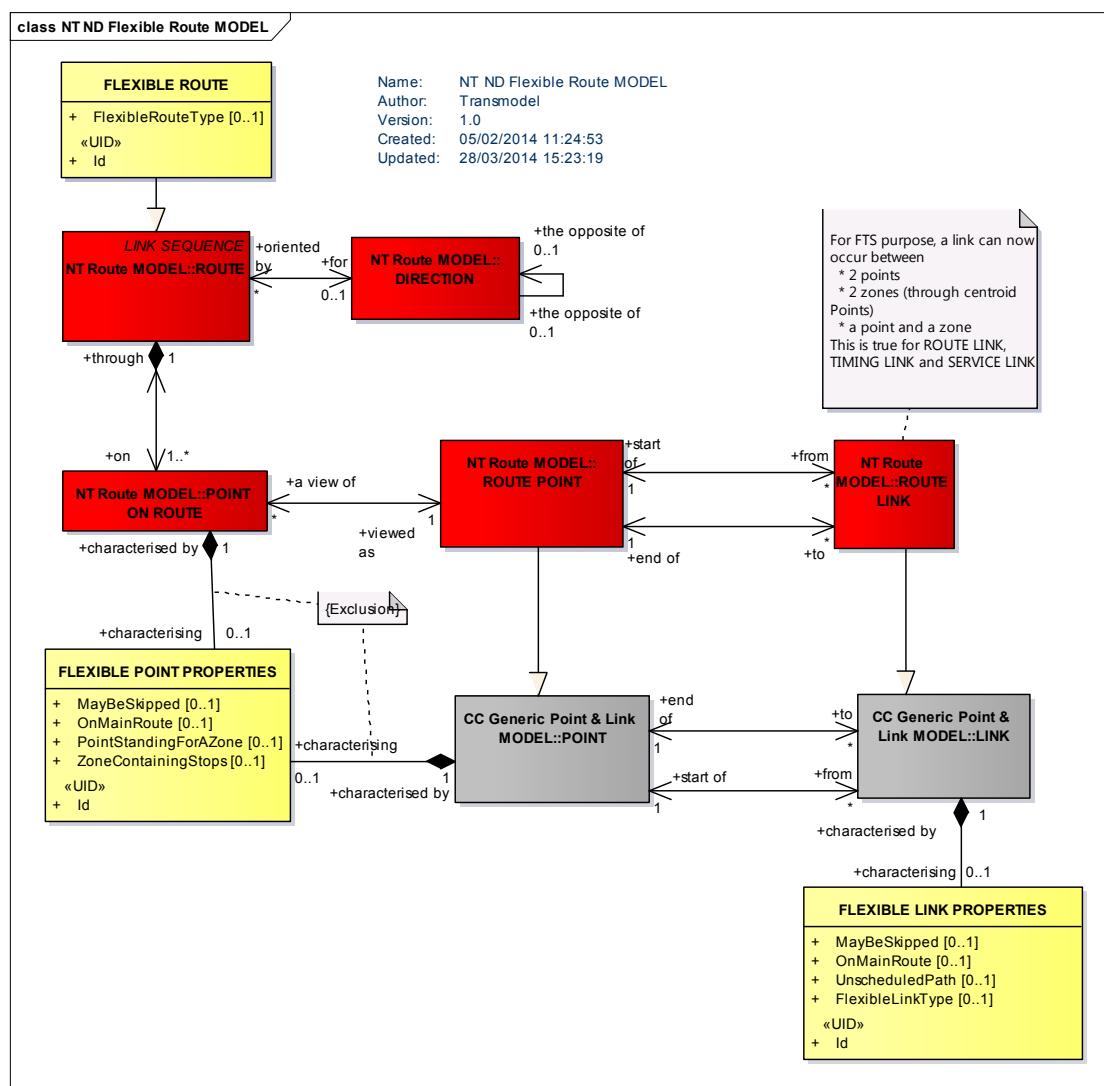


Figure 17 — Flexible route – Conceptual model

5.3.9.3.3 Flexible lines

A FLEXIBLE LINE is a group of FLEXIBLE ROUTEs which is generally known to the public by a similar name or number and which have common booking arrangements

