CEN/TC 278

Date: 2007-12

TC 278 WI 00278207

CEN/TC 278

Secretariat: NEN

Road traffic and transport telematics — Public transport — Identification of fixed objects in public transport

ICS:

Descriptors:

Document type: Technical Specification
Document subtype:
Document stage: Formal Vote
Document language: E

D:\Projects\PtStandards\PtStandardsPublic\ifopt\schema\0.4\doc\CENTC278WG3SG6_IFOPT_20081110_36.doc
STD Version 2.2

Contents

Page

Foreword

This document (prCEN/TS 28701) has been prepared by Technical Committee CEN/TC 278 “Road transport and traffic telematics”, the secretariat of which is held by NEN.

This document is currently submitted to the Technical Committee for Approval.

Introduction

Information systems for Public Transport (PT) need information related to objects or events of the real world, such as bus stops, beacons, points of interest, access points to train stations, vehicles, traffic lights, accidents, works, etc.

It is possible to classify these data into three families:

— Fixed objects: bus stops, beacons, points of interest, roads, …

— Mobile objects: vehicles, on board validators …

— Events: accidents, works, and situations affecting parts of the network…

Subsets of these objects are of particular importance for certain functional domains of Public Transport. For instance, Automatic Vehicle Monitoring systems are concerned with the mobile objects (vehicles) and their positions relative to the infrastructure.

Passenger Information systems are concerned with:

— Information provision and exchange about the network services (timetables, …),

— Optimization of passenger trips (trip proposals made according to specific criteria, …),

— Management of Public Transport resources (sales points, validators, passenger information devices …).

These systems need all types of data, but information related to the fixed objects is crucial, in particular about the Public Transport stops, their unambiguous identification, their accurate description, and their location in space.

Several particular problems apply to such data. One of them is the fact that the same fixed objects (stops, interchanges) are often used by several operators or several modes and appear with different descriptions and identifiers, so that complex correspondence tables have to be set up and maintained to ensure inter-modal trip planning, for instance, where it is important to uniquely identify the stops.

Another problem appears when apparently the same fixed objects (e.g. a train station, a bus stop) are considered as simple (points) or complex (clusters of points or areas) depending on the viewpoint of a subsystem (for instance, precision of the map). This aspect is often solved by the identification of several objects as one single object (a type of projection), but engenders at the same time the problem of the location referencing of the complex object that has been considered as simple, without a precise method for locating it in space.

Another aspect of the problem of referencing fixed objects for Public Transport is that they are often related to urban infrastructure. The latter is often relevant and used for the description of these objects. Topographical descriptors are introduced to characterise objects that are specific to Public Transport and, furthermore, knowledge of the access points to buildings and other infrastructure objects may be relevant for journey planning. In this case, if any change of the urban infrastructure occurs, Public Transport specific data have to be updated and, in a multi-operator context, a certain incoherence of information is likely to appear.

All these reasons have led to several national programs to provide solutions to address at least parts of the problem particularly relevant for Passenger Information. The UK-NaPTAN system focuses on Public Transport stops, their unambiguous identification, their location in space and their description, choosing a certain level of detail. In Germany DELFI and VDV-Datenmodel deal with similar issues. The Swedish "Samtrafikens transportformat" provides topographical identification including addresses, Public Transport stops with localization and path links for passengers.

Other European standards that exchange PT data, such as TPEG or TRIDENT, ALERT C, ILOC, EU-Spirit, Transmodel or SIRI, aim at the description of location referencing of stops, but do not provide a comprehensive solution for all the problems.

Another important recent study has been the French CERTU's 'Étude des systèmes de localisation pour les transports – Clarification des concepts liés aux ârrets de transports en commun' which makes a systematic study of stop location concepts and furthermore relates them to the existing concepts of the Transmodel standard. This "Identification of Fixed Objects" document draws heavily on the CERTU study, which was carried out by the leading French Transmodel experts.

The identification of fixed objects needs to be managed at a national level and the standard has to take into account the respective national organisational models for administering data. Because of the large number of stops and their geographical dispersal, this will typically involve a distributed process with a number of parties needing to be coordinated.

1 Scope

This Technical Specification defines a model and identification principles for the main fixed objects related to public access to Public Transport (e.g. stop points, stop areas, stations, connection links, entrances, etc.), in particular:

— To identify the relevant functions which need a unique identification of fixed objects especially for the Passenger Information domain in a multi-modal, multi-operator context.

— To identify the main fixed objects related to the Public Transport system, choosing a certain viewpoint, i.e. considering a certain level of detail (“granularity”) of the given description taking into account the needs of the identified functions.

— To give a typology of these objects together with definitions.

— To present relationships between the identified Public Transport objects.

— To unambiguously describe these objects through their main properties (attributes).

— To describe how to locate these objects in space through coordinates and through the link to topographic objects with a clear separation between the “Public Transport layer” and the “topographic layer” described in its turn by geographic objects.

— To enable the assignment of data administration (responsibility for data maintenance) of each fixed object.

Geospatial location referencing techniques of PT objects (e.g. use of satellites, roadside equipment for positioning) or representation techniques on maps (projections) are outside the scope of this standard.

1.1 Explicit Exclusions from Scope

In order to limit the scope for this version of the Fixed Object Standard, certain types of potential Fixed Object have been excluded for the time being, but will be proposed for inclusion in a second or subsequent part of the standard. These include:

— Roadside Equipment: Such as Traffic Signals and Traffic Lights and approach information for Urban Traffic Management and Control Systems.

— Road crossings and interchange data (though Access links may project onto tracks in other models that consider these, such as the EuroRoads project).

— Parking: A Car Park Model defines the availability and nature of car, bicycle and other parking. IFOPT includes only a rudimentary Parking model to indicate the relationship of the car parks to the rest of the Stop Place model.

— Relationships with the location referencing requirements of DATEX2 and TPEG.

Fixed Objects are concerned primarily with physical infrastructure and equipment as referenced by information services. Concepts that relate to fixed points that belong to other information layers, such the structure of Tariff Zones or Fare stages (which belong to the fares layer of Transmodel) are not covered.

IFOPT describes a generic structure for classifying Points of Interest, for example as Museums, Stadiums etc, but does not set out a recommended informative value set of Point Of Interest Categories.

1.2 Exclusions from Terminology

For the convenience of readers, the Terms and Definitions section of the IFOPT specification repeats definitions of certain key Transmodel concepts that are fundamental to understanding the IFOPT model. It does not repeat definitions of a number of other related Transmodel elements that are part of other Transmodel information layers, i.e. not specific to the Fixed Object layer, for example LINE, DESTINATION DISPLAY, PASSING TIME, or are not within the direct scope of the Fixed Object models, such as RAILWAY ELEMENT, RAILWAY JUNCTION, ROAD ELEMENT, ROAD JUNCTION.

1.3 Approach – Modularisation

This Technical Specification builds on the Transmodel Standard to define four related sub models – See Figure 1 — Fixed Object Submodels.

Each model is described as a set of entities, attributes and relationships with other models.

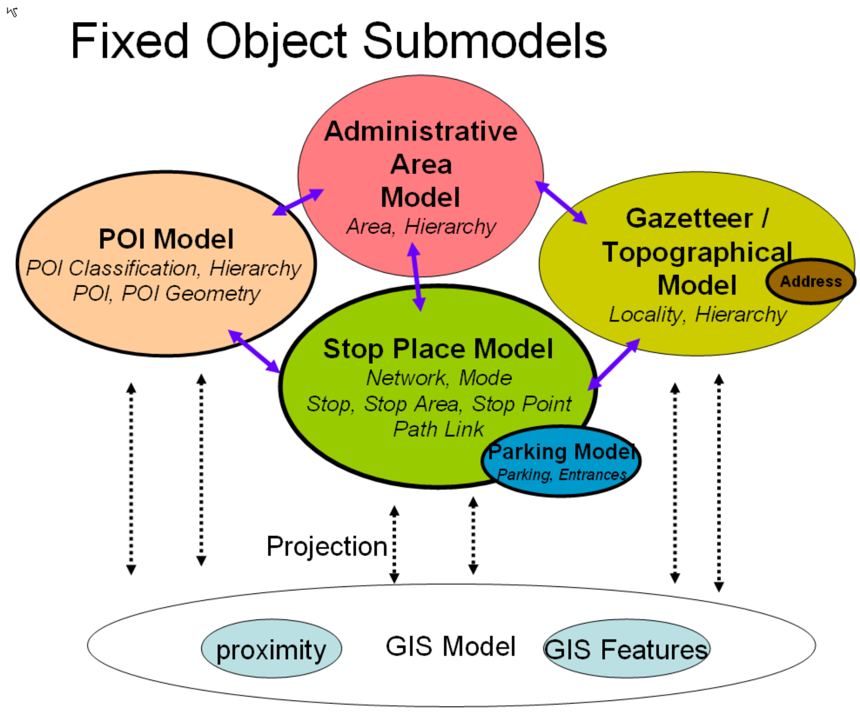


Figure 1 — Fixed Object Submodels

These constituent models of the Fixed Object model are enumerated as follows:

— **Stop Place Model:** Describes the detailed structure of a STOP PLACE (that is station, airport, etc**)** including physical points of access to vehicles and the paths between the points, including ACCESSIBILITY. Note that the concept of stops and the links between them in the Stop Place Model is distinct from the STOP POINT and CONNECTION LINK concepts used in Transmodel to describe the logical stopping points and connections of journey patterns for timetables: the Stop Place model describes the stops and paths as actual physical locations in space.

- **Point of Interest Model:** Describes the structure of a POINT OF INTEREST including physical points of access, i.e. ENTRANCEs. Also provides a model for a standardised POINT OF INTEREST CLASSIFICATION hierarchy – a means of providing a taxonomy of different types of POINT OF INTEREST relevant for journey planning.

- **Gazetteer Topographical Model:** Provides a topographical representation of the settlements (cities, towns, villages etc) between which people travel. It is used to associate Stop and Station elements with the appropriate topographic names and concepts to support the functions of journey planning, stop finding, etc. The TOPOGRAPHICAL PLACE entities in the Gazetteer model may be referenced by the Stop Place and Point of Interest Model but do not reference the elements of those models.

- **Administrative Model.** Provides an organisational model for assigning responsibility to create and maintain data as a collaborative process involving distributed stakeholders. Includes namespace management to manage the decentralised issuing of unique identifiers.

The Stop Place Model is the mandatory part of the Fixed Object model. The other models are ancillary and may be implemented on an optional basis

1.3.1 Motivation for Modularisation

This partitioning of Fixed Object into distinct sub-models is in particular of significance for data exchange. For data exchange, a model held on one computer system must typically be serialised into an XML document or other flat file format and then, after transmission, be de-serialised and re-referenced back into another model on a different system. In order to exchange data efficiently it must be possible to partition the data of a large model (for example all the bus stops in a country) into smaller coherent subsets (for example all the bus stops in a single area within a country) that include references to objects that are not included in the export (for example stops in adjacent areas, or the full definitions of the areas). This raises considerations for ensuring integrity of reference and in particular for the management of the identifiers that are used to implement the reference across different systems.

In practice the coherent subsets of data that are needed for efficient exchange must reflect the operational processes and frequency of change of the data. The four Fixed Object submodels represent four primary sets of data that usually will be exchanged as distinct documents between different parties on different timescales. Thus for example, the Administrative model is a small model that typically needs to be set up centrally with a view to coordinating the work of different stakeholders; once created, its data will change only occasionally, but it will be extensively referenced by other documents. At the other extreme, the Point of Interest and Stop Place models will need to be managed as discrete large data sets for each locality, each requiring detailed geographical surveying and local access knowledge for its creation and maintenance.

A second reason for modularisation is that it allows a more flexible and incremental approach to adoption of the standards.

1.4 Approach – Modelling

1.4.1 Relationship to Transmodel

The Fixed Object model is developed from the existing Transmodel as follows:

- A number of existing Transmodel entities are referenced. In addition, the same separation of concerns and use of distinct layers for different levels of discourse is followed as in Transmodel.

- Some new entities and attributes are added that are not present in Transmodel 5.1.

— A few existing Transmodel entities are refined or their semantics clarified, notably that the Transmodel STOP POINT is actually a SCHEDULED STOP POINT and should be renamed as such.

The Fixed Object submodels are expressed as an abstract model as per Transmodel, using the UML notation and the relationships of 'association' or 'inheritance' between named entities. This is the normative expression.

An example XML schema is provided as an informative concrete representation.

1.4.2 Level of Detail & Use of Partially Populated models

Different applications will be concerned to describe a STOP PLACE to different levels of detail. The model is designed so that it may be used in sparsely or partially populated instances, as well as in fully or densely populated implementations. For example, the model should still be useful if only data for the Platforms of a Station are available, as opposed to a full data set that includes every access space, entrance and accessibility. This enables an incremental approach to capturing data over time.

For journey planning applications it is in any case necessary to reduce the complicated structure of a large interchange into a computationally tractable representation, and the model is designed to support an efficient computation by reducing an interchange to a small number of nodes and edges for the computation of navigation paths.

Thus there may be a difference between the *data capture* representation of a Stop Place, which aims to describe the full physical details of a terminus in a general purpose representation suitable for arbitrary data exchange, and a *journey planning* representation, which might be an optimised statically computed simplification of the full model to reduce a full set of links to a simplified graph for computing journeys and that is correlated with GIS, schedule and other data from other information layers. The fixed object model is concerned to describe the data capture model, but to do this in a way that is structured to meet the way that journey planners need to process and collate the captured data to create their own efficient representations.

1.4.3 Data Administration

On a National scale, instances of a fixed object model can include large data sets (e.g. millions of locations, hundreds of thousands of stop places) that need to be gathered and managed on a distributed basis. The model must take into account how data can be partitioned into appropriate small subsets for the purposes of exchange as the payload of generic data exchange services. The IFOPT administrative model will support this.

Table 1 — Indicative numbers of Access points gives approximate total numbers of different types of fixed object nodes in an average European country (the number of links to each node will be much larger). The numbers of instances of different types of stop is significant both for their administration (it is the large data sets that must be partitioned), and for the schemes used to identify instances for public reference. The length of the public facing code must be large enough to handle the number of instances, yet should be as short as possible in order to be usable by humans. Textual names of objects are also subject to usability considerations. For some types of stop – for example airports or rail stations – the number of instances is quite small and there are intuitive names (typically the town name) that can be used for them. For other type of node, in particular bus stops and Points of Interest, there will be many more than can be named or easily remembered and there will be a need to describe a stop in several different ways, and with various qualifiers, to support stop finding and name discrimination tasks.

	Indicative number of Fixed Object Entities per country	
City, Town or District Names	0-100,000	City, Town or District Names
Rail Stations	0-20,000	City or Towns
Bus /Tram Stops	50,000-500,000	Local Point Name
Ports & Ferry piers	2,000-20,000	City or Town Names or Local Name
Airports	0-500	Major Towns
Coach Stops	10,000-200,000	City or Town Names
Points of Interest	1,000,000 - 10,000,000	Local Point Name & National names
Data Administration Jurisdictions	10-500	State, County names
Topographic Localities	10,000-500,000	State, County, City, Parish names

Table 1 — Indicative numbers of Access points

The informative XML XSD schema appended to this document gives an example of serialisation into useful packages.

1.4.4 Stop Identification & Labelling

A particular use of Fixed Object model data is to enable stop and place finding by users of journey planners and other on-line applications. This requires the appropriate association of entities with topographical places. The Model is designed to allow for meaningful codes and labels to be constructed according to many different application and usage contexts.

1.4.5 Relationship to GIS Standards

The Fixed Object model has a relationship to other standards describing the geographical features of a country, but is not itself a GIS standard. The Fixed Object model describes the semantic structure of stop places in a way that can be related to the Public Transport universe of discourse of Transmodel. Transmodel and the Fixed Object model exclude the detailed description of geographic features, and use standard GIS model elements to describe the GDF references needed to relate the Fixed Object model entities to the underlying GIS models.

The Location models used in the Fixed Object need to be represented in a way such that they can be projected onto a variety of geospatial representations. The Fixed Object model upholds the principles from Transmodel of separation of information layers and the use of Point and Link representations within the distinct layers which can be used to project elements between the models.

Point and Link and address data sufficient to make this projection are included in Fixed Objects: the choice of coordinate reference systems is open.

1.4.6 Vertical Levels versus Altitude

Transport interchanges are often complex buildings with many interconnected levels. The labelling and description of the levels is used in describing stops and directions in PT info systems and so needs to be part of the Fixed Object model. This LEVEL is a distinct concept from that of a vertical spatial coordinate in that it is a semantic label (for example “*Departures*”, “*Basement*”, “Floor 1”, etc). Altitude is in effect the z coordinate of a POINT.

1.4.7 Security

The Fixed Object model describes data for exchange between responsible stakeholders. Such data may include information that is for internal operational use rather than general public use. Where appropriate; data can be flagged to indicate that its audience should be restricted.