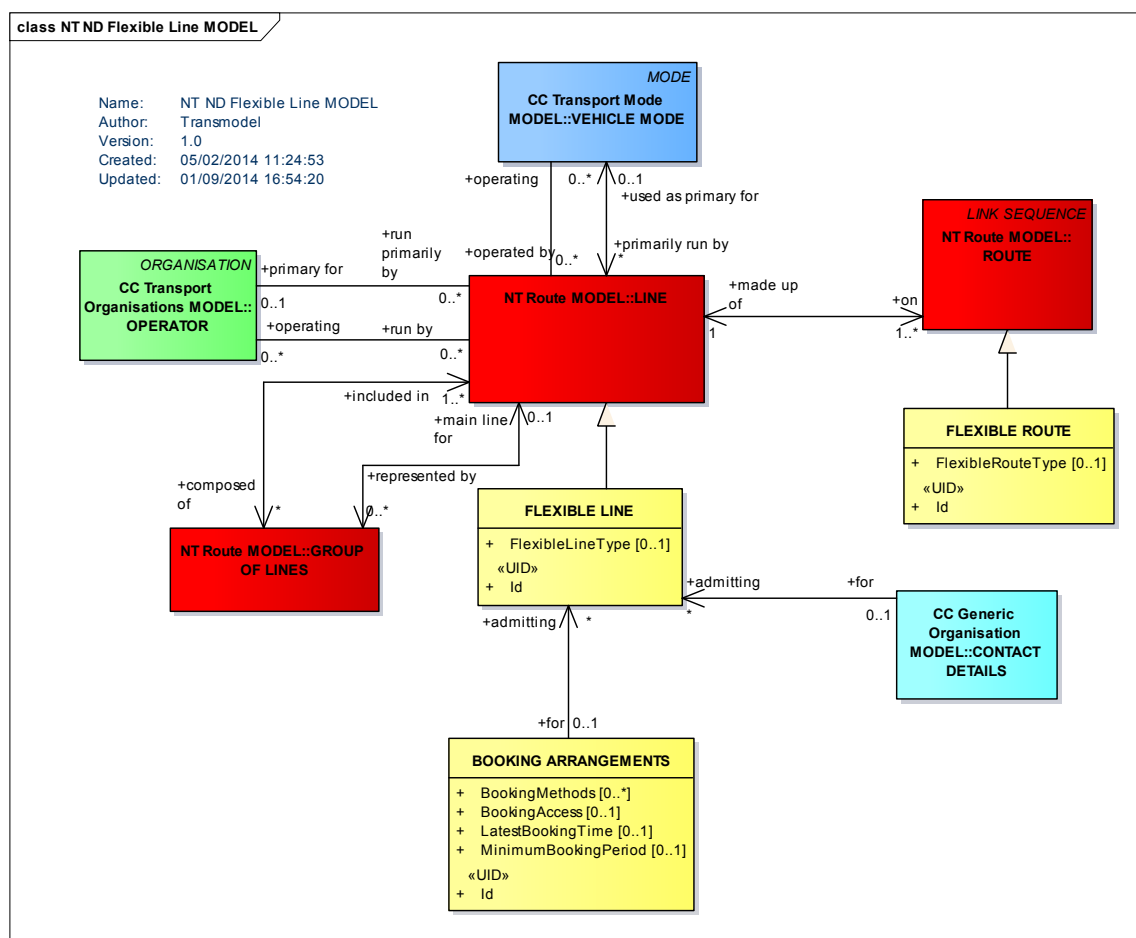


Figure 18 — Flexible line – Conceptual model

5.4 Fixed object model

5.4.1 Model overview

The fixed objects model describes fixed stops and out of vehicle passenger aspects of a network and is itself divided into a number of separate sub-models.

The sub-models depend on a number of general framework models (for example, generic point and link model, notice model, etc.) described in the part “Public transport - Reference data model – Part 1: Common concepts”. The following sub-models are described in the sections below:

- SITE model: models a location that passengers travel from or to;
- STOP PLACE model: models a station or stop;
- FLEXIBLE STOP PLACE model: models an area covered by a flexible transport service;
- POINT OF INTEREST model: models a public site other than a station or stop to or from which a passenger may want to travel;
- EQUIPMENT description model: models on one hand the installed equipment, i.e. fixed equipment and passenger equipment (that may be also on-board), on the other hand local services, considered as immaterial equipment;

- NAVIGATION PATH model: models the paths through a SITE;
- CHECK CONSTRAINT model: models processes that may slow a passenger down when using a SITE;
- PARKING model: models a parking facility associated with a SITE;
- VEHICLE STOPPING model: models where vehicles stop within a SITE.

5.4.2 Site

5.4.2.1 General

The SITE model provides a general description of the common properties of a physically situated location, such as a station or point of interest, including its entrances, levels, equipment, paths, accessibility properties. etc. The SITE model is refined by specific sub-models such as STOP PLACE, POINT OF INTEREST, PARKING, etc. to define specializations of PLACE.

5.4.2.2 SITE – Conceptual model

5.4.2.2.1 SITE – Basic conceptual model

Figure 19 shows the basic elements making up a SITE.

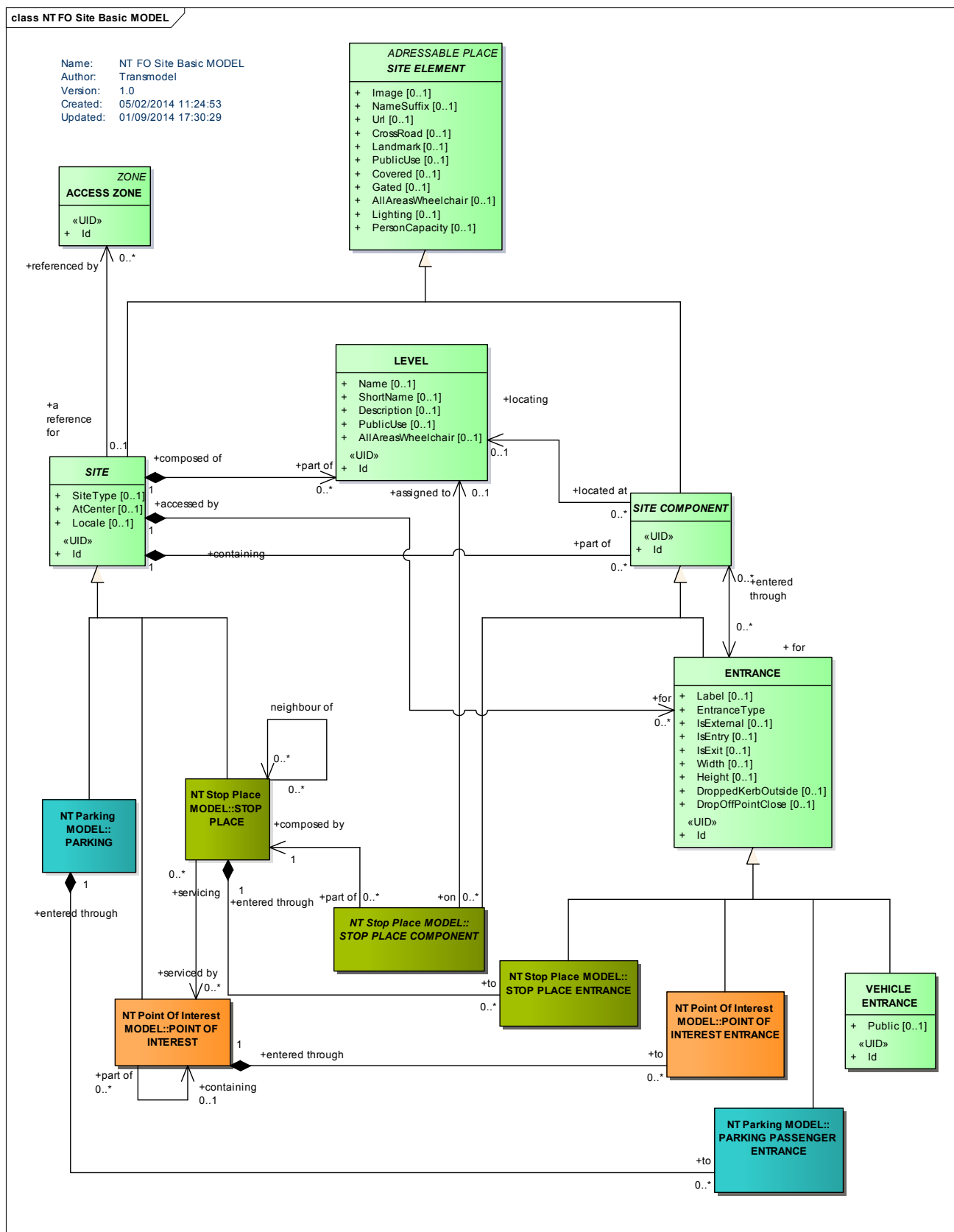


Figure 19 — Site - Basic conceptual model

A SITE COMPONENT is an element of a SITE describing part of its structure, such as a platform, concourse, ticket hall, entrance hall, forecourt, room, retail area, etc., etc.

A LEVEL is an identified storey (ground, first, basement, mezzanine, etc.) within an interchange building or SITE on which SITE COMPONENTs reside.

An **ENTRANCE**: A physical entrance or exit to/from a **SITE**.