1.4.8 Scope of Phase 1

This first part of the IFOPT Technical Specification is restricted in its scope to a core set of objects relating to passenger information on public transport. We recognise that in future it may be useful to consider additional fixed objects relevant for traffic and transport such as Traffic lights, pedestrian crossings and Tariff Zones. Discussion of some of these elements needs to be in consultation with other CEN Working Groups

The first part of IFOPT covers the following entities:

— **Stop Model:** Rail Stations, Metro Stations, Bus and Coach Stations, On-street bus, tram coach and trolley bus stops and their associated Equipment. The same model may be used for Airports, Ship and Ferry Ports, Taxi ranks and other access points.

— **Point of Interest Model**: Well known locations to which both Tourists and Residents are likely to wish to Travel, such as Museums, Parks, Stadia, Galleries, Law Courts, Prisons etc. A classification mechanism is also provided.

— **Topographical model;** Cities, Towns, Hamlets, Suburbs and Quarters and other settlements to which people may wish to travel and whose relation to Stop Places, Points of Interest and Addresses is relevant. It includes an Address model.

— **Administrative Model:** An organisational structure or Administrators, roles and Administrative Areas used to manage other data elements. The Fixed Object models are conceived as discrete models, but share certain common concepts and base data type. Figure 2 indicates the dependencies between the different Fixed Object Models. The Stop Place and Point of Interest Models reference common concepts in the Administration and Topographical Models (though can be used with a minimal implementation of these concepts). Further application views may be constructed that reference some or all of the elements of the models. Further packages, that reference these models can be added in future.

The contents of the Stop Place Model and Point of Interest Model may be organised using elements established in the Administrative and Topographical Model. All the models assume the existence and reuse of common Address and generic data type packages. In any concrete implementation of the individual Fixed Object models in XML, these can be based on reusable XML subschema, with the logical dependencies shown in Figure 2 — Dependencies of Fixed Object Models. An informative XML schema is separately available at http://www.ifopt.org.uk.

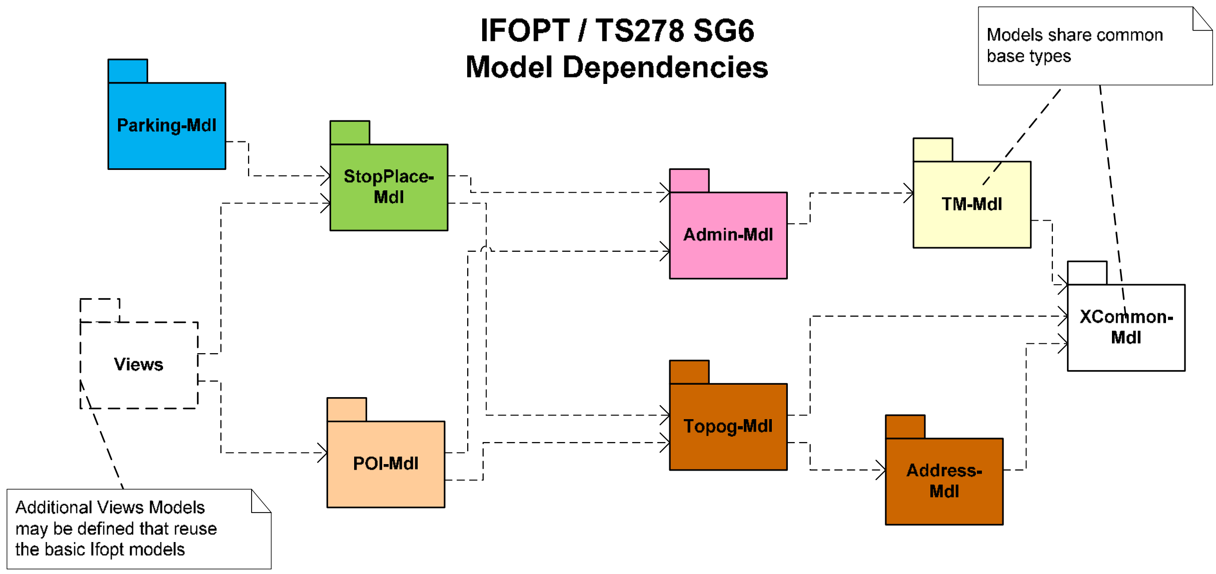


Figure 2 — Dependencies of Fixed Object Models

2 Normative references

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

EN 12896:2006, *Road transport and traffic telematics - Public transport – Reference data model*

CEN/TS 15531:2007 (all parts), *Public transport – Service interface for real-time information relating to public transport operations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12896:2006, CEN/TS 15531:2007 and the following apply.

3.1 Transport Related Terms

This section includes terms for both PT entities and properties of PT entities used in IFOPT. For each term, it is indicated whether the term derives from Transmodel version 5.1 (EN 12896:2006), another Technical Specification (e.g. SIRI – CEN/TS 15531) or whether the term is specific to IFOPT. Definitions of most common Transmodel and SIRI terms used in IFOPT are not repeated here (for example VEHICLE JOURNEY, JOURNEY PATTERN, CONTROL ACTION), but a few are included where it is considered helpful to the reader (for example STOP POINT).

The glossary follows the Transmodel convention of using upper case to describe Transmodel entities, for example STOP PLACE. It also uses upper case for IFOPT entities, as these may be regarded as candidates for a future version of Transmodel. It furthermore follows the Transmodel practice of assigning particular semantics to particular English nouns, for example POINT, ZONE and LINK each have connotations of a particular spatial geometry, PLACE has a spatial implication (but not necessarily a topographic one), and GROUP indicates a collective mechanism.

3.1.1
ACCESS LINK – Transmodel
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 STOP POINT (origin of the PT TRIP), or

- The walking movement from a STOP POINT (destination of the PT TRIP) to a PLACE (destination of the trip).

In IFOPT, a STOP PLACE, an ADDRESS, a POINT of INTEREST, a PARKING and a TOPOGRAPHICAL PLACE are all types of PLACE and so an ACCESS LINK may also explicitly connect them.

3.1.2
ACCESS PATH LINK – IFOPT
A type of external PATH LINK connecting a PLACE with another PLACE. A sequence of ACCESS PATH LINKs may project onto an ACCESS LINK.

Each end of an ACCESS PATH LINK should connect to an entity that is a concrete subtype of PLACE, for example STOP PLACE, POINT OF INTEREST, ADDRESS, ROAD ADDRESS, QUAY, etc that is a ACCESSIBLE PLACE. Each end of an ACCESS PATH LINK may further have a specific ENTRANCE of the same concrete subtype of PLACE associated with that end, that is, STOP PLACE ENTRANCE, QUAY ENTRANCE, POINT OF INTEREST ENTRANCE, etc; to indicate the exact entrance to the building.

Inside a physical STOP PLACE, STOP PATH LINKs should be used instead of ACCESS PATH LINKs.

3.1.3
ACCESS SPACE – IFOPT
A passenger area within a STOP PLACE such as a concourse or booking hall, immigration hall or security area that is accessible by passengers, but without a direct access to vehicles. Direct access to a VEHICLE is always from a QUAY and/or BOARDING POSITION. An ACCESS SPACE may be a Room, Hall, Concourse, Corridor, or bounded open space within a STOP PLACE.

3.1.4
ACCESS SPACE ENTRANCE – IFOPT
An entrance or exit for passengers to or from an ACCESS SPACE.

An entrance may be Internal, giving access to another ACCESS SPACE or QUAY, in which case it should connect to some other part of the same STOP PLACE; or External, representing a point of attachment with which to navigate a route to the STOP PLACE.

3.1.5
ACCESS ZONE – Transmodel
A ZONE for which the duration to cover any ACCESS LINK to a particular STOP POINT is the same.

The IFOPT Concept of an ACCESS SPACE is distinct from the Transmodel concept of an ACCESS ZONE as an ACCESS SPACE may have different NAVIGATION PATHS whose traversal takes different durations.

3.1.6
ACCESSIBLE PLACE – IFOPT
A type of PLACE, such as a STOP PLACE, POINT OF INTEREST or ADDRESS, to which passengers may wish to travel. An ACCESSIBLE PLACE may be the endpoint of a PATH LINK and can have designated entrances that represent the best point of access for different USER NEEDs.

3.1.7
ACCESSIBILITY – IFOPT
The possibility of a user with a specific USER NEED, such as a disability or encumbrance, to access either fixed or moving Public Transport facilities.

3.1.8
ACCESSIBILITY ASSESSMENT – IFOPT
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.

3.1.9
ACCESSIBILITY LIMITATION – IFOPT
A categorisation of the ACCESSIBILITY characteristics of a STOP PLACE COMPONENT such as a STOP PATH LINK, STOP PLACE or ACCESS SPACE 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.

3.1.10
ACCESSIBILITY SUPPORT SERVICES – IFOPT
The provision of services to enable guidance of specific classes of user, for example personal or auditory or tactile device assistance for the blind, or visual devices and text announcement for the deaf, or luggage porterage or language services.

In IFOPT these are specified as types of LOCAL SERVICE.

3.1.11
ACTUAL STOP POINT EQUIPMENT – Transmodel
An item of equipment of a particular type actually available at an individual STOP POINT (e.g. post, shelter, seats, information display).

The IFOPT STOP PLACE EQUIPMENT is a generalisation of STOP POINT EQUIPMENT that may include equipment located elsewhere in the STOP PLACE as well as on the QUAY.

3.1.12
ACTUAL VEHICLE EQUIPMENT – Transmodel
An item of equipment of a particular type actually available in an individual VEHICLE.

3.1.13
ADDRESS – IFOPT
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.

An ADDRESS can be associated with a PLACE or POINT OF INTEREST where a trip can start or end.

3.1.14
ADMINISTRATIVE AREA – IFOPT
A grouping of STOP PLACE, PLACE or other managed data for management by a DATA ADMINISTRATOR. Each administrative area will have a common IDENTIFIER NAMESPACE for allocating identifiers.

A distinction can be made between the management of the Transport of an area (the role of an AUTHORITY managing an ADMINISTRATIVE ZONE) and the administration of the Transport related data (the role of a DATA ADMINISTRATOR of an ADMINISTRATIVE AREA) which may be, but is not necessarily, performed by the same body.

3.1.15
ALTERNATIVE COMMON NAME – IFOPT
Passenger Information systems will support the use of one or more names to identify PLACEs, STOP PLACEs, DESTINATIONs, POINTs OF INTEREST, etc to users in journey planners and other systems.

3.1.16
AREA IDENTIFIER NAMESPACE – IFOPT
The IDENTIFIER NAMESPACE used to control the unique allocation of stop identifiers for each ADMINISTRATIVE AREA, allowing the distributed management of STOP DATA.

3.1.17
AUTHORITY – Transmodel
The organisation under which the responsibility of organising the public transport service in a certain area is placed.

3.1.18
BOARDING POSITION – IFOPT
A location within a QUAY from which passengers may directly board, or onto which passengers may directly alight from, a vehicle.

3.1.19
BOARDING POSITION ENTRANCE – IFOPT
An entrance or exit for passengers to/from a BOARDING POSITION within a QUAY.

3.1.20
CHECKPOINT– IFOPT
The characteristics of a STOP PLACE COMPONENT representing a process, such as check-in, security screening, ticket control or immigration, that may potentially incur a time penalty that should be allowed for when journey planning. Used to mark STOP PATH LINKs to determine transit routes through interchanges.

3.1.21
CHECKPOINT DELAY– IFOPT
Delay associated with a specific CHECKPOINT. The CHECKPOINT DELAY may vary according to time of day as specified by a VALIDITY CONDITION, in line with the passenger processing capacity of the CHECKPOINT and traffic congestion levels.

3.1.22
CHECKPOINT PROCESS – IFOPT
A classification of a CHECKPOINT as a particular type due to the process that takes place at it, such as security, ticketing etc.

3.1.23
COMMON NAME – IFOPT
The canonical name given to a STOP PLACE, POINT OF INTEREST, or TOPOGRAPHICAL PLACE that will be used on displays and other media to identify a stop.

3.1.24
COMPASS BEARING – SAE J1939/71 (ENV13149)
The heading of an object relative to another in degrees expressed as a floating point number: compliant to SAE J1939/71 (Compatible with ENV13149).

A BEARING may be stated on the road from a bus or other on street stop to indicate the direction in which the stop serves traffic and is thus an attribute of an on street QUAY.

3.1.25
COMPASS OCTANT – IFOPT
The heading of an object relative to another expressed as quadrants of the compass e.g. SW, N, SE etc.

3.1.26
COMPLEX FEATURE – Transmodel
An aggregate of SIMPLE FEATUREs and/or other COMPLEX FEATUREs; e.g. a STOP AREA: combination of STOP POINTS; a train station: combination of SIMPLE FEATUREs (POINTs, LINKs) and COMPLEX FEATUREs (STOP AREAs).

An IFOPT STOP PLACE is a type of COMPLEX FEATURE.

3.1.27
CONNECTION LINK – Transmodel
The physical (spatial) possibility for a passenger to change from one public transport vehicle to another to continue a trip. Different transfer times may be necessary to cover interchange over a given connection link, depending on the kind of passenger.

3.1.28
CONNECTION LINK ASSIGNMENT – IFOPT
The association of a CONNECTION LINK (e.g. between two journeys of a JOURNEY PATTERN) with a PATH LINK or set of PATH LINKs representing different paths to indicate that the journey connection should be made over that path within the STOP PLACE. May be subject to a VALIDITY CONDITION.

3.1.29
COUNTRY – General term
For the purposes of IFOPT the primary use of COUNTRY is as a unique name space within which to identify TOPOGRAPHICAL PLACEs, STOP PLACEs, STOP PLACE COMPONENTs, POINTs OF INTEREST, ADDRESSes, etc, according to an ADMINISTRATIVE MODEL.

A STOP PLACE or TOPOGRAPHICAL PLACE may span a jurisdictional boundary, but in this case the entity should be assigned to one or other jurisdiction for the purpose of allocating identifiers.

3.1.30
DATA ADMINISTRATION ROLE – IFOPT
A data management function of a DATA ADMINISTRATOR needed for the distributed processing and sharing of data in a STOP PLACE, POINT OF INTEREST or TOPOGRAPHICAL PLACE model.

3.1.31
DATA ADMINISTRATOR – IFOPT
An organisation responsible for managing data of a specific type, for example TOPOGRAPHICAL PLACE, POINT OF INTEREST, STOP PLACE and STOP POINT data in one or more ADMINISTRATIVE AREAs. Administration may be decentralised to many different DATA ADMINISTRATORs, each with responsibility for data of a particular scope. A DATA ADMINISTRATOR may correspond to an ORGANISATIONAL UNIT or may be an external body such as a Local Authority or responsible organisation.

Within a physical STOP PLACE, different DATA ADMINISTRATORS may be responsible for all or just some of the data, for example different modes may be managed by different administrators.

Different DATA ADMINISTRATORs may be responsible for different data processing roles such as gathering, aggregating or distributing the data depending on their DATA ADMINISTRATION ROLE. The role of data administrator may be procured by the responsible organisation from a contractor.

Each DATA ADMINISTRATOR will use a known NAMESPACE for issuing identifiers.

3.1.32
DATA MANAGED OBJECT – IFOPT
An entity that is managed by a DATA ADMINISTRATOR as part of a distributed system of data management of objects with well defined identifiers and data ownership. Such objects conform to the abstract DATA MANAGED OBJECT supertype that defines associations and behaviour for data management.

3.1.33
DATA SYSTEM – Transmodel
The origin of operational data referring to one single responsibility. References to a data system are useful in an interoperated computer system.

For IFOPT, this entails in particular specific systems for assigning unique identifiers to relevant entities such as STOP POINTS or STOPS, which can be matched to the locally known entities identified by the respective internal operating data. The DATA SYSTEM must be mutually agreed between different systems that exchange data. A DATA SYSTEM has both a data model to describe the entities and their relationships, and a NAMESPACE to describe the unambiguous set of identifier values.

3.1.34
DIRECTION – Transmodel
A classification for the general orientation of ROUTEs.

In IFOPT the DIRECTION may be an important aspect of a PATH LINK that may only be traversed one way.

3.1.35
DYNAMIC STOP POINT ASSIGNMENT – IFOPT
The dynamic association of a SCHEDULED STOP POINT (i.e. a STOP POINT of a SERVICE PATTERN or JOURNEY PATTERN) with the next available STOP PLACE, QUAY or BOARDING POSITION within a STOP PLACE. May be subject to a VALIDITY CONDITION.

3.1.36
ENTRANCE – IFOPT
An identified point of entry or exit for a passenger to or from a STOP PLACE, ACCESS SPACE or POINT OF INTEREST. It may or may not have a physical manifestation such as a Door, barrier, turnstile or other obstacle.

The passenger may be on foot, in a wheelchair, on a bicycle or on some other private mode of transport. The ENTRANCE may have a TRANSPORT MODE to indicate the permitted modes. A door may be marked for use for entry, exit or both.

3.1.37
ENTRANCE TO VEHICLE – IFOPT
An entrance or exit for passengers onto a VEHICLE, usually having a door. Distinct from an ENTRANCE FOR VEHICLES, which is for access by a vehicle to a STOP PLACE.

3.1.38
ENTRANCE FOR VEHICLES – IFOPT
An entrance for VEHICLEs to a STOP PLACE. Distinct from an ENTRANCE TO VEHICLE, which is for passenger access to a vehicle. May be marked for entry, exit use, or both.