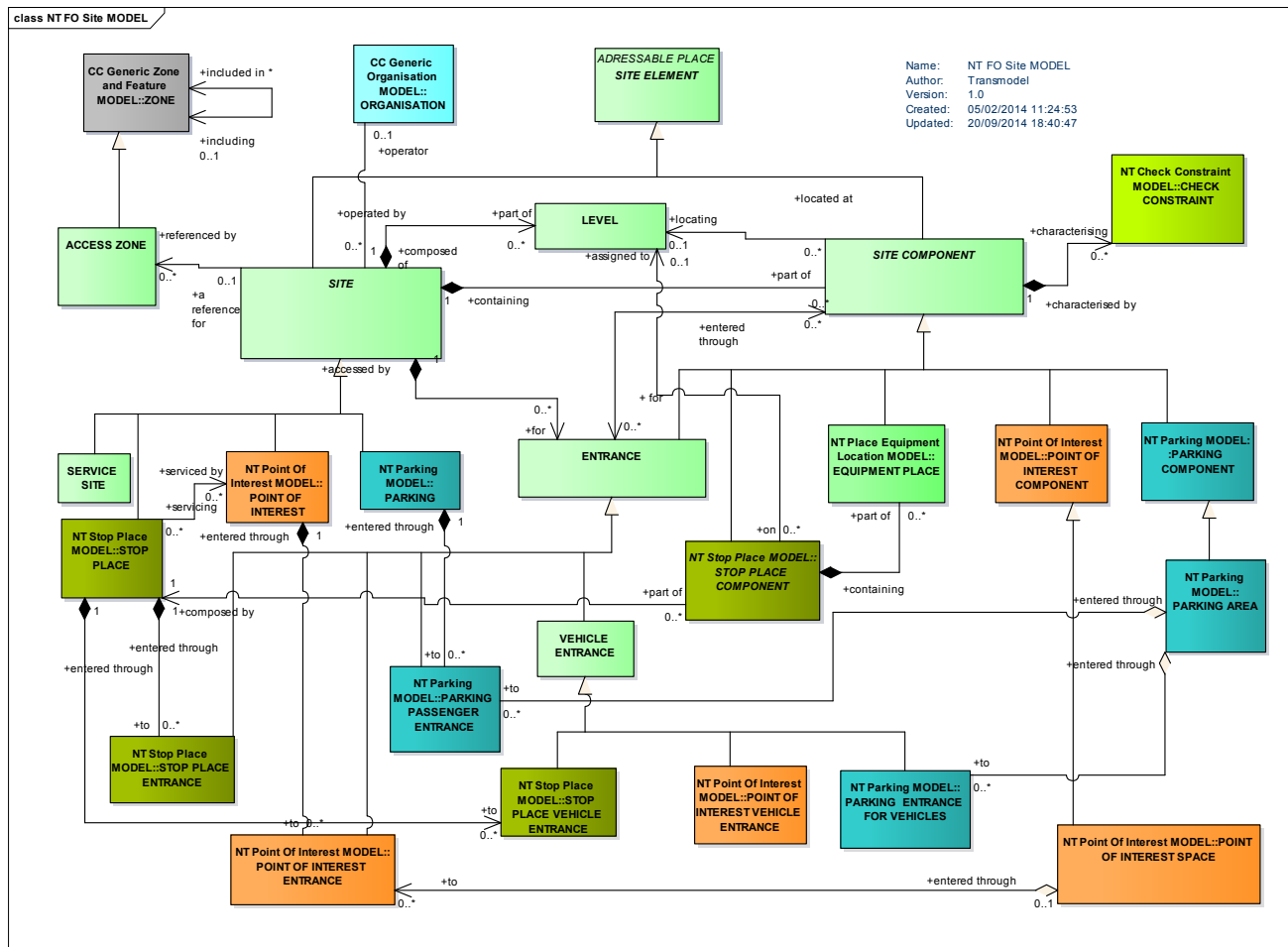


Figure 20 — Site - Conceptual model

5.4.2.2.2 SITE ELEMENT - Conceptual model

The SITE model allows a number of additional characteristics to be specified that are relevant to passenger use of the SITE.

- The accessibility of the SITE and its components can be described using ACCESSIBILITY ASSESSMENTS. Accessibility is described further in the next section.
- The availability of parts of the SITE may be specified using a VALIDITY CONDITION.
- The nature and likely time impact of processes taking place at points on the site, such as Check in, ticket purchase, security checks etc., can be specified with a CHECK CONSTRAINT and a CHECK CONSTRAINT DELAY.
- The ROAD and POSTAL ADDRESS of components can be specified.

- The EQUIPMENT found on the site such as barriers, gates, stairs, lifts, seats, lavatories etc., etc. can be specified.
- The NAVIGATION PATHS to go between the different points of the site can be specified. These are made up of PATH LINKS and PATH JUNCTIONS (cf. separate model).

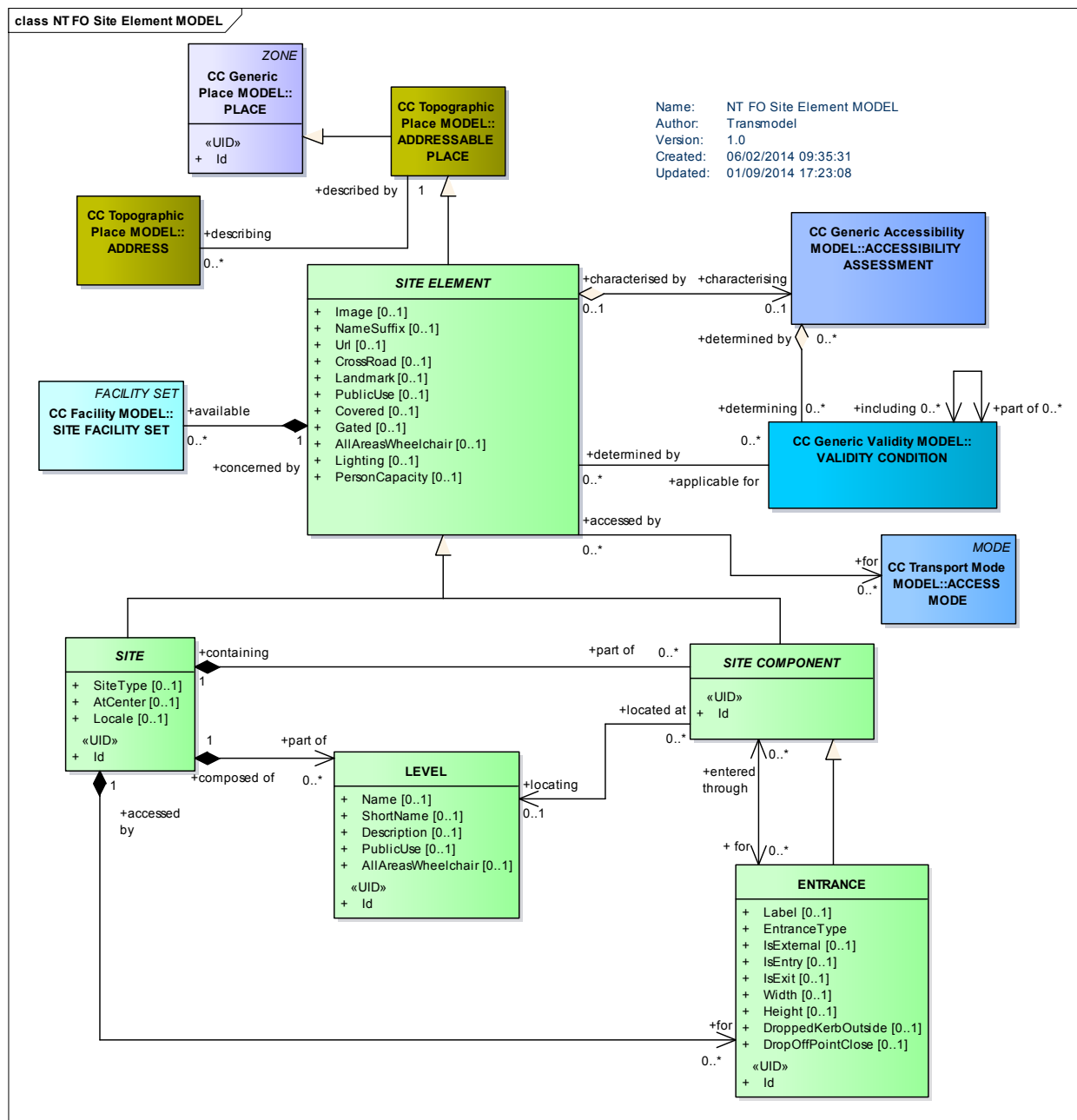


Figure 21 — Site element – Conceptual model

An overview of the hierarchy of the ZONES is given in the diagram below.