3.1.39
EQUIPMENT PLACE – IFOPT
A STOP PLACE COMPONENT containing equipment associated with other STOP PLACE COMPONENTs or other places accessible to passengers.

3.1.40
EQUIPMENT POSITION – IFOPT
The precise position within an EQUIPMENT PLACE where particular equipment is placed.

3.1.41
IDENTIFIER NAMESPACE – IFOPT
A managed set of unique identifiers used to control the allocation of component identifiers in a distributed administrative model.

3.1.42
INFO LINK – IFOPT
An element of the STOP PLACE Model that can be used to associate an arbitrary link to an external web resource such as an image or URL with any STOP PLACE COMPONENT

3.1.43
LEVEL – IFOPT
An identified storey (ground, first, basement, mezzanine, etc) within an interchange building on which STOP PLACE COMPONENTs reside. A STOP PATH LINK may connect components on different levels.

3.1.44
LOCAL SERVICE– IFOPT
A named service relating to the use of the STOP PLACE 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 non-material EQUIPMENT.

EXAMPLE Examples of Services are TICKETING SERVICE, CUSTOMER SERVICE, LEFT LUGGAGE SERVICE, LOST PROPERTY SERVICE, COMPLAINTS SERVICE, LUGGAGE SERVICE, HIRE SERVICE, MONEY SERVICE, REFRESHMENT SERVICE, COMMUNICATION SERVICE.

3.1.45
LOCATING SYSTEM – Transmodel
The system used as reference for the location and graphical representation of the network and other spatial objects.

3.1.46
MONITORING POINT– SIRI
A point at which real-time status is reported. Normally corresponds to a STOP POINT.

In IFOPT only a minimal representation of MONITORING POINTs is made sufficient to relate their location to the STOP PLACE and its components.

3.1.47
MONITORING POINT ASSIGNMENT– IFOPT
A MONITORING POINT ASSIGNMENT associates a MONITORING POINT with a specific SCHEDULED STOP POINT.

3.1.48
NAVIGATION PATH – IFOPT
A representation of a detailed pathway that a passenger may take between two PLACEs within a STOP PLACE, or between STOP PLACE, POINT OF INTEREST, etc. A NAVIGATION PATH can be made up of an ordered set of PATH LINKs IN SEQUENCE, an ordered set of ACCESSIBLE PLACEs IN SEQUENCE or both – a POINT or a LINK representation may be useful for different applications

There may be multiple NAVIGATION PATHs between the same STOP PLACE COMPONENTs or other PLACEs, reflecting different physical paths and with particular ACCESSIBILITY ASSESSMENTs.

NAVIGATION PATHs may be predefined, or be computed dynamically from the underlying set of STOP PLACE COMPONENTs and other PLACE and LINK types.

The same PATH LINK may occur in different sequences in different NAVIGATION PATHs.

3.1.49
OPERATOR – Transmodel
An organisation in charge of the operation of some or all transport services within a particular area.

3.1.50
ORGANISATIONAL UNIT – Transmodel
A grouping of responsibilities in a public transport company for planning and control.

3.1.51
PARKING – IFOPT
Designated locations for leaving vehicles such as cars, motorcycles and bicycles.

3.1.52
PARKING AREA – IFOPT
A marked zone within a PARKING containing PARKING BAYs.

3.1.53
PARKING BAY – IFOPT
A place to park an individual vehicle.

3.1.54
PARKING ENTRANCE FOR VEHICLES – IFOPT
An entrance for vehicles to the PARKING from the road.

3.1.55
PARKING PASSENGER ENTRANCE – IFOPT
An entrance to the PARKING for passengers on foot or other out-of-vehicle mode, such as wheelchair.

3.1.56
PASSENGER ACCESSIBILITY NEEDS – IFOPT
A passenger’s requirements for ACCESSIBILITY, comprising one or more USER NEEDs. For example, that they are unable to navigate stairs, or lifts, or have 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.

3.1.57
PASSENGER ENTRANCE TO PARKING - IFOPT
A Passenger entrance to a PARKING facility.

3.1.58
PASSENGER STOP POINT ASSIGNMENT – IFOPT
The allocation of a SCHEDULED STOP POINT (i.e. a STOP POINT of a SERVICE PATTERN or JOURNEY PATTERN) to a specific STOP PLACE, and also possibly a QUAY and BOARDING POSITION. May be subject to a VALIDITY CONDITION. Assignment may be done in advance, or be done in-real-time as a DYNAMIC STOP POINT ASSIGNMENT made as a result of a CONTROL ACTION. May be accompanied by a VEHICLE STOPPING POINT ASSIGNMENT for the allocation of a VEHICLE to a VEHICLE STOPPING PLACE and VEHICLE STOPPING POSITION.

3.1.59
PATH ASSIGNMENT – IFOPT
The allocation of a specific NAVIGATION PATH with which to make a CONNECTION LINK.

3.1.60
PATH JUNCTION – IFOPT
A designated point, inside or outside of a STOP PLACE or POINT OF INTEREST, at which two or more PATH LINKs may connect. This allows ACCESS PATH LINKs to be linked together outside of a specific STOP PLACE. Within a STOP PLACE, ACCESS SPACEs are usually used as junction points.

3.1.61
PATH LINK – IFOPT
A link between any two STOP PLACEs, STOP PLACE SPACEs (that is, ACCESS SPACEs or QUAYs or BOARDING POSITIONs), POINTs OF INTEREST or PATH JUNCTIONs that represents a step in a possible route for pedestrians, cyclists or other out of vehicle passengers within or between a PLACE.

A STOP PATH LINK is used within a STOP PLACE and may have further properties and attributes derived from its relationship with the STOP PLACE. An ACCESS PATH LINK is used outside of a STOP PLACE.

NOTE It is possible but not mandatory that a PATH LINK projects onto a more detailed set of infrastructure or mapping links that plot the spatial course, allowing it to be represented on maps and to tracking systems.

3.1.62
PATH LINK IN SEQUENCE – IFOPT
A step of a NAVIGATION PATH indicating traversal of a particular PATH LINK as part of a recommended route.

The same PATH LINK may occur in different sequences in different NAVIGATION PATHs.

3.1.63
PATH LINK VIEW – IFOPT
A PATH LINK VIEW specifies information about which details of a PATH LINK referenced by a PATH LINK IN SEQUENCE should be used when describing a step of a NAVIGATION PATH.

3.1.64
PLACE – Transmodel
A geographic location of any type which may be specified as the origin or destination of a trip. A PLACE may be of dimension 0 (a POINT), 1 (a road section) or 2 (a ZONE).

In IFOPT a PLACE may be of dimension 3 and be further associated with a LEVEL.

3.1.65
PLATFORM CHANGE – IFOPT
A CONTROL ACTION of interest to passengers marking the reassignment of a SCHEDULED STOP POINT from one designated QUAY and or BOARDING POSITION to another.

3.1.66
POINT OF INTEREST – IFOPT
A type of PLACE to or through which passengers may wish to navigate as part of their journey and which is modelled in detail by journey planners.

A POINT OF INTEREST may further have a complex spatial substructure with constrained POINT OF INTEREST ENTRANCEs and access pathways described using ACCESS PATH LINKs. A journey planner will normally provide an optimised route from a STOP PLACE to a POINT OF INTEREST ENTRANCE using a NAVIGATION PATH comprising one or more PATH LINKs IN SEQUENCE.

3.1.67
POINT OF INTEREST CLASSIFICATION – IFOPT
A category used to classify a POINT OF INTEREST by nature of interest using a systematic taxonomy, for example *Museum, Football Stadium*.

3.1.68
POINT OF INTEREST CLASSIFICATION HIERARCHY– IFOPT
A set of multilevel hierarchies used to organise POINT OF INTEREST CLASSIFICATIONs systematically

EXAMPLE 1 *Cultural Attraction* – *Museum* – *Art Gallery, or Government Office* – *Department for Transport*.

A POINT OF INTEREST CLASSIFICATION can belong to more than one hierarchy.

EXAMPLE 2 A given *Sports Stadium* can appear as both a *Football Ground* and a *Rugby Ground*.

3.1.69
POINT OF INTEREST ENTRANCE – IFOPT
A specific located external ENTRANCE to a POINT OF INTEREST. A journey planner will normally provide an optimised route from a STOP PLACE to a POINT OF INTEREST ENTRANCE as an ACCESS PATH LINK.

3.1.70
POINT OF INTEREST MEMBERSHIP– IFOPT
Assignment of a POINT OF INTEREST to one or more POINT OF INTEREST CLASSIFICATIONs.

3.1.71
POSTAL ADDRESS – IFOPT
The data associated with a PLACE that can be used to describe the geographical context of a PLACE for the purposes of identifying it. The POSTAL ADDRESS refines the ADDRESS and uses the attributes used for conventional identification for mail. Comprises variously a building Identifier, Street name, Post code and other descriptors.

3.1.72
QUAY – IFOPT
A place such as platform, stance, or quayside where passengers have access to PT vehicles, Taxi cars or other means of transportation. A QUAY may serve one or more VEHICLE STOPPING PLACEs and be associated with one or more STOP POINTS.

A QUAY is a recursive structure that may contain other sub QUAYs. A child QUAY must be physically contained within its parent QUAY.

3.1.73
QUAY ENTRANCE – IFOPT
An entrance or exit for passengers to/from a QUAY.

3.1.74
ROAD ADDRESS – IFOPT
The data associated with a PLACE that can be used to describe the geographical context of a PLACE for the purposes of identifying it in terms of the road network. The ROAD ADDRESS refines the ADDRESS of a PLACE located on a road and uses the attributes such as road number, and name used for conventional identification of a road.

3.1.75
ROUTE – Transmodel
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.

Each JOURNEY PATTERN may be associated with a particular ROUTE.

3.1.76
SCHEDULED STOP POINT – Same as Transmodel STOP POINT
A POINT in a journey where Passengers can board or alight from vehicles.

SCHEDULED STOP POINT refines the primary Transmodel sense of a STOP POINT, which is that of the logical stop point within a scheduled journey, rather than a physical point in the infrastructure where boarding and alighting, may take place, for which the terms for specific STOP PLACE COMPONENTs such as QUAY or BOARDING POSITION are used. Although the same identifiers are often used for both SCHEDULED STOP POINT and STOP PLACE COMPONENT, a practice which provides significant benefits for data management, they nonetheless represent distinct concepts. A STOP POINT ASSIGNMENT is used to associate a SCHEDULED STOP POINT with a STOP PLACE COMPONENT.

3.1.77
SIMPLE FEATURE – Transmodel
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) which may be viewed as SIMPLE FEATUREs.

3.1.78
SITUATION – Trident
A set of traffic/travel circumstances linked by a causal relationship which apply to a common set of locations. A situation can be composed of situation elements.

SITUATION is not a Transmodel term, but is used in Trident and SIRI as a generic term for incidents and planned disruptions.

In IFOPT the STOP PLACE model provides a precise location model for specifying the scope of an incident and may be referenced by other services such as SIRI.

3.1.79
STOP AREA – Transmodel
A group of STOP POINTS close to each other.

3.1.80
STOP PATH LINK – IFOPT
A path between any two physical STOP PLACE SPACEs within an interchange that represents a step of a possible transfer route for passengers within a STOP PLACE.

A STOP PATH LINK is a STOP PLACE COMPONENT in its own right and may have ACCESSIBILITY LIMITATIONs and CHECKPOINTs associated with it to indicate impediments that may prevent access or slow a user down. A sequence of one or more STOP PATH LINKs may make up a NAVIGATION PATH.

Each end of a STOP PATH LINK should connect to an entity that is a concrete subtype of an ABSTRACT STOP PLACE SPACE, that is, ACCESS SPACE or QUAY or BOARDING POSITION. Each end of a STOP PATH LINK may further have a specific ENTRANCE of the same concrete subtype of ABSTRACT STOP PLACE SPACE associated with that end, that is QUAY ENTRANCE, ACCESS SPACE ENTRANCE or BOARDING POSITION ENTRANCE.

STOP PATH LINKs should be used only within an interchange. ACCESS PATH LINKs should be used for PATH LINKs outside the physical STOP PLACE.

3.1.81
STOP PLACE – IFOPT
A place comprising one or more locations where vehicles may stop and where passengers may board or leave vehicles or prepare their trip. A STOP PLACE will usually have one or more well known names.

3.1.82
STOP PLACE COMPONENT – IFOPT
An element of a STOP PLACE describing part of its structure. STOP PLACE COMPONENTs share common properties for data management, accessibility and other features.

3.1.83
STOP PLACE ENTRANCE – IFOPT
A physical entrance or exit to/from a STOP PLACE. May be a door, barrier, gate or other recognizable point of access.

3.1.84
STOP PLACE EQUIPMENT – IFOPT
An item of equipment of a particular type actually available at a location within a STOP PLACE that is itself a place, such as QUAY, ACCESS SPACE or STOP PATH LINK.

STOP PLACE EQUIPMENT may comprise information equipment; Info Equipment, Passenger Info Equipment, Signage: Stop Sign, Other Sign, Heading Sign, Access Equipment, Queueing Equipment, Stair Equipment, Lift Equipment, Ramp Equipment, Crossing Equipment, Entrance Equipment, Escalator Equipment, Staircase Equipment, Rough Surface, or other service related equipment such as Ticketing Equipment, Trolley Stand Equipment, Waiting Equipment, Passenger Safety Equipment, Luggage Locker Equipment, Shelter Equipment, Waiting Room Equipment, Sanitary Facility Equipment.

3.1.85
STOP PLACE SPACE– IFOPT
A physical area within a STOP PLACE, for example, a QUAY, BOARDING POSITION, ACCESS SPACE or EQUIPMENT PLACE.

3.1.86
SUITABILITY – IFOPT
Whether a particular facility such as a STOP PLACE COMPONENT or VEHICLE can be used by a passenger with a particular USER NEED.

3.1.87
STOP POINT – Transmodel
A POINT in a planned journey where passengers can board or alight from vehicles.

NOTE Renamed in IFOPT to SCHEDULED STOP POINT.

3.1.88
TARIFF ZONE – IFOPT
A ZONE used to define a zonal fare structure in a zone-counting or zone-matrix system.

3.1.89
TIME BAND – Transmodel
A period in a day, significant for some aspect of public transport, e.g. similar traffic conditions or fare category.

3.1.90
TOPOGRAPHICAL DATA SYSTEM – IFOPT
An extended Gazetteer of PLACEs within a geographical area labelled in a consistent manner so as to be suitable for use in different contexts in customer facing services. Will include associations representing topographical relationships such as hierarchy, adjacency.

3.1.91
TOPOGRAPHICAL PLACE – IFOPT
A geographical settlement which provides 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.

A TOPOGRAPHICAL PLACE may be associated with a PLACE (including a STOP PLACE), but not all PLACEs are TOPOGRAPHICAL PLACEs. TOPOGRAPHICAL PLACEs may be organised through hierarchical containment and disjoint adjacency relationships.

A TOPOGRAPHICAL PLACE must always have a canonical gazetteer name. It may be necessary to use the hierarchical topographical relationships of the TOPOGRAPHICAL PLACE to establish a unique context with which to distinguish between two TOPOGRAPHICAL PLACEs with the same name.

3.1.92
TRAIN – Transmodel
A vehicle composed of TRAIN ELEMENTs in a certain order, i.e. of wagons assembled together and propelled by a locomotive or one or more of the wagons.

3.1.93
TRAIN BLOCK – Transmodel
A composite train formed of several TRAIN BLOCK PARTs coupled together during a certain period. Any coupling or separation action marks the start of a new TRAIN BLOCK.

3.1.94
TRAIN BLOCK PART – Transmodel
A component of a vehicle TRAIN BLOCK.

3.1.95
TRAIN ELEMENT – Transmodel
An elementary component of a TRAIN (e.g. wagon or locomotive).

3.1.96
TRAIN STOP POINT ASSIGNMENT– IFOPT
The association of a TRAIN, TRAIN BLOCK PART or TRAIN ELEMENT at a SCHEDULED STOP POINT with a specific STOP PLACE and also possibly a QUAY and BOARDING POSITION.

3.1.97
TRANSPORT MODE – Transmodel
A characterisation of the operation according to the means of transport (e.g. bus, tram, metro, train, ferry, ship).

3.1.98
TYPE OF STOP PLACE – IFOPT
A classification of STOP PLACEs, indicating in particular the mode of transport (rail station, airport etc).

3.1.99
TYPE OF TOPOGRAPHICAL PLACE – IFOPT
A classification of the TOPOGRAPHICAL PLACES according to their size and relevance for different types of journey planning.

3.1.100
USER NEED – IFOPT
An ACCESSIBILITY requirement of a passenger. For example, that they are unable to navigate stairs, or lifts, or have visual or auditory impairments.

3.1.101
VALIDITY CONDITION – Transmodel
A 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.).

3.1.102
VEHICLE– Transmodel
A public transport vehicle used for carrying passengers.

3.1.103
VEHICLE EQUIPMENT PROFILE – Transmodel
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'.

3.1.104
VEHICLE MODEL – Transmodel
A classification of public transport vehicles of the same VEHICLE TYPE, e.g. according to equipment specifications or of a particular model.