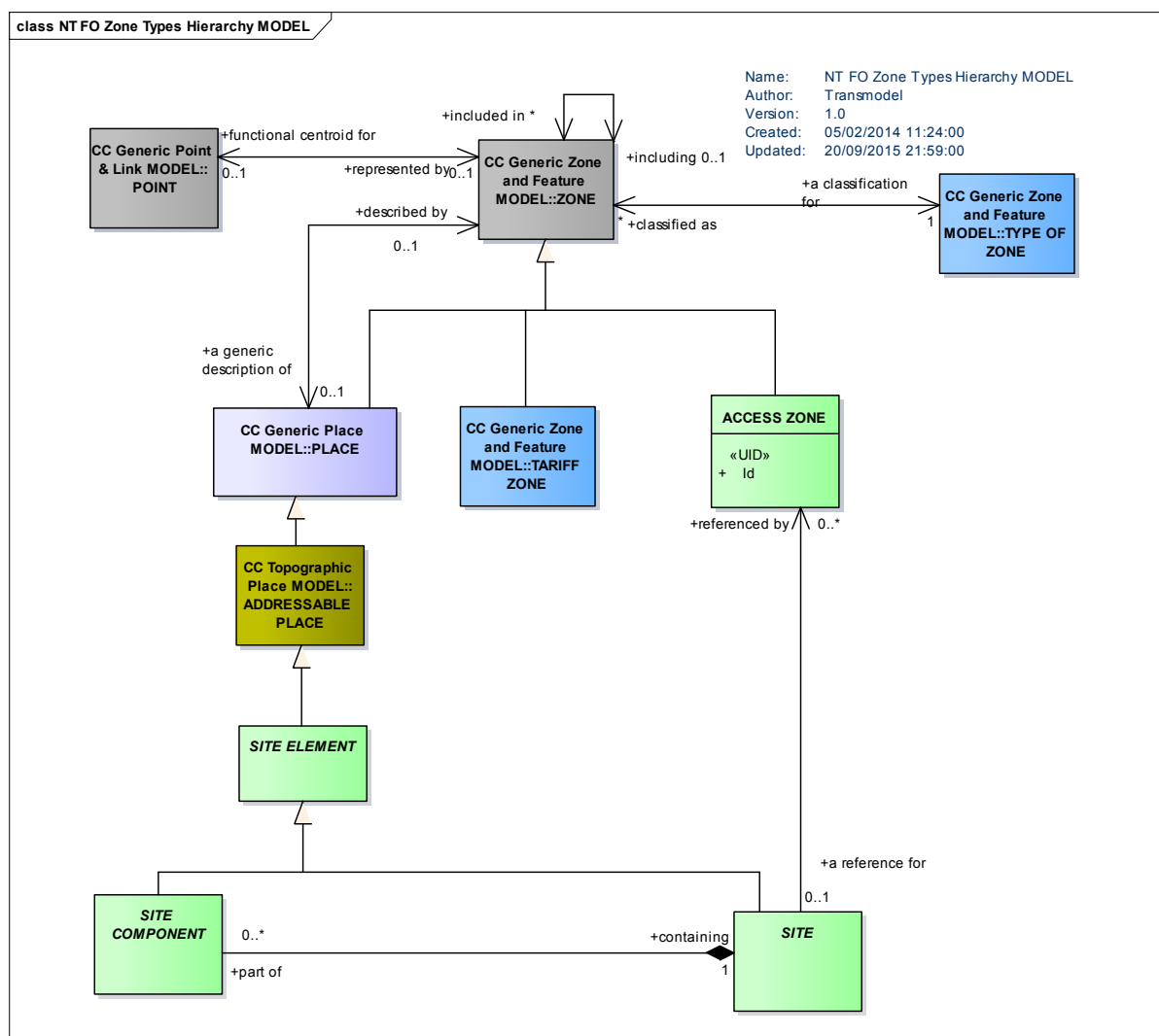


Figure 22 — Zone types hierarchy – Conceptual model

5.4.2.2.3 SITE accessibility – Conceptual model

The accessibility of the SITE and its components can be specified using ACCESSIBILITY ASSESSMENTS. (cf. reusable components model – “Public transport - Reference data model – Part 1: Common concepts”). A number of different types of EQUIPMENT may also be relevant for disabled users.

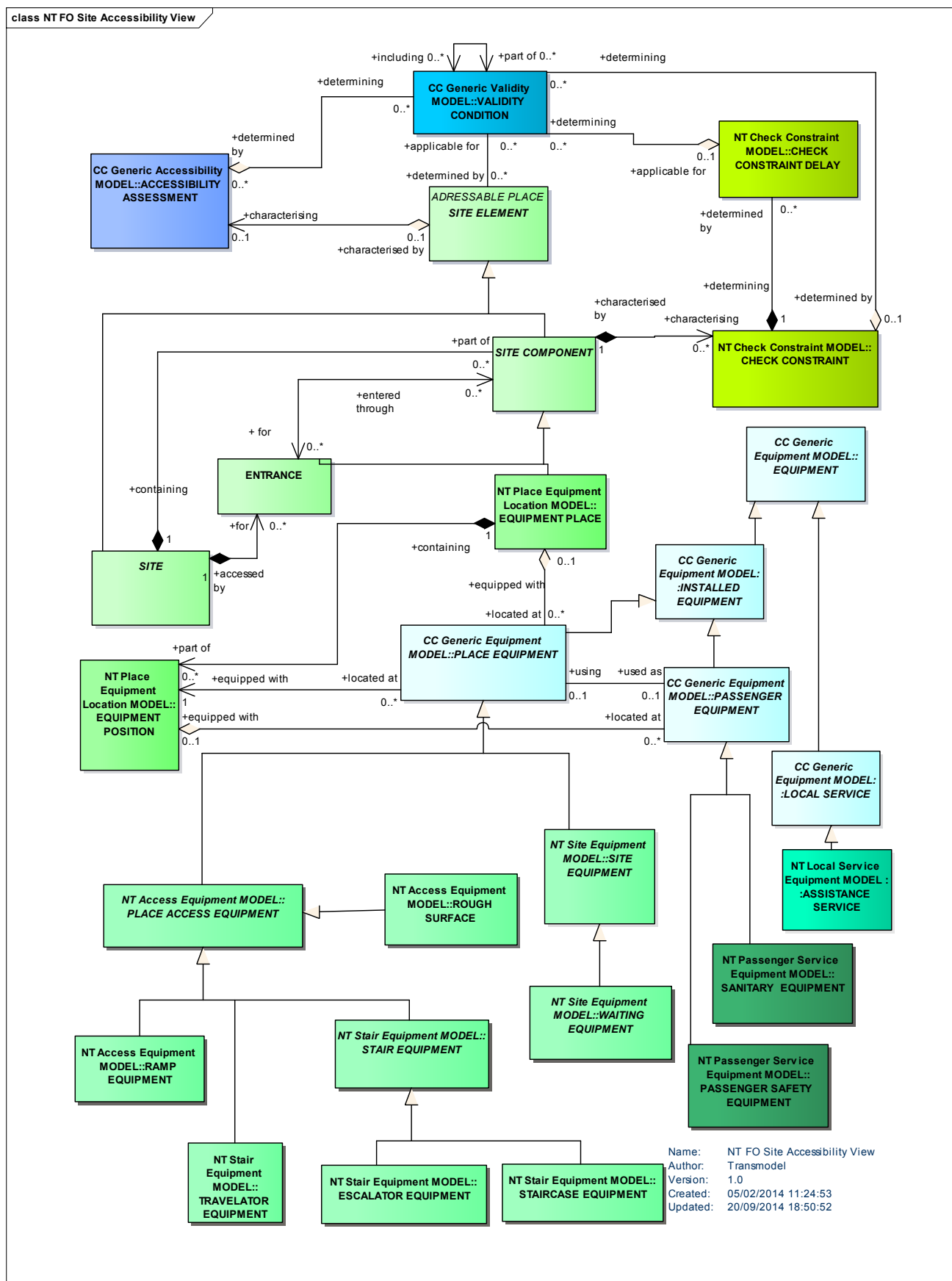


Figure 23 — Site accessibility view – Conceptual model

5.4.3 Stop place

5.4.3.1 STOP PLACE – Conceptual model

The STOP PLACE model describes different aspects of a physical point of access to transport, such as a stop or station. For a complex interchange, such as a station, this includes all the component areas of the station; the entrances, concourses, platforms; the levels they are on, the paths through the station and the various types of equipment found in the station, such as ticket machines and lifts, barriers, signs and seating. It also allows detailed accessibility attributes to be recorded at both the element and the station level.

A STOP PLACE represents a *physical* stop or station; that is an interchange, a stop point, a pair of stop points or a cluster of stop points on a LINE. A STOP PLACE is a type of SITE. Note that a STOP PLACE is a distinct concept from the representation of the stop in a timetable – the SCHEDULED STOP POINT. The two can be connected using a STOP ASSIGNMENT (cf.5.5.9).