3.1.105
VEHICLE POSITION ALIGNMENT– IFOPT
The alignment of a particular BOARDING POSITION with the entrance of a VEHICLE as the result of positioning the VEHICLE at a particular VEHICLE STOPPING PLACE.

3.1.106
VEHICLE STOPPING PLACE – IFOPT
A place on the vehicle trackway where vehicles stop in order for passengers to board or alight from a vehicle.

A vehicle trackway is located on the respective INFRASTUCTURE LINK for the MODE (RAILWAY ELEMENT of rail network, ROAD ELEMENT of road network, etc). A VEHICLE STOPPING PLACE may be served by one or more QUAYs.

3.1.107
VEHICLE QUAY ALIGNMENT– IFOPT
The alignment of a particular QUAY with a vehicle as the result of positioning a VEHICLE at a particular VEHICLE STOPPING PLACE.

3.1.108
VEHICLE STOPPING POINT ASSIGNMENT– IFOPT
The association of a SCHEDULED STOP POINT (e.g. a STOP POINT of a SERVICE PATTERN or JOURNEY PATTERN) with a specific VEHICLE STOPPING PLACE, or VEHICLE STOPPING POSITION within a STOP PLACE. May be subject to a VALIDITY CONDITION.

3.1.109
VEHICLE STOPPING POSITION – IFOPT (SIRI attribute)
The stopping position of a vehicle or one of its components as a Location. May be specified as a ZONE corresponding to the bounding polygon of the vehicle, or one or more POINTs corresponding to parts of the vehicle such as a door.

If given as a single point, indicates the position for the door relative to an indicated side of the vehicle.

3.1.110
VEHICLE TYPE – Transmodel
A classification of public transport vehicles according to the vehicle scheduling requirements in mode and capacity (e.g. standard bus, double-deck).

3.1.111
VERSION– Transmodel
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, e.g. NETWORK VERSION for Line 12 starting from 2000-01-01.

NOTE In SIRI Interface Versions are also used for software release levels.

3.1.112
VERSION FRAME – Transmodel
A set of VERSIONS referring to the same DATA SYSTEM and belonging to the same TYPE OF FRAME. A FRAME may be restricted by VALIDITY CONDITIONs.

NOTE In IFOPT, used to group elements such as STOP PLACEs, STOP PLACE SPACEs and PATH LINKs into a common model version when each item does not have its own version.

3.2 Communications & Software Concepts

This Section describes Software concepts relevant for describing the representation or exchange of data models. For each term, it is indicated whether the term derives from general software usage, or whether the term is specific to IFOPT.

3.2.1
ABSTRACT CLASS – General Software Term
A generic type that describes common properties shared by a number of specific concrete subtypes that conform to the supertype though an inheritance relationship. Properties of abstract classes, both attributes and methods, are inherited by all their subtypes. In the UML diagrams, abstract classes are shown with names in italics and the inheritance arrow (Open white triangle) is used to indicate a subtyping relationship.

3.2.2
NAMESPACE – General Software Term
A well defined named scope within which a set of unambiguous, i.e. unique, identifiers for a given entity type or types may be distinguished. Separate namespaces are allowed in IFOPT for various types of reference data, for example, STOP PLACE COMPONENTs, POINTS OF INTEREST, ADMINISTRATIVE AREAs. Namespace is also used as a technical term within XML in a related sense, to identify the scope within which XML elements, and attribute names are unique.

4 Symbols (and abbreviated terms)

AVL Automated Vehicle Location

AVMS Automated Vehicle Management System

GIS Geographical Information System

GDF Geographic data format

HTTP HyperText Transfer Protocol

IANA Internet Assigned Numbers Authority

IATA International Air Transport Association

IETF Internet Engineering Task Force

ISO	International Standards Organisation
POI	Point of Interest
PT	Public Transport
SIRI	Service Interface for Real-time Information
TRIDENT	TRansport Intermodality Data sharing and Exchange NeTworks
UML	Unified Modelling Language
URL	Universal Resource Locator
VDV	Verband Deutscher Verkehrsunternehmen (D)
W3C	World Wide Web Consortium
WGS	World Geodetic Standard
XHTML	Extensible Hyper Text Mark-up Language
XML	eXtensible Mark-up Language
XSD	XML Schema Document

5 Use Cases for Stop Point Data

Fixed Object data, including Stop, connection path and Point of Interest Data has a very wide variety of uses in PT info systems The relationship between physical stop points and complex features (i.e. stations and other interchange points) is relevant for timetabling, journey planning and real time operations, both to identify points on the network, and to describe interchange paths. Both exact and approximate stop naming strategies need to be supported.

The following Use Cases illustrate functional cases for using Fixed Object data in PT information systems and provide specific scenarios that the IFOPT model is intended to support.

The Use Cases are organised under

- Primary Use Cases
  - Timetable preparation & Scheduling Systems.
  - Journey Planning.
  - AVL systems and real-time information providers.
- Secondary Use Cases
  - Public Transport operations.
  - Urban Traffic Management Control systems.
  - Geographic Information Systems Use Cases.
  - Local Authorities.
  - Other.
- General Use Cases.
- Excluded Use Cases.

The same use cases may be used both in centralised and in decentralised organisations, for example to plan and manage the exchange of data between a central database or distributed databases. The roles may be undertaken by responsible authorities themselves, or procured from external suppliers.

5.1 Use Cases: Timetable Preparation & Scheduling Systems.

The following Use Cases describe the use of Fixed Object data for the preparation of timetables and schedules.

5.1.1 SCHED#01 Identifying the stops and connection stops in a PT network when creating a schedule

Schedulers of Public Transport timetables plan and schedule journeys for PT vehicles that will move between designated stops and timing points. To do this the stops and timing points must be given unique identifiers that can be used to reference unambiguously the scheduled stopping points of the journey. The identifiers for internal scheduling and operational use may be different from those given out on the timetable or other information to the public. Public identifiers may comprise a label, a short code, a long code or all three.

EXAMPLE 1 *'London Heathrow', 'Heathrow', 'LHR',* 4900345671, or *'Kings Cross', 'Kings Cross Rail Station', 'KGX',* and *'9100KINGX*'.

Timing points that are not stops are not normally published to the public but will still need to be identified internally. There may be multiple internal identifiers for the same stop point relating to reservation, operation or control systems.

A scheduled stop point is, in effect, a planned break in the journey for alighting or boarding that may be, but is not necessarily, related to an actual physical stop point. For example, for scheduled stops at large stations the vehicle journey may be additionally assigned to a specific platform or stance within the station.

EXAMPLE 2 *'Kings Cross, Platform 9'.*

The scheduled stop point exists independently of this assignment, which may change when the vehicle journey occurs.

To prepare a schedule, a scheduler normally will begin by creating a service pattern, a list of the designated stops points in sequence that defines a route. Where an existing set of reusable stop points already exists, the list will be selected from these existing points. If there is no general system the stops will be assigned arbitrary names on an ad hoc basis, and identifiers allocated from a designated name scope. If the schedule involves a new stop there may be a need to define a stop and allocate new identifiers.

The definition of the route may be identified and exchanged independently of the timetable.

5.1.2 SCHED#02 Identifying the stops in a timetable or for a particular Vehicle Journey when creating a schedule

Once the route and service pattern is established as a list of stops, the scheduler will add timings to create a journey pattern for making each journey, followed by specific vehicle journeys that traverse the route using the journey pattern at a designated times. Default platforms at each stop may be assigned at the same or a later time.

5.1.3 SCHED#03 Identifying the interchange and connection points in journeys when creating a schedule

Places in the network where there is a possibility of making a transfer may be designated as interchanges and explicitly identified by connection links or other grouping mechanisms that associate stop points. To represent the possibility of transfer between two stop points, schedulers may create Connection Links which may have unique identifiers within the system so that they may be reused. Connections may also be made between services using the same stop point. Connection Links ideally should represent the physical movement between stop points; any contingency time at the connection point to allow for irregular operation of services should be identified separately.

Certain connection points may be favoured over others and be assigned weightings.

5.1.4 SCHED#04 To schedule services between the stops, allowing adequate time for connections.

In creating a schedule, schedulers will try to plan the overall timetable for the network so that there are convenient connections between different vehicle journeys on different routes that give sufficient but not excessive buffer times between journeys.

Having identified designated connection points as per SCHED#03, to indicate that there is a planned interchange between vehicle journeys in a timetable, schedulers will create an interchange record that references a connection link and may provide attributes (as to the timing and nature advertised, guaranteed etc) of the journey interchange. Depending on the sophistication of the scheduling system, the individual timings required for transfers between different stop areas or stop points within an interchange may be taken into account or just an average time for any transfer at the station may be used.

Journey planners and other applications subsequently may use the interchange and/or connection information to find suitable journeys.

5.1.5 SCHED#05 To plan transfer margins for guaranteed connections between services.

The Scheduler may give the connection link and interchange record created in SCHED#04, specific properties to support the management of guaranteed connections These will be used subsequently by AVMS systems.

5.1.6 SCHED#06 To relate physical stops with complex features such as stations.

In preparing a schedule that has a scheduled stop point at a large station or interchange, schedulers may need to give an indication of where in the interchange each stopping point is located. This advice may be given at various levels.

EXAMPLE ‘Waterloo’, ‘Waterloo East’, ‘Waterloo East platform 6’.

In planning schedules, transfer times may be material, in which case normal transfer times for different types of user will need to be recorded.

5.1.7 SCHED#07 To plan use of platforms so that sections of a train may be related to sections of the platform.

Accommodation on trains is not always the same in each section - first class seating, catering accommodation, sleeping accommodation etc will be allocated to different sections of a train. In some cases trains will be split or combined during the journey - so passengers making journeys between two stopping points may need to be in a particular section of a train. Also on Express trains, tickets are also often pre-assigned to a specific seat in a specific carriage. Both of these situations lead to a need to identify to the public the section(s) of the stopping point (platform) at which a section of a train with relevant features will stop. This may be in formats such as "platform 3, front part of the train" or "platform 3, yellow zone" or "Platform 3, section D".

5.1.8 SCHED#08 To plan the shared use by different trains at the same time of the same single platform that is broken down into sectors.

At some major rail stations it is possible for a single "platform" to be occupied by more than one separate train, each departing at a different time for different destinations. This is a special version of SCHED#07. The platform may have a secondary split into sectors "platform 4A", "platform 4B", to indicate to passengers where they should stand in order to board their designated carriage efficiently, or to access the correct part of a multi-part train.

5.1.9 SCHED#09 To plan for flexible pick up points for demand responsive and other services.

Demand responsive services, and Hail & Ride services, seek to serve passengers by stopping at a location close to their door on a pre-ordained route. That route may be one which is followed regularly, or it may be one that is created dynamically for each journey to meet specific passenger requirements that have been booked in advance. In these cases there are both operational and public information needs to be able to identify stopping places which may represent a linear section of a predetermined route, or a zone of streets, on which the vehicle will stop on one or more occasions as necessary on an individual vehicle journey. There is a need both for codes for such stops and labels that can be used for the public provision of information.

5.1.10 SCHED#10 To assign labels for destinations, places, and stops, for use in destination boards, stops, tickets, on-board displays, announcements etc.

Schedulers need to assign consistent unambiguous names to stops, and stop points, on all forms of printed and electronic media. Normally there will be a number of canonical labels to use for different media types and footprints, such as a short name (e.g. '*Kings Cross'*), a long name (e.g. '*London Kings Cross Station'*), a name to print on tickets, (e.g. '*London Kings Cross*)a name to use in SMS messages (e.g. '*KingsX'*), etc. Typically systems will hold a set of definitive labels that follow uniform typographical and spelling conventions for example as to hyphenation, capitalisation, use of abbreviations etc.

EXAMPLE 1 Frankfurt. a. m. vs. Frankfurt am M,. or St. Jean-en-Provence vs. St Jean en Provence)).

This is to ensure a consistent brand, for the service provider and to make the presentation of lists of similar names ergonomic to the user.

Different delivery systems will need to compose different labels for the same stop in different contexts. Where there are identical or similarly-named elements it may be necessary to include additional qualifiers such as the name of the administrative area to discriminate between them.

Destination displays on buses and on signs at stop points may be constrained to be within a limited number of characters, and formatted in a style which is appropriate to the context of the service being provided. A destination may be described differently between a local service and a long-distance one.

EXAMPLE 2 For example, consider two services heading for '*Bristol, Marlborough Street Bus Station'* - the local service within Bristol will not state the name of the town, for instance, and just say *"Marlborough Street Bus Station"*, whilst the long-distance service may only state the name of the town and ignore the detail of where in the town the service stops, "*Bristol*".

AVL systems will use these same headings for dynamic displays.

Mechanisms are needed to distribute changes to reflect renaming and the addition of new stops.

5.2 Use Cases: Journey Planning

The following Use Cases describe the use of Fixed Object data for journey planning.

5.2.1 JP#01 To identify Stops and Stations used by PT transport networks.

Journey planning systems reference stops and stations in many different ways; both associating them with topographical and address data to support place finding, and describing the scheduled stop points of the journey. Suppliers of journey planning systems typically must assemble topographical address, stop and timetable data into a normalised format in order to transform it into the internal representation used by their journey planning engines. Stop data provides a crucial role in this process as it constitutes a separate and distinct information layer that can be used to relate timetable data to GIS data layers.

5.2.2 JP#02 To find stops and stations for a place (point, locality, or general area).

Passengers using journey planning systems will need to find the nearest points of access to PT for the origin and destination of their trip. They may not necessarily know of the existence of, let alone the name of, the relevant stop or stopping point, and may use a variety a strategies to indicate their location: entering a point of interest name, a place name, an address or postcode, or clicking on a map. The journey planner will use gazetteers and other mechanism to make a location-based search to find the nearest stop or stops that may be relevant In order to be able to do this the journey planner must be able to relate the stop to a GIS context and/or to associate it with a topographical name.

Journey planners may support multiple aliases for both places and stops.

EXAMPLE 'London Kings Cross', 'Kings Cross', 'Kings Cross station'.

The precision of the search may vary widely in different contexts. To take a local bus the passenger will be interested in a few stops within easy walking distance. For long-distance travel passengers may tolerate a much larger search area: typically journey planners will support specific PT related concepts of place such as "*London any airport*" or "*London (any mainline station*)".

5.2.3 JP#03 To find PT services available for travelling to or from a place

Often a passenger will be interested in knowing the services available at a specific stop. Having found a stop (either by a location based search or by explicitly entering a name or public stop code), a passenger will be shown the services available at the stop. This could be either as a departure board, or as a list of modes (for example to see how they might travel to an airport). The stop may be identified either by its canonical name, public short code or both - thus providing a means of familiarising passengers with the alternative ways of accessing information about the stop place. The results will also show the destinations of different services as either place names, stop names or Point of Interest names.

5.2.4 JP#04 To find PT services available for travelling to or from a specific POI

The passenger's goal will often be a Point of Interest, not a stop. They may use a stop finder to find the stop nearest to the POI, and then look at the timetable of services to or from that stop, as per JP#03.

5.2.5 JP#05 To describe the relation of the stop to nearby objects and landmarks to help identify them to the public

A journey planner needs to be able to offer a passenger detailed guidance on how to find a stop. The name of a stop may be additionally labelled or qualified in terms of places or POIs in the immediate vicinity. Map based presentations may show the relative positioning and access paths needed to reach the stop in relation to landmarks and Points of Interest.

5.2.6 JP#06 To relate physical access points (entrances) with complex features such as stations and POIs

Large transport interchanges and POIs may have a number of different entrances, addresses, parking areas etc and a journey planner may need to indicate to the user which entrance they should use and how to identify it in relation to the urban context.

5.2.7 JP#07 To plan journeys between places

Passengers may often wish to use topographical place names to state their travel objectives.

EXAMPLE 'Cambridge to Oxford'.

The topographical scope may be quite large, for example 'London to Paris' reflecting considerable flexibility in the user's choice of stops. The journey planner needs to be able to associate topographical places with stop places at different scales appropriate to the scale and mode of travel, and in accordance with common sense notions of place - for example airports may be outside the physical boundaries of city, but are the air access point stops to the city. A within-city journey would consider local stations, whilst an intercity journey would consider mainline termini as the starting points.

5.2.8 JP#08 To plan journeys to the entrance points of POIs which are large enough to have multiple access points with different journey opportunities

Often a passenger will be interested in knowing the services available to reach a specific POI. They may use the POI as a destination a journey planner. For large POIs the journey planner may consider all the access points to the POI and then offer the passenger a number of journey options to go to all or some of the stops closest to the access points. The passenger may specify additional constraints such as wheelchair use that further limit the journey planning.

5.2.9 JP#09 To describe the stops of a journey or trip

Journey planners provide passengers with both summary and detailed itineraries that describe the way points on their journey. The stop names and any public codes shown on the itinerary should correspond to the signage used on the stops so that users can follow their progress. The departure stop, interchange points and sometimes the arrival stop may also include the platform identifier.

5.2.10 JP#10 To identify stop points when exchanging data between distributed journey planners.

For large scale distributed Journey planning, networks of separate regional journey planners exchange queries and results collaboratively in order to establish a multiregional journey plan. In order to do this they must be able to use common identifiers for stops and locations. For efficient computation certain stops or other points in the transport network will be distinguished as points known to both engines.

5.2.11 JP#11 To plan journeys through the network, including detailed connection times.

In planning a multi-leg Journey plan through a network, a journey planner will take into account the transfer time needed to transfer between services at an interchange point. Depending on the sophistication of the journey planning system and the availability of data, the individual timings required for transfers between different stop areas or stop points within an interchange may be taken into account or just an average time for any transfer at the station may be used.

Journeys may be made passengers on foot, on a bicycle, in a car or using a combination, for example park and ride or kiss and ride. The stop model should support journey planning of intermodal journeys.

5.2.12 JP#12 To plan journeys through the network, including detailed connection times, under different constraints for mobility restricted users.

As a refinement to JP#11, in planning a multi-leg trip through a network, a journey planner may additionally take into account the accessibility requirements and different transfer times needed for different types of user, with different walk speeds or other needs, in particular for impaired mobility accessibility. Depending on the sophistication of the journey planning system and the availability of data, the individual timings required for transfers between different stop areas or stop points within an interchange using specifically identified navigation paths and accessibility needs may be taken into account or just an average time for any transfer at the station may be used, scaled to a particular walk speed.

5.2.13 JP#13 To provide detailed guidance for making an interchange between two services over a connection.

Journey planners providing journey plans for journeys involving the traversal of large interchanges will be concerned to provide detailed guidance on the navigation of the interchanges, typically as step by step instructions that can be related to the signage found within the interchange. Depending on the sophistication of the journey planning system and the availability of data, the individual paths required for transfers between different stop areas or stop points within an interchange using specifically identified navigation paths and accessibility needs may be given.

5.2.14 JP#14 Stop Finding for complex stop types

Some stops do not have simple point geometries.

EXAMPLE

— Hail and Ride sections: These will typically be a contiguous section of road marked by a start and end point

— Flexible zones: these will typically be arbitrary polygons

— Variable bays: These will be dynamically allocated bay assignments within a bus station.

Journey planners will typically use additional mechanism to find such stops and additional labels to describe such stops.

5.3 Use Cases: AVMS and Real-time Information Providers

The following Use Cases describe the use of Fixed Object data for real-time AVMS services.

5.3.1 RT#01 To identify monitoring points to the public as stations / stops / platforms

AVL systems will typically make predictions for vehicle progress against agreed monitoring points (i.e. timing points covered by the AVL system). For those monitoring points that are associated with stop places, the public will want to find the departure and arrival boards.

5.3.2 RT#02 To identify the monitoring points exchanged between different AVL systems

Different AVL systems exchanging information about buses roaming between their respective coverage areas will want to exchange information about arrival and departures at monitoring points and predictions for vehicle progress in order to include roaming buses in stop displays, To do this they need a mutually agreed set of monitoring points that are either the same as, or can be associated with, the known stop places and stop place components.

5.3.3 RT#03 To identify the relationship of the monitoring points to other points in an interchange

In order to provide effective real-time information to the public, AVL systems must understand the relationship between the monitoring points in an interchange and the physical layout of the interchange, including the actual quays and boarding positions

5.3.4 RT#04 To manage the connections between stop points at an interchange

A particular concern of AVL systems exchanging information about connecting services is to relate the real-time connection information with the relative physical locations of stops in an interchange so as to be able to allow for accurate transfer times. This is especially important for large interchanges. where there may be a big difference between near and far transfers.

5.3.5 RT#05 To report progress and predictions against monitoring points for on-board and off-vehicle information systems

One of the ways AVL systems inform passengers is to predict arrival at the calling points of a vehicle journey. This requires a model of the stop points and of their relationship to the monitoring points. that can be understood by the passengers

5.3.6 RT#06 To manage guaranteed connections, allowing for connection times at the interchange

Some AVL systems support the automatic management of guaranteed connections with predefined margins of tolerance. To do this they need to exchange information about connecting feeder and distributor services in relation to the interchange's stop points.

5.4 Use Cases: Public Transport Operations

5.4.1 OPS#01 To relate signage and labels to infrastructure management systems

The installation and maintenance of stop and station fixtures includes the provision of stop labels and other signage with which passengers can orient themselves within the physical infrastructure. The work of maintenance teams placing signs is typically supported by asset management databases, which relate Equipment and other assets to the inventory and other systems and the workflow to be performed. Such systems need to be able to access and exchange fixed object data, in particular for Stop Places.

5.4.2 OPS#02 To relate situations to the network and to journeys in the network

Real-time incident capture systems (ICS) gather information about planned and unplanned disruptions to the network as structured situation messages, which are then distributed to dissemination channels such as in-station displays, on-board displays, online travel news, alert systems and journey planners. In order to be able to classify situation data and to associate it with the affected services, stations and lines in a way that downstream computers systems can process the situation content, it is necessary to tag it with appropriate fixed object data such as the stop points or connection links that are affected by the situation. Typically ICS allow the selection of station names and line connections. These are then translated to stop point codes and path codes in the situation location model and transmitted to other systems which make use of the same model and code sets to process the situation.

5.5 Use Cases: Urban Traffic Management Control systems

5.5.1 UTMC#01 To manage the traffic for an area including through a particular stop or interchange

Urban Traffic Management Control systems seek to optimise the flow of traffic over a road network, often giving precedence to public transport vehicles which provide a more efficient method of transporting large numbers of users, for example, giving buses priority at traffic lights. The real-time position of the buses in relation to their monitoring points is a useful input to such systems. Real-time data will typically be exchanged in relation to agreed points. The monitoring points and stop points for vehicles are therefore relevant to such systems.

5.5.2 UTMC#02 To report disruptions within the network in relation to specific stops or arrivals at a stop

UTMC systems may be concerned to relate specific disruptions with specific known stops. For example to identify public transport stops affected by traffic disruptions. Real-time data will typically be exchanged in relation to agreed points. Real-time data may include both structured Situation and data as to the real-time progress of vehicles and factors affecting the progress of vehicles at known stop places.

5.6 Use Cases: Geographic Information Systems

5.6.1 GIS#01 To show stops on a map

Stop Places and Stop Points are significant features on maps. Typically geocoded stop point data will be distributed as bulk data files to the map suppliers who will transform it into the representation used in their datasets.

5.6.2 GIS#02 To show signs on maps and Virtual-reality displays

Some kinds of map guidance or personal navigation systems may wish to show the signs or sign textual content that appears to a user at a particular location as part of an interactive visualisation in two or three dimensions.

5.7 Use Cases: Local Authorities

The following use cases describe the use of Fixed Object data for transport planning purposes.

5.7.1 LA#01 To plan and understand the PT Coverage of an area

In order to model and plan the adequate supply of Public Transport services within a Region in detail, a precise model of the location of stop places for different public transport modes is needed. This can be used to relate the frequency and timing of transport services with local infrastructure and demographics. Typically geocoded stop point and point of interest data will be distributed as bulk data files for analysis and cross correlation with other data sets.

This may include both immediate access to local points and a larger scale analysis of accessibility of connectivity between areas.

5.7.2 LA#02 To plan and understand the accessibility of an area

In order to plan the adequate accessibility on the PT service within a region, a detailed model of actual accessibility is needed.

5.7.3 LA#03 To show the available PT points for Tourist and Residential Attractions

Information services have a very common requirement to give advice on the use of public transport to reach both tourist attractions and places of interest to residents, such as universities, law courts, police stations etc. This requires stop data, point of interest data and information about the access links which connect them. Data will be disseminated to users by on-line self-service systems using maps and journey planners, printed material prepared from databases, and by call- and information-centre staff with access to systems. Particular uses include:

— Available PT points for workers to reach their work places.

— Available PT points for pupils and students to reach schools and universities.

— Available PT points for shopper to reach shopping facilities.

— Available PT points to reach leisure areas.

5.8 Use Cases: Other

5.8.1 OTH#01 Estate Agents - to show the relationship between stops and properties

Access to public transport is an important consideration for many house purchases and real-estate agents and information services have a common requirement to be able to show the relationship of properties to access points to public transport services and to Points of Interest. Typically the stop data sets will be included in the map data sets that are used to provide particulars for houses.

5.8.2 OTH#02 To show the relationship between stops and business premises

Access to public transport is of importance to a variety of businesses in order to inform current and future employees of transportation options and to inform customers of the business location related to the PT network.

5.9 General Use Cases

Some general use cases are common to many other cases include:

5.9.1 GEN#01 Distributed assignment of responsibility for Data Management

The data sets covered by IFOPT are large and belong to many different stakeholders. The task of gathering, collating and aggregating the data necessarily must be distributed among many different organisations. Some degree of central coordination is needed to agree who is responsible for which type of data, to agree common interfaces, and to agree the partition of code namespaces so that data coded to a common standard can be aggregated without clashes as to the unique identifiers.

5.9.2 GEN#02 Temporal Change in Stop Availability,

Systems must allow for the temporal change of stop availability or accessibility, through the addition or closing of stops or the reassigning of scheduled stop points from one physical location to another – the moving of stops, or by alterations to accessibility. Typically such changes are planned in advance and can be distributed with a validity condition along with other updates to the stop data.

5.9.3 GEN#03 National Language Support

Systems that display or accept textual labels may need to allow for alternative names in different National languages for textual names for entities and their terms of relationship. Typically systems will be coded in a primary language and aliases will be added for other languages, tagged with a language code.

5.9.4 GEN#04 Stop Finding

The task of Stop finding and disambiguation using text or map interfaces is common to many different type of online-systems, and the Fixed Object models should facilitate the reuse of common consistent components. Typically a given journey planner will use a consistent stop finder component for finding places. Similar consistency is needed on paper based presentations that will use standard labels and abbreviations for stops.

5.9.5 GEN#05 Incremental Data Exchange

Fixed object data sets involve large qualities of data collected from many different systems. To coordinate the management of such data it is normal practice to use change attributes to allow the reconciliation of changes made in different places. This enables the incremental exchange of data.

5.10 Excluded Use Cases

The Fixed Object Standard does not yet consider the following uses which will be considered for inclusion in a subsequent Part of this technical standard: See discussion in 1.1.

— Traffic Light prioritisation and control of Roadside Traffic Management Equipment.

— Road crossings and road interchange data.

— Detailed use of Parking for passengers and vehicles.

— Complex relation of Fare or Tariff Zones to Stops and Stop Points.

The use cases defined in 5.1– 5.9 may also be updated in subsequent parts of this Technical Specification to achieve further harmonisation with DATEX2 and TPEG.

6 Stop Place Model

The Stop Place Model describes the detailed physical structure of a Transport Interchange as a conceptual model of nodes and links that can be used to compute a navigable path for a passenger.

6.1 Physical Models

6.1.1 Example: Modelling a Railway Station

Figure 3, and its more detailed diagrams, Figure 4, Figure 5 and Figure 6, show an example of the physical layout of a Railway Station, a typically complex type of STOP PLACE that has both rail, bus and taxi components. The interchange has a TYPE OF STOP PLACE of ‘railway station’. It can be considered to be made up of two distinct sets of elements: those modelling the PT vehicle and trackways: and those modelling the passenger areas.

— The ***PT Vehicle Area*** model comprises elements concerned with Vehicles and Trackways:

  — RAILWAY ELEMENTs (linking to the Rail Network infrastructure model as described in Transmodel by RAILWAY JUNCTION, etc), and ROAD ELEMENTS, including ENTRANCEs FOR VEHICLES, VEHICLE STOPPING PLACEs, and VEHICLE STOPPING POSITIONs within the stop place.

  — Movable PT elements including VEHICLEs (and their more specialised TRAIN & TRAIN ELEMENT entities), which may also have ENTRANCEs TO VEHICLE that are the boarding points, and VEHICLE EQUIPMENT (such as low floors, etc, relevant for accessibility).

— The ***Passenger Area*** model comprises two main types of STOP PLACE SPACE component reflecting the physical structure of a station: QUAYs (providing access to PT Vehicles), and ACCESS SPACEs (providing access to QUAYs and urban infrastructure, but no direct access to PT VEHICLEs).

  — QUAYs may also contain other QUAYs, thus there might be a parent QUAY for the whole surface, and then child QUAYs for each edge or even part of an edge.

  — Within QUAYs there may be designated BOARDING POSITIONs.

  — QUAYs and ACCESS SPACEs may have designated QUAY ENTRANCEs and ACCESS SPACE ENTRANCEs respectively. The modes of access of ENTRANCES (e.g. foot, cycle, taxi) may be specified.

  — Possible routes between STOP PLACE SPACEs are represented by STOP PATH LINKs, which connect QUAYs, ACCESS SPACEs and BOARDING POSITIONs. STOP PATH LINKs may have transit duration times associated with them including those relevant to ACCESSIBILITY LIMITATION or CHECKPOINTs. There may be more than one STOP PATH LINK between the same pair of STOP PLACE SPACEs, reflecting different routes, with different accessibility and other impediments.

  — Not all STOP PATH LINKs or STOP PLACE SPACEs may be suitable for transit by all types of user. ACCESSIBILITY LIMITATIONs may be associated with a STOP PATH LINK to indicate the nature of the ACCESSIBILITY, for example, ”*No Wheelchair Access, Step Use Required, Lift Use Required, Escalator Use Required, Lift Available, Escalator Available*”, The values are chosen so that a planner efficiently ascertains whether the route can be navigated (i) by a wheelchair (ii) by someone requiring step-free access (iii) by someone unable to use lifts (iv) by someone unable to use moving travelators.

Within the Station two NAVIGATION PATHs are shown that connect a sequence of ACCESS SPACEs, and QUAYs with STOP PATH LINKs, using specific ENTRANCEs. One path, representing a journey that starts at the STOP PLACE, runs from an external entrance.

6.1.1.1 Example: Illustration of a Hypothetical Rail Station

Schematic examples of a hypothetical station with areas labelled with the Fixed Object element are shown in the following four diagrams:

- Figure 3: Overview diagram of physical layout a Station with multimodal interchange.
- Figure 4: Detail diagram of part of TRACK and QUAY area.
- Figure 5: Detail diagram of part of Set-down, Entrance and Booking hall access spaces.
- Figure 6: Detail of Taxi Rank and Concourse Area.

Illustrations of a station with areas labelled with the Fixed Object element are shown in the following four diagrams:

6.1.1.2 Example: Illustrations of Actual Rail Stations

Some real-world examples of rail station maps at a number of different scales show particular aspects of the Stop Place Model in a realistic context.

- Figure 7: shows a Rail and bus station interchange for *Gelsenkirchen* at a high level.
- Figure 8: shows a more detailed view of an external entrance and access space for *Gelsenkirchen*.
- Figure 11: shows an internal path link between an ACCESS SPACE and a QUAY entrance at Gelsenkirchen main station.
- Figure 12: shows multimodal navigation from a Rail Station – the main rail station in Gothenburg.