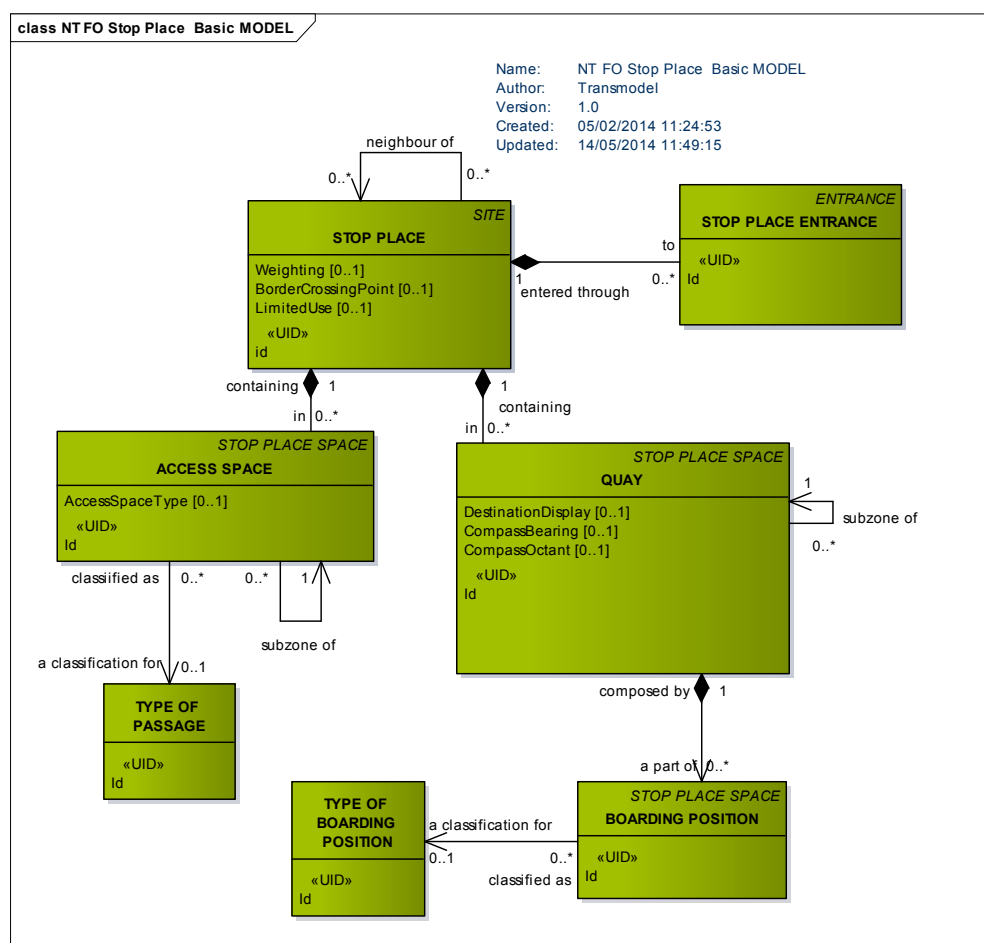


Figure 24 — Stop place – Basic conceptual model

The various spaces of which a STOP PLACE is comprised are described as different types of SITE COMPONENT specific to a STOP PLACE, such as platforms (QUAYS), and concourses (ACCESS SPACES), etc. The physical point of access to transport is always a QUAY. ENTRANCES describe the internal and external entrances to the STOP PLACE.

- QUAYs and ACCESS SPACES can be connected to each other using PATH LINKs.

- SITE and SITE COMPONENT inherit common properties from SITE ELEMENT, including ACCESSIBILITY characteristics, and the ability to specify ALTERNATIVE NAMES, ACCESSIBILITY, PATH LINKS, CHECK CONSTRAINTs and EQUIPMENT, all of which are discussed separately. It is also possible to specify whether the component is indoors or outdoors, or with a gated area.

Furthermore:

- Specific labelled points on a QUAY can be identified as BOARDING POSITIONS, for example the positions to board Eurostar coaches, or the doorways points to an enclosed metro line like the TfL Jubilee Line.
- STOP PLACES can be organized into a hierarchy so that clusters of transport interchanges, such as a paired rail and tube station, can be described.
- QUAYS can be nested; this allows one to represent composite platforms with two or more sides or named sections. One can thus journey plan to any level of detail. See later below for examples. Similarly ACCESS SPACES can be nested – within another ACCESS SPACE.
- ENTRANCES describe points at which a passenger can access a stop place, normally on foot – an Access mode can be used to identify other permitted modes of entry such as cycle or car. ENTRANCES can be external (for example the main entrance) or internal (for example from an entrance concourse to a platform).