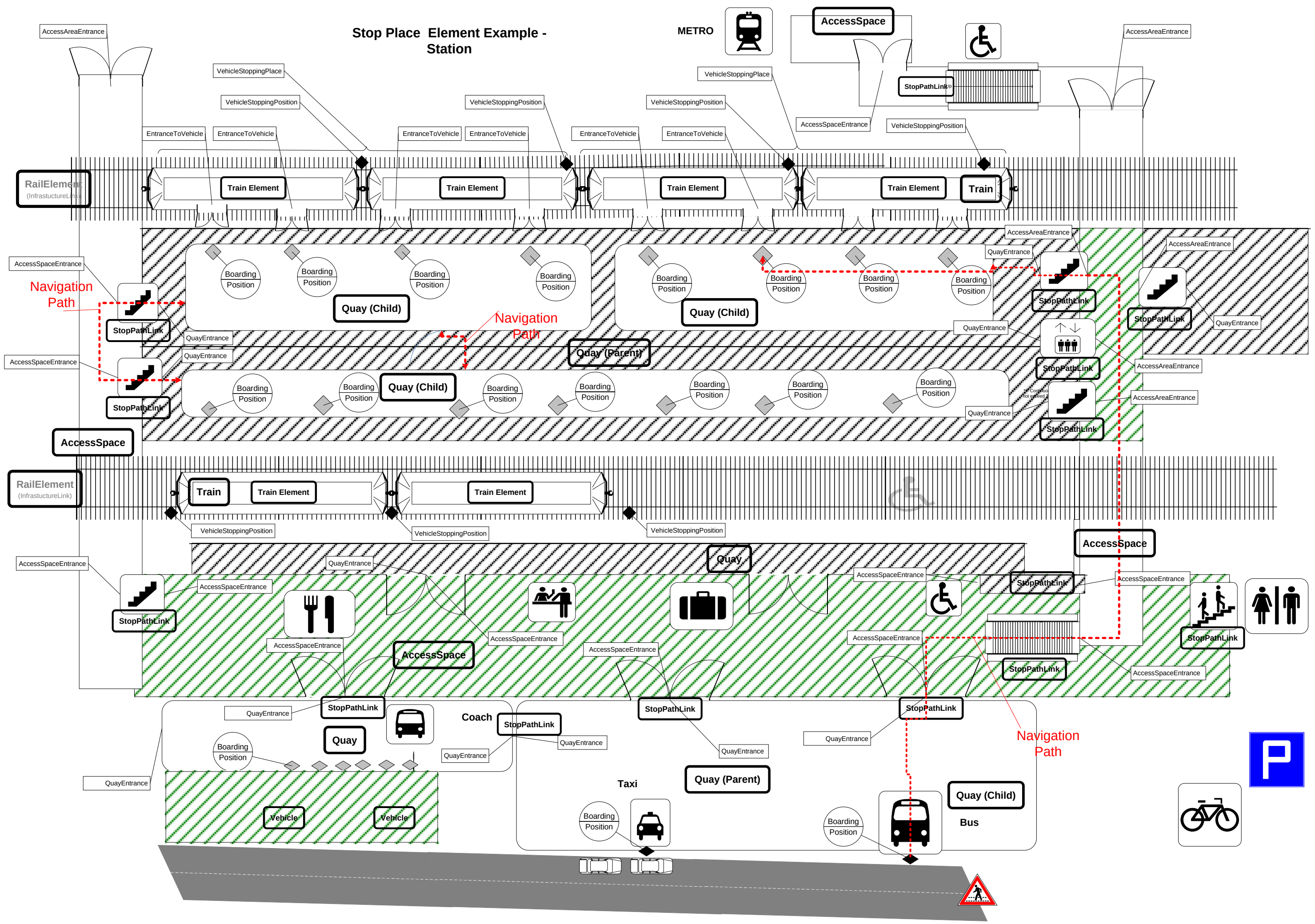


Figure 3 — Stop Place Example Physical layout

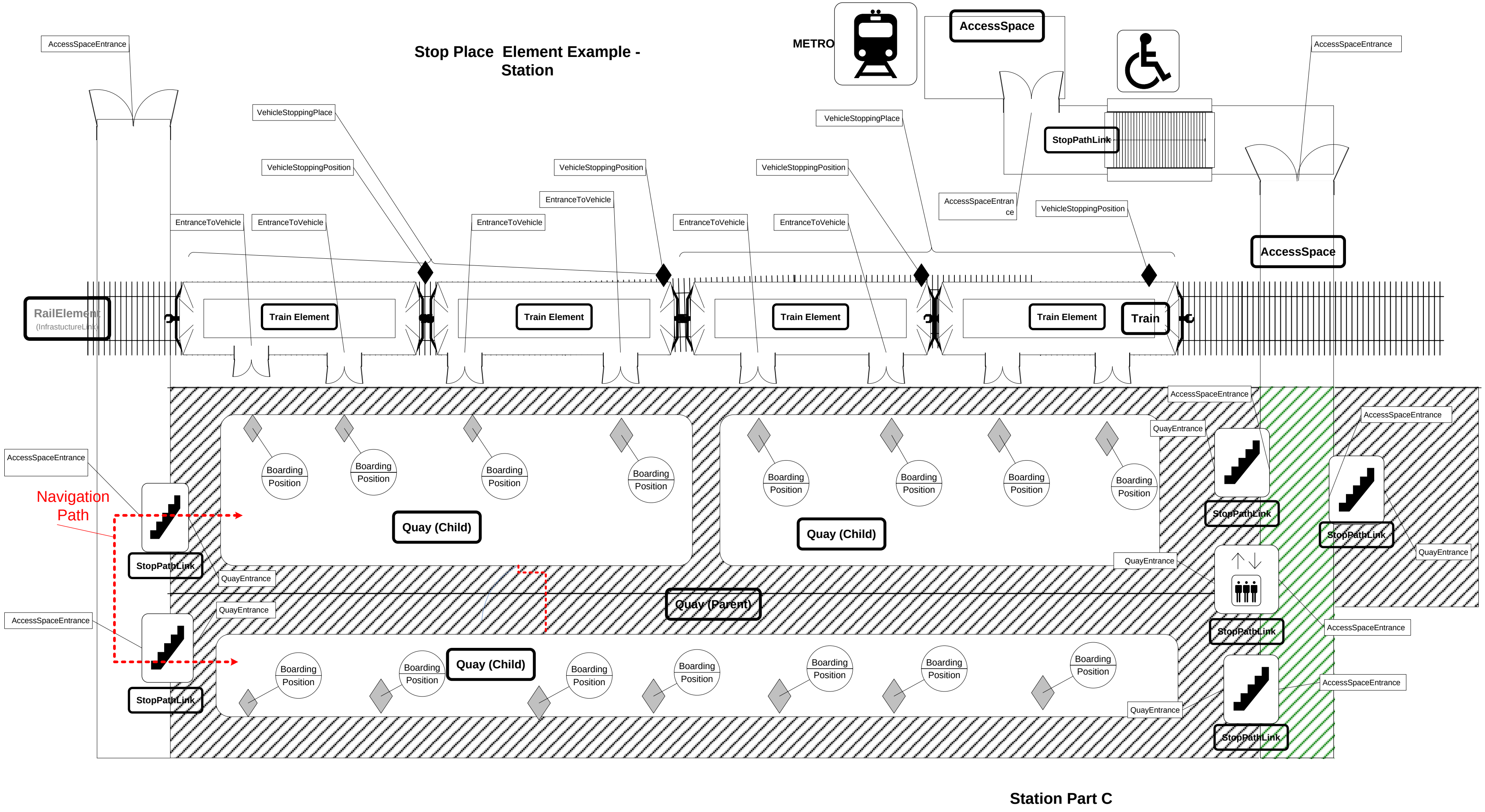


Figure 4 — Stop Place Station Example: Detail of Platform and Track area

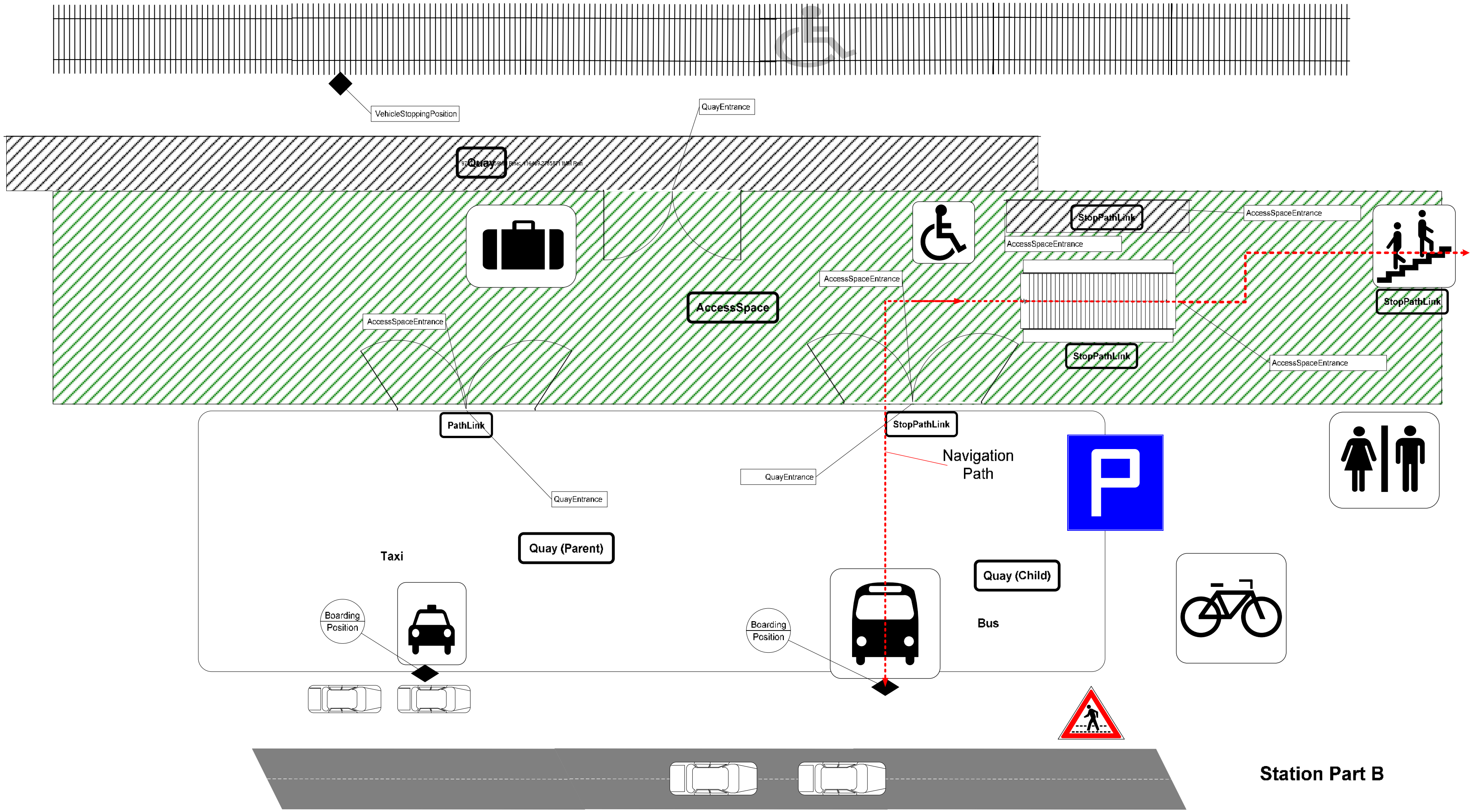


Figure 5 — Place Station Example: Detail of Set-down, Entrance and Booking hall area

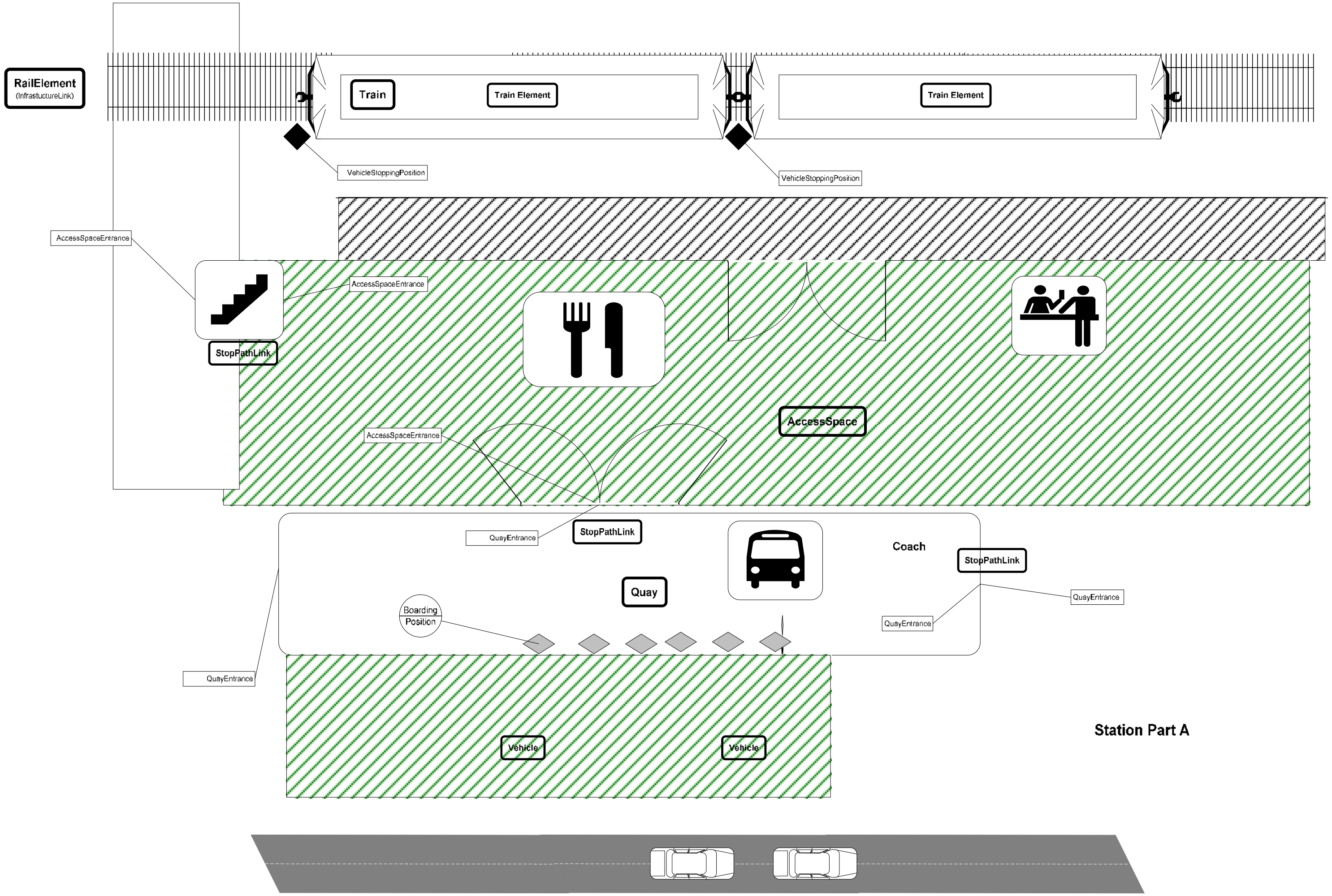


Figure 6 — Place Station Example: Detail of Detail of Taxi Rank and Concourse Area

Figure 7 — Medium Scale view of a Rail Station as an Interchange. (Courtesy of MDV)