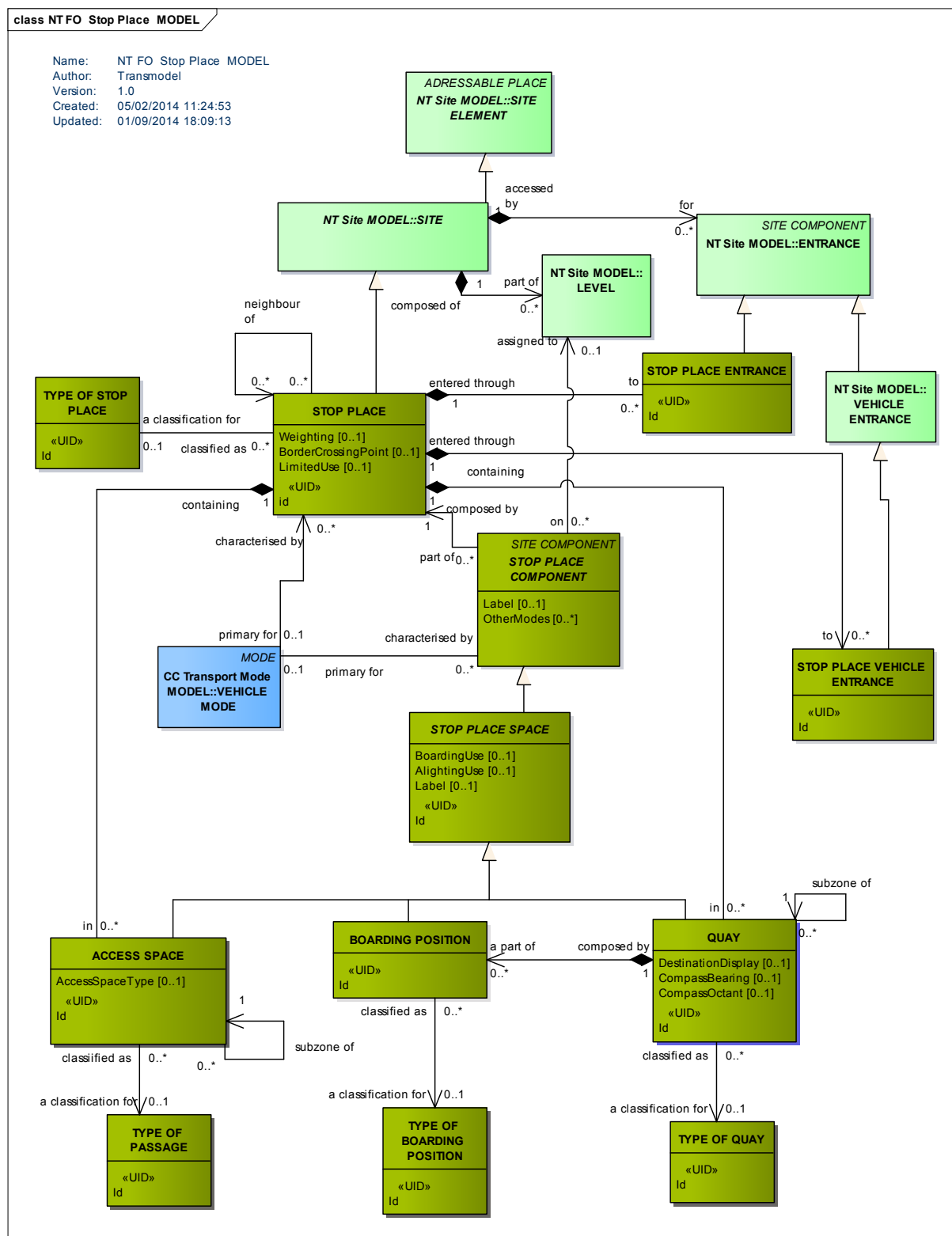


Figure 25 — Stop place - Conceptual model

5.4.3.2 Stop place – Examples

5.4.3.2.1 General

Table 2 shows how the different elements would be used to represent different types of stop.

Table 2 — Common stop element combinations (source NeTEx)

	Stop	Transmodel	Comment
On street	Single bus stop	1 STOP PLACE + 1 QUAY	EQUIPMENT for stop furniture
	Pair of bus stops on a route bus stop	1 STOP PLACE + 2 QUAYs	
	On street bus cluster	1 STOP PLACE + n QUAYs	
	Hail and Ride Zone	1 STOP PLACE + 1 FLEXIBLE QUAY	
	FlexibleZone	1 STOP PLACE + 1 FLEXIBLE QUAY	Zone projection for flexible area
Off-street	Single mode rail station	1 STOP PLACE + n QUAYs + x ACCESS SPACES + y ENTRANCES.	Use PATH LINKs + NAVIGATION PATHs for connectivity.
	Single mode metro station	1 STOP PLACE + n QUAYs + x ACCESS SPACES + y ENTRANCES.	
	Bus or Coach station	1 STOP PLACE + n QUAYs + x ACCESS SPACES + y ENTRANCES.	
	Airport	1 STOP PLACE + n QUAYs + x ACCESS SPACES + y ENTRANCES.	
Multi modal interchange	Discrete places for each mode	As for single mode, Use PARENT STOP PLACE reference to link to main STOP AREA.	
	Shared use of platforms by different modes	1 STOP PLACE + n QUAYs + x ACCESS SPACES + y ENTRANCES. Distinct SCHEDULED STOP POINTs for each mode, with STOP ASSIGNMENTs	See example

5.4.3.2.2 Examples of simple on-street Stop Places

This section illustrates some of the commonly used combinations.

Figure 26 shows an on-street bus stop as a simple STOP PLACE with a single QUAY for a single direction, as might commonly be found at a terminus of a service.



Figure 26 — Example of a single bus stop on street (source NeTEx - Part1)

Figure 27 shows an on-street bus stop pair named '*St George's Road*' as a simple STOP PLACE with two QUAYS, one for each direction.

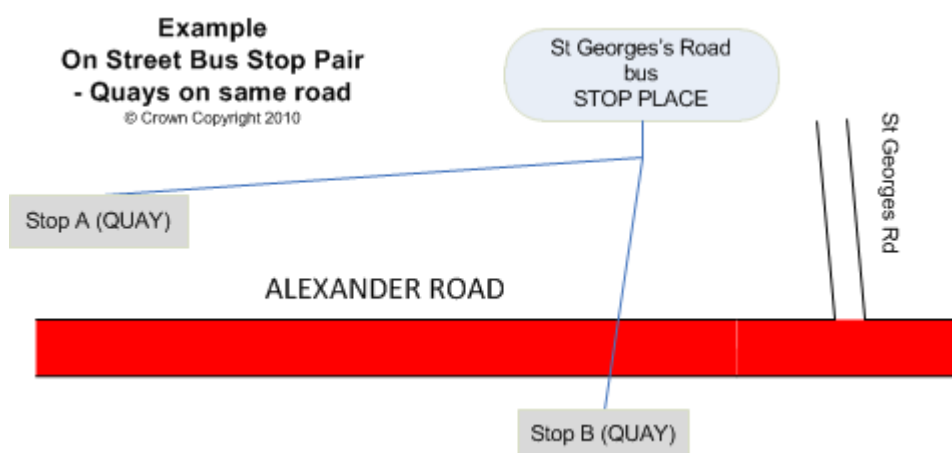


Figure 27 — Example pair of bus stops on street (source NeTEx - Part1)

Figure 28 shows an on-street bus cluster as a simple STOP PLACE with four QUAYS.