Path in Gelsenkirchen Hauptbahnhof
3) Main hall with North- und South entrance

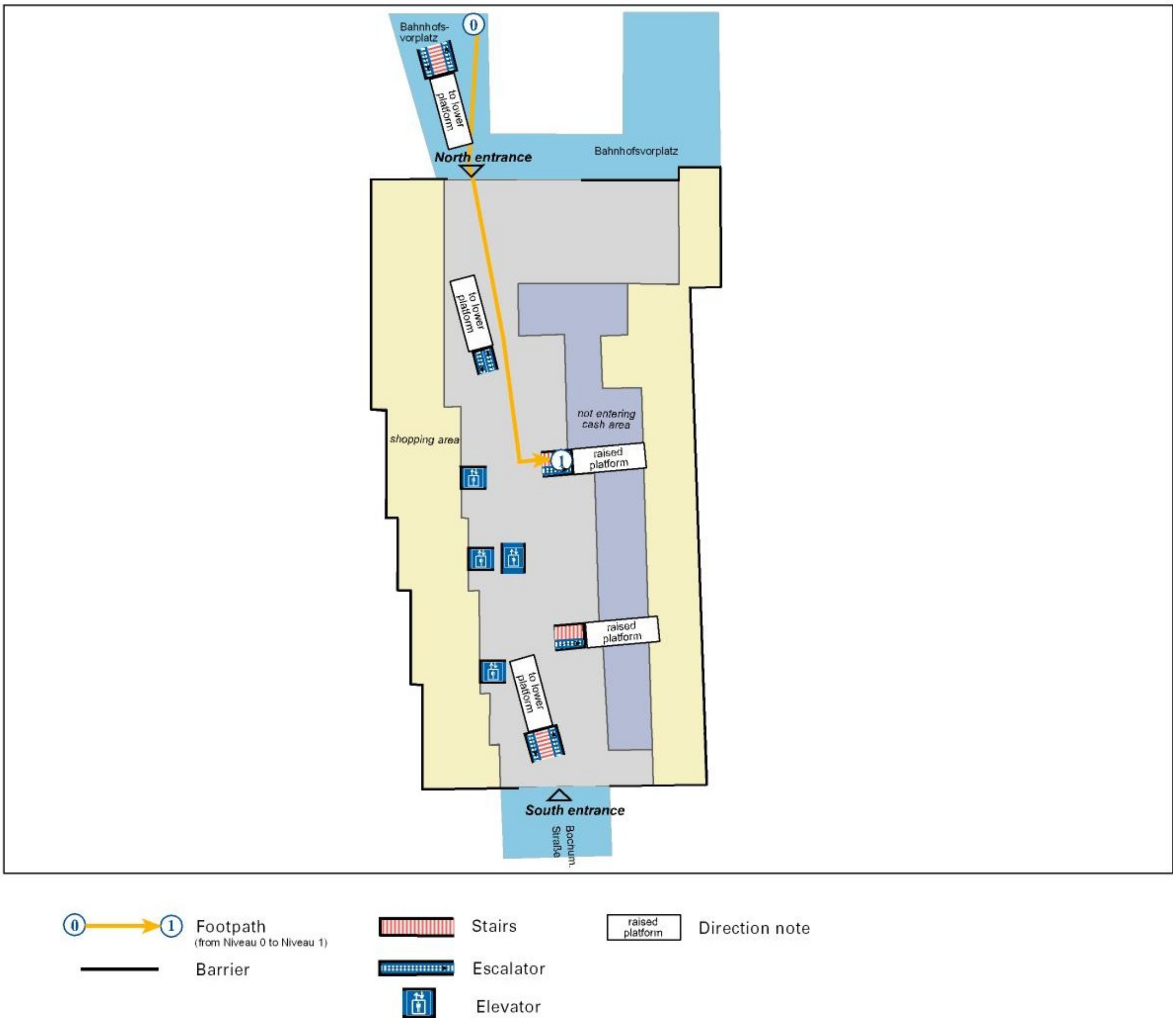
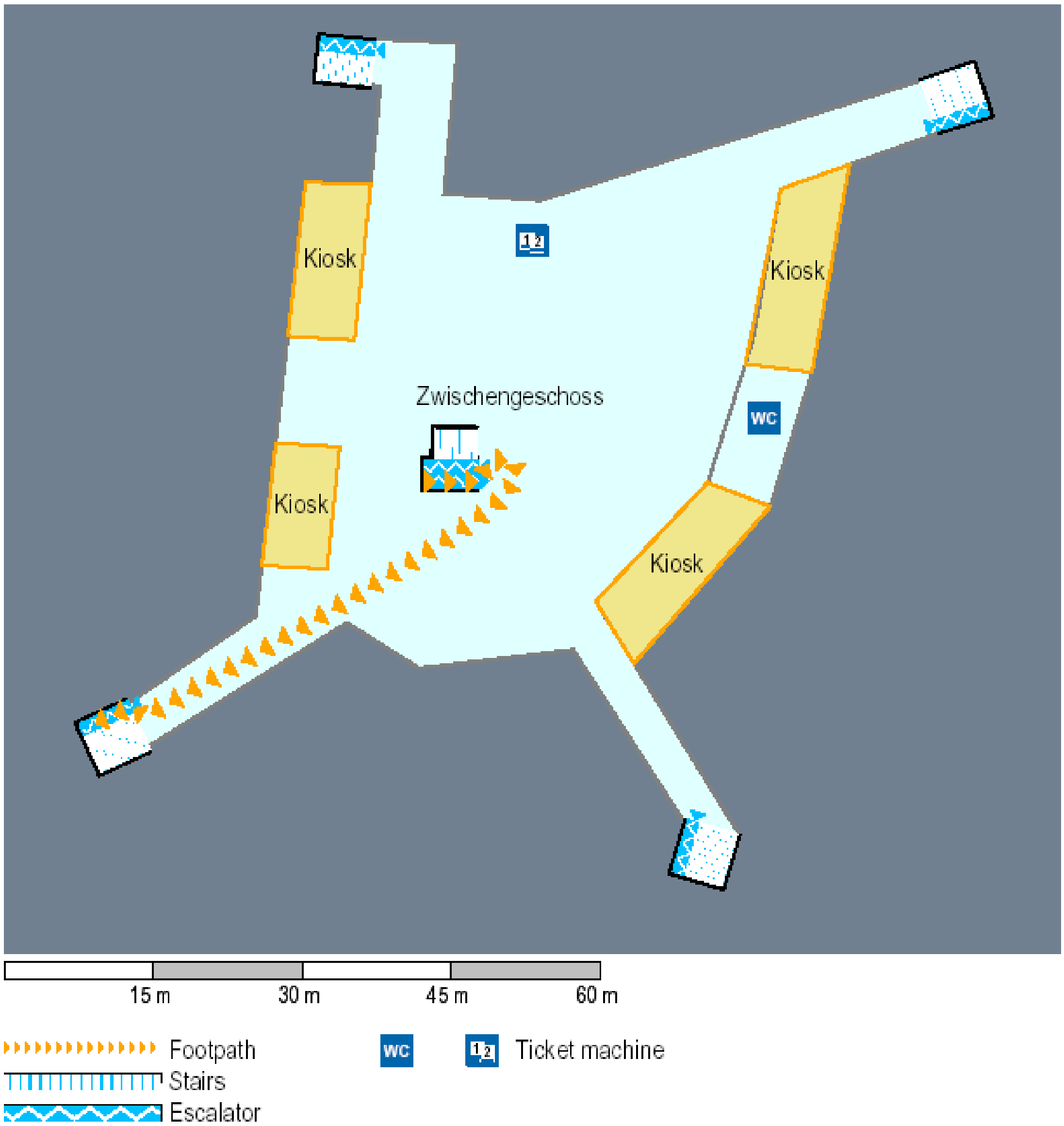


Figure 8 — Illustration of a Rail Station External Entrance & Path Link. (Courtesy of MDV)

Route inside S-Bahnhof Isartor:
Section Zwischengeschoss



		Bahnsteig ->	
1.	Straight Ahead	Escalator upwards	20 m 20 m
2.	Turn Left	Zwischengeschoss	
3.	Turn Right	Follow sign "Ausgang Thomas-Wimmer-Ring/ Thierschstraße"	50 m 70 m
4.	Turn Right	Escalator upwards towards "Ausgang Thomas-Wimmer-Ring / Thierschstraße"	10 m 80 m

Figure 9 — Illustration of a Rail Station Entrance & Path Link. (Courtesy of MDV)

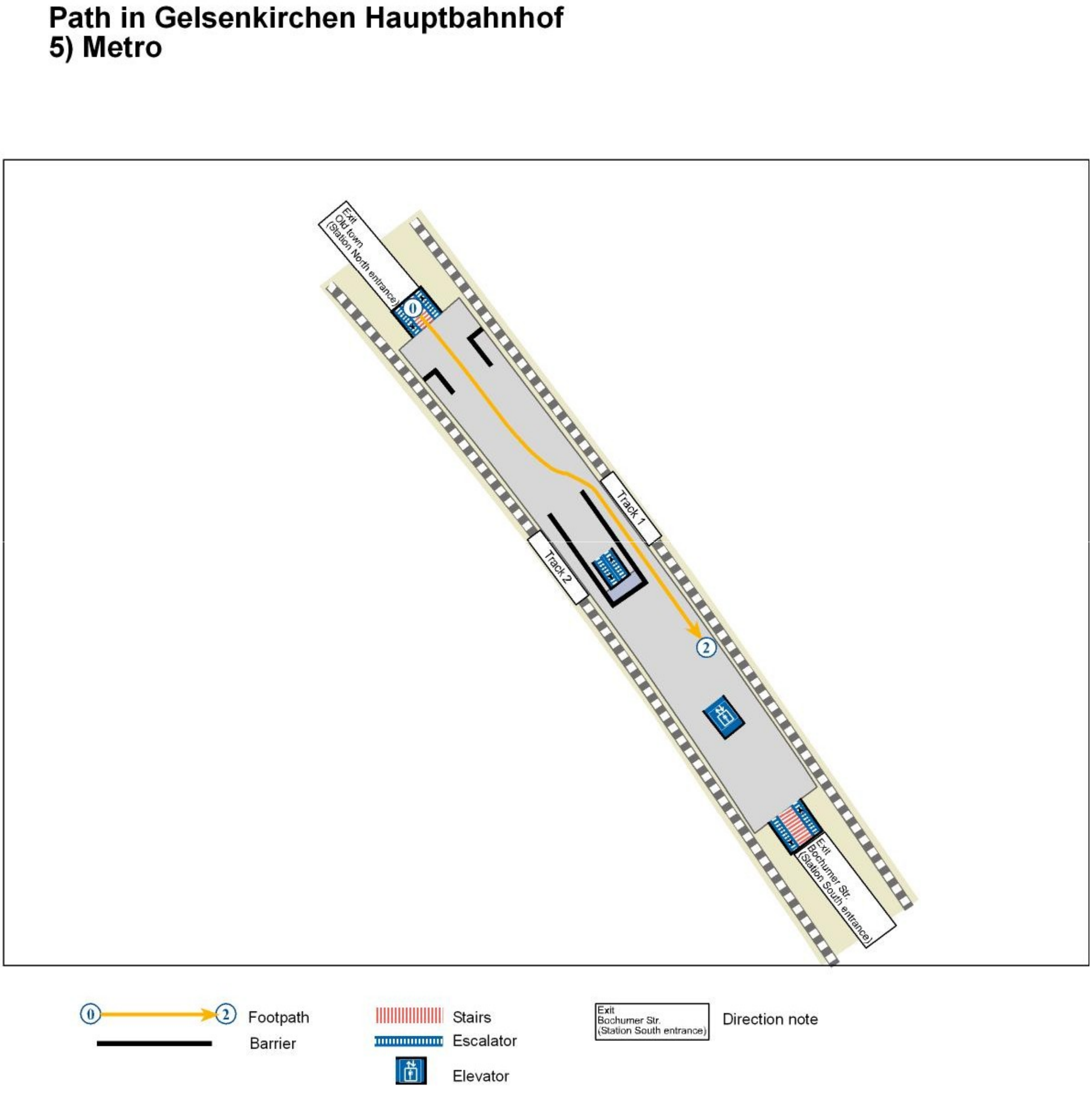
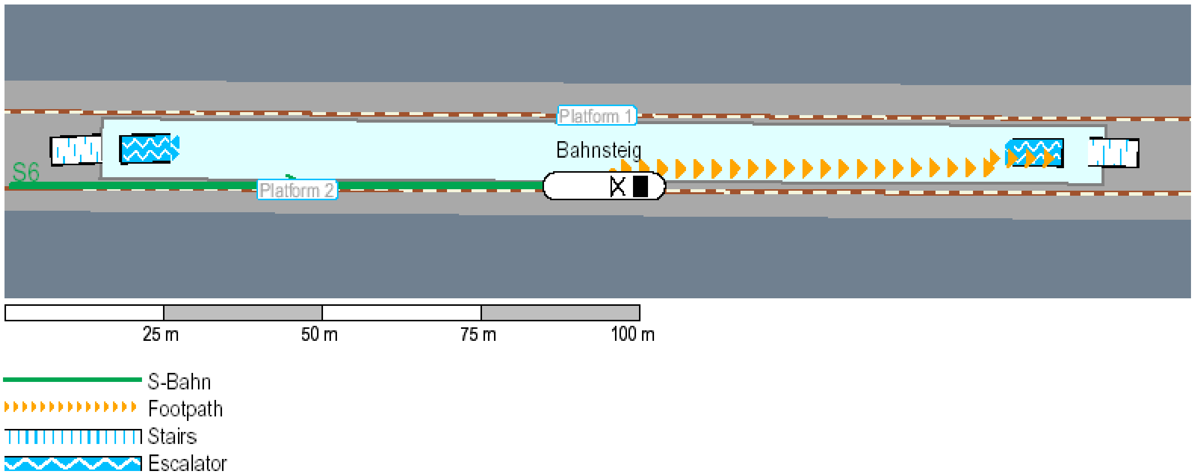


Figure 10 — Illustration of a Rail Station Internal Path Link. (Courtesy of MDV)

Route inside S-Bahnhof Isartor:
Section Bahnsteig



1.		Straight Ahead	In the direction of travel	60 m	60 m
2.			Follow sign "Ausgang Isartor"		
3.			Escalator upwards	30 m	90 m
			-> Zwischengeschoss		

Figure 11 — Illustration of a Rail Station Internal Path Link. (Courtesy of MDV)

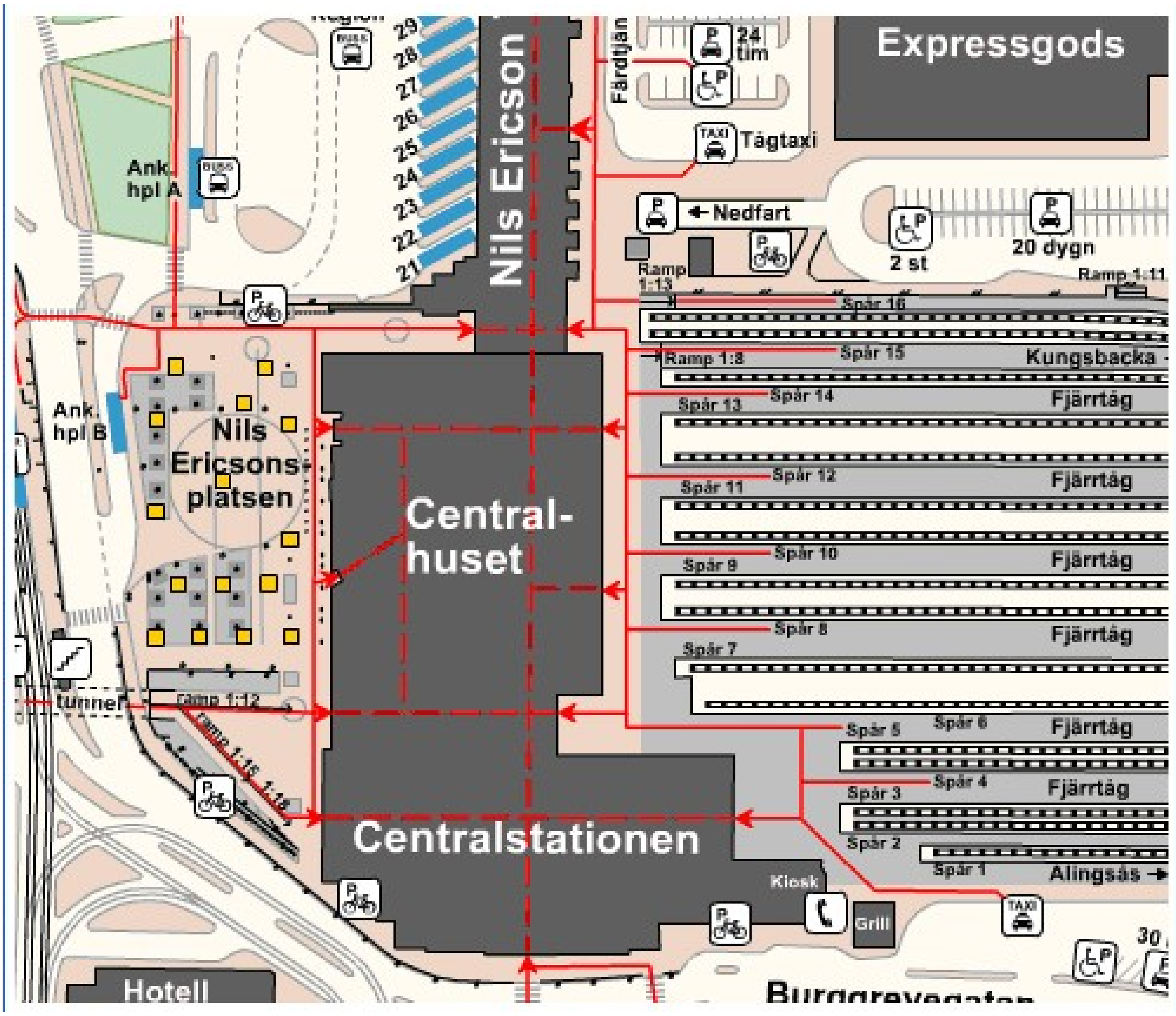


Figure 12 — Illustration of a multimodal interchange. (Courtesy of Samtrafiken AB)

6.1.2 Example: Modelling a Bus Station

Figure 13 shows an example of a Bus Station, another typically complex type of STOP PLACE. Again, it can be considered to be made up of two distinct sets of elements: those modelling the PT vehicle and track ways; and those modelling the passenger areas.

In Figure 13 — Illustration of a Bus Station and Path Link, the main station could be represented as a STOP PLACE in its own right. Within the STOP PLACE, there would be QUAYs for the continuous platform area, containing child QUAYs for each stop. The stopping points in the trackway would be represented by VEHICLE STOPPING PLACEs.

Figure 14 shows a schematic view of a bus station at Versailles Rive Gauche. The STOP PLACE will again have QUAYs containing QUAYs to represent the stops on either side of the road way.

6.1.2.1 Illustration of a Bus Station and Navigation Path within it

Path in Gelsenkirchen Hauptbahnhof
2) Central bus station (ZOB)

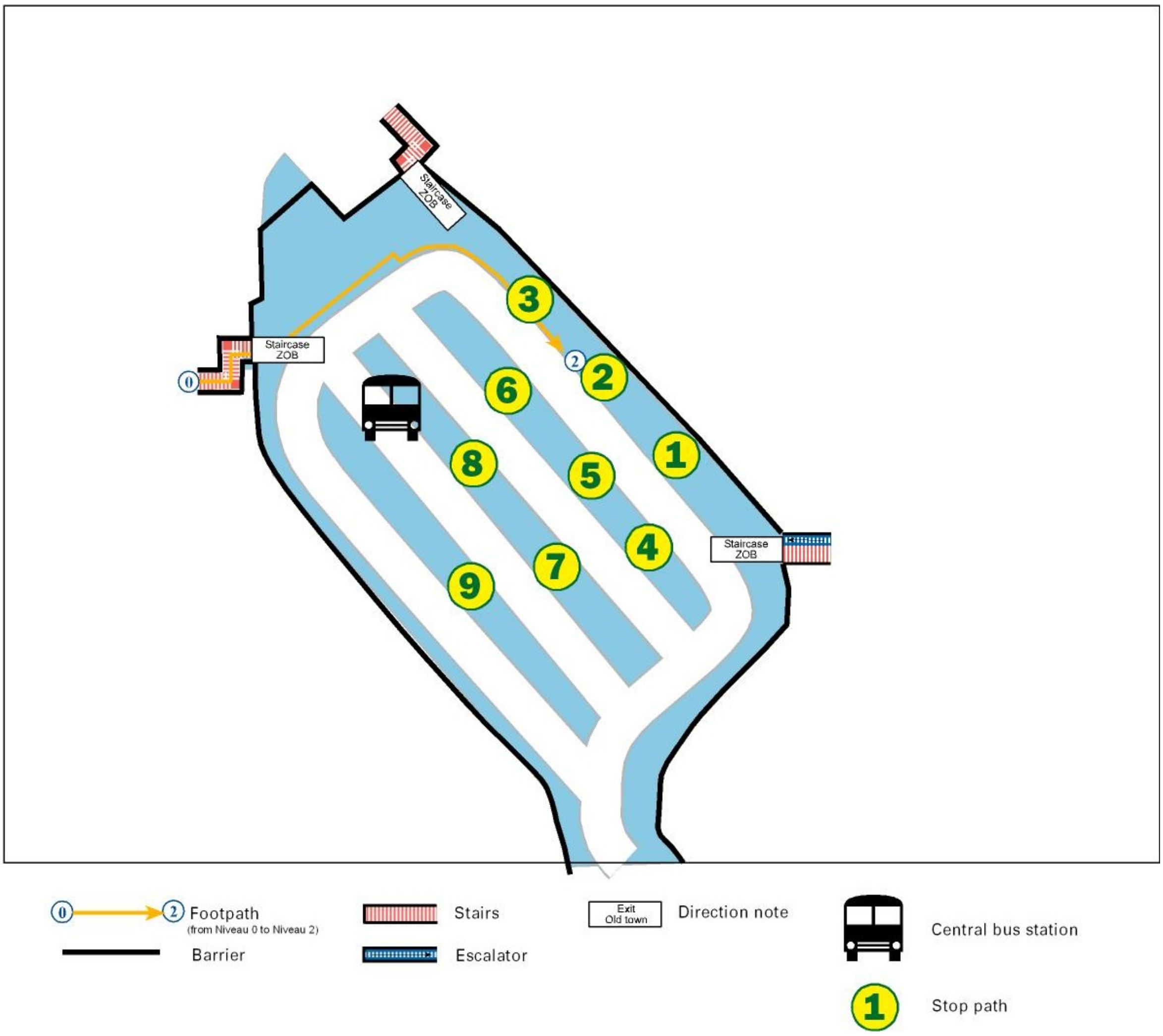


Figure 13 — Illustration of a Bus Station and Path Link. (Courtesy of MDV)

Figure 14 — Example of Bus Station - Versailles Rive Gauche (Courtesy of RATP)

6.1.3 Modelling Bus Stops on a Street

Elements of the Stop Model may also be used to describe on-street stops for buses, coaches, trams, trolley buses, etc. Particular cases to consider include:

- A pair of stops on either side of the road.
- A single stop on one side of the road (for example in a one way system).
- A cluster of stops on a street or nearby streets all sharing a common name, and providing an interchange point for different services.
- A section of street over which hail and ride services operate. Services will stop at any safe point in the section.
- A designated zone in which demand responsive transport operates: services will visit most locations within the zone on demand.

To represent a pair of stops on a street. A STOP PLACE may be used to name and group the pair; a QUAY is used for each stop, with optionally a BOARDING POSITION for each pole. Shelters, signage, etc associated with the stop can be treated as STOP PLACE EQUIPMENT.

6.1.3.1 A pair of stops on either side of the road.

The most common situation is a pair of stops, one in each direction either side of a street. The stops will serve the same streets, points of interest, etc. The boarding position of the stops is usually designated by a pole. However in Rural areas there is sometimes no visible pole in one or both directions).

Figure 15 shows an example physical layout of a pair of bus stops on a street.

Figure 15 — Example of a pair of bus stops on street. (Courtesy of MDV)

For each pair of stops there may be a STOP PLACE instance. There will be a QUAY for each stop in each direction. There may optionally be a VEHICLE STOPPING PLACE element exactly indicating the stopping bay for the vehicle. Figure 16 shows a UML instance Diagram for an example comprising a simple stop pair with vehicle positions as well. (Note these are object instances, not classes as in most other UML Class Diagram.)

In this case the STOP PLACE is likely to relate to a STOP AREA, and each QUAY to one more SCHEDULED STOP POINTs. There may one or more BOARDING POSITIONs within the QUAY, though for an on-street stop there is often only one (and its existence may be implicit in that of the QUAY). The VEHICLE STOPPING PLACE is of importance to the driver but not to the passenger, who is interested in the resulting BOARDING POSITION associated with the QUAY – in this case not shown.

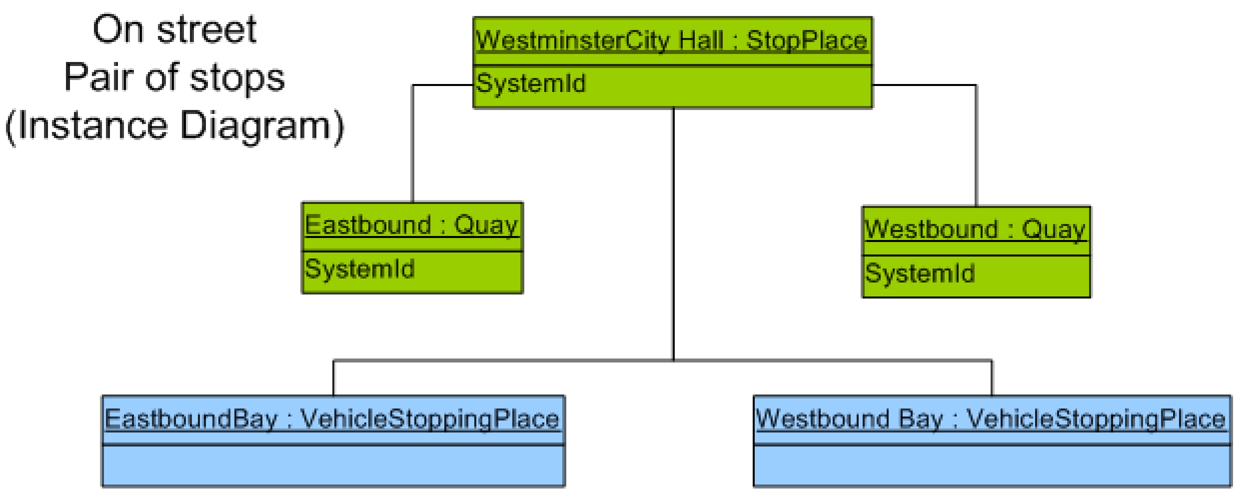


Figure 16 — UML Diagram of Instances for Pair of on Street Stops

6.1.3.2 A single stop on one side of the road.

Sometimes there is a bus stop only on one side of the road. This can be represented by a STOP PLACE instance with a single QUAY. There may optionally be a VEHICLE STOPPING PLACE element exactly indicating the stopping bay for the vehicle. Figure 17 shows a UML diagram of Object Instances for a simple stop pair with vehicle positioning elements as well.

Again the passenger would be primarily interested in the BOARDING POSITIONs corresponding to the VEHICLE STOPPING PLACEs

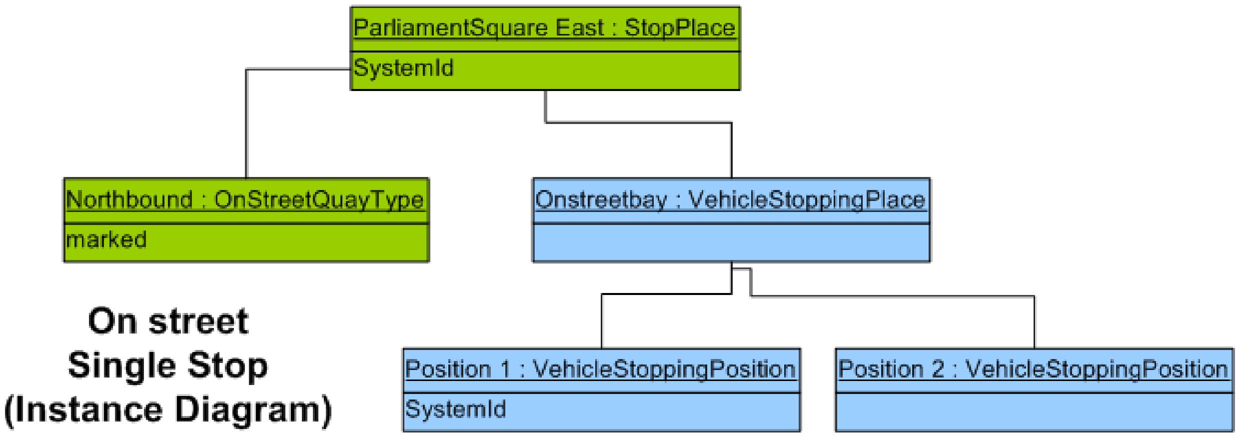


Figure 17 — UML Diagram of Instances for Single on Street Stop

6.1.3.3 A cluster of stops on a street or nearby streets with a common name.

There may be several bus stops grouped as a named stance or stop cluster. This can be represented by a STOP PLACE instance with multiple QUAYs. Figure 18 shows a UML instance diagram for a cluster of three stops s with vehicle bays as well.

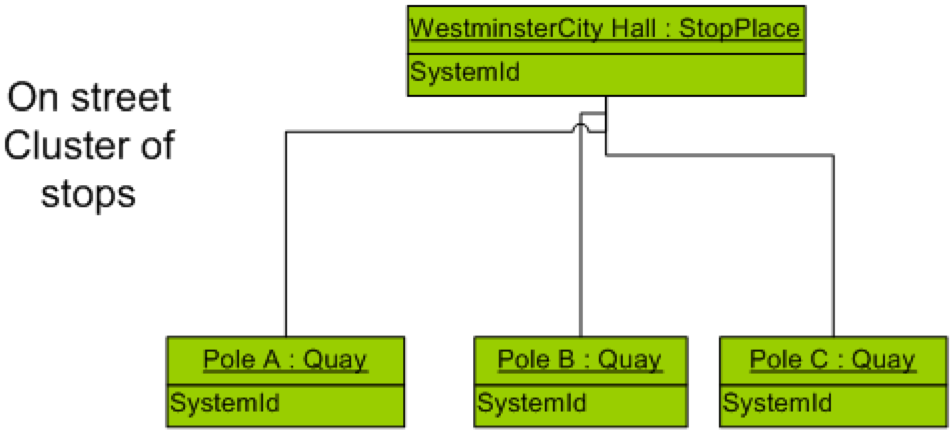


Figure 18 — UML Diagram of Instances for On-Street Stop Cluster

6.1.3.4 A section of street for which hail and ride services operate.

A section of street allowing hail and ride may be represented simply by a STOP PLACE instance with no QUAY. This indicates that the service is available in the PLACE associated with the STOP PLACE.

6.1.3.5 A designated zone in which demand responsive transport operates.

A zone of operation for demand responsive transport may be represented simply by a STOP PLACE instance with no QUAY. This indicates that the service is available in the PLACE associated with the STOP PLACE.

6.1.4 Modelling an Airport

An Airport is a complex type of STOP PLACE where passengers can interchange between an aircraft and other modes of transport. Figure 19 and Figure 20 show examples of the physical layout of an Airport. Again this can be considered to be made up of two distinct sets of elements: those modelling the PT vehicle and trackways; and those modelling the passenger areas.

The PT VEHICLE model comprises aircraft parking bays as VEHICLE STOPPING PLACEs and VEHICLE STOPPING POSITIONs within the bays. Movable elements include VEHICLEs, i.e. Aircraft which may also have ENTRANCEs TO VEHICLEs that are the aircraft boarding doors.

The Passenger area model for an airport typically has a complex set of ACCESS SPACEs representing the departure hall, immigration, baggage areas etc, and QUAYs representing the Boarding Gates.

A large aircraft such as a Jumbo Jet may have separate BOARDING POSITIONs representing the separate air-bridges connecting to its front or rear doors.

The ACCESS SPACEs and QUAYs are connected by STOP PATH LINKs which may be long and subject to complex ACCESSIBILITY LIMITATIONs.

The ticketing, check in, security, immigration, gate security and baggage reclaim ACCESS SPACEs may have associated CHECKPOINTs.

The IFOPT model provides a framework within which the essential details of an airport can be modelled consistently with those of other mode interchanges.

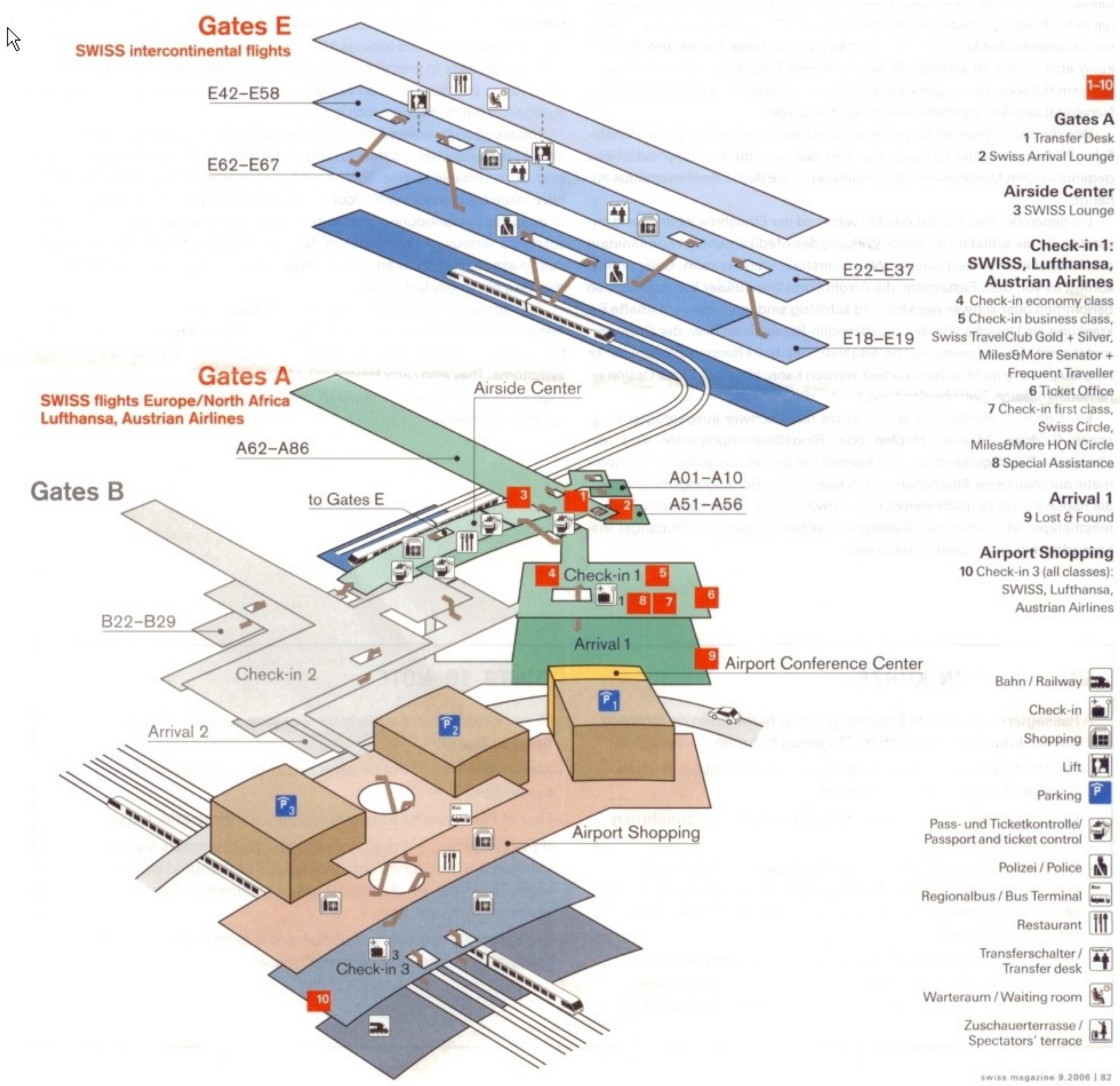


Figure 19 — Example of an Airport Interchange (Zurich - Courtesy of Swissair)

Figure 20 — Example of an Airport (Paris Charles de Gaulle – Courtesy of bonjourfrance)

6.1.5 Modelling a Sea or Ferry Harbour Terminal

A Ship or Ferry Harbour Terminal is another typically complex type of STOP PLACE where passengers can interchange between a boat and other modes of transport. A Harbour Terminal can be modelled by the same two distinct sets of elements: those modelling the PT vehicle and trackways; and those modelling the passenger areas.

6.1.6 Modelling a Taxi Rank

Taxi Ranks are very often part of a larger transport interchange. A Taxi Rank can be represented as a QUAY with a TRANSPORT MODE of ‘taxi’ within a STOP PLACE. A Taxi only STOP PLACE may be used for a Taxi Rank that is independent of any other mode. The Taxi Rank QUAY may optionally have a collection of vehicle stopping positions and a BOARDING POSITION representing the head of a queued rank.

6.2 UML Model for Stop Place

6.2.1 Introduction to the Stop Place Model

Figure 21 shows a UML class diagram introducing the main STOP PLACE entities concerned with passenger information for journey planning, as discussed above. This is elaborated in Figure 22, Figure 23 and subsequent figures.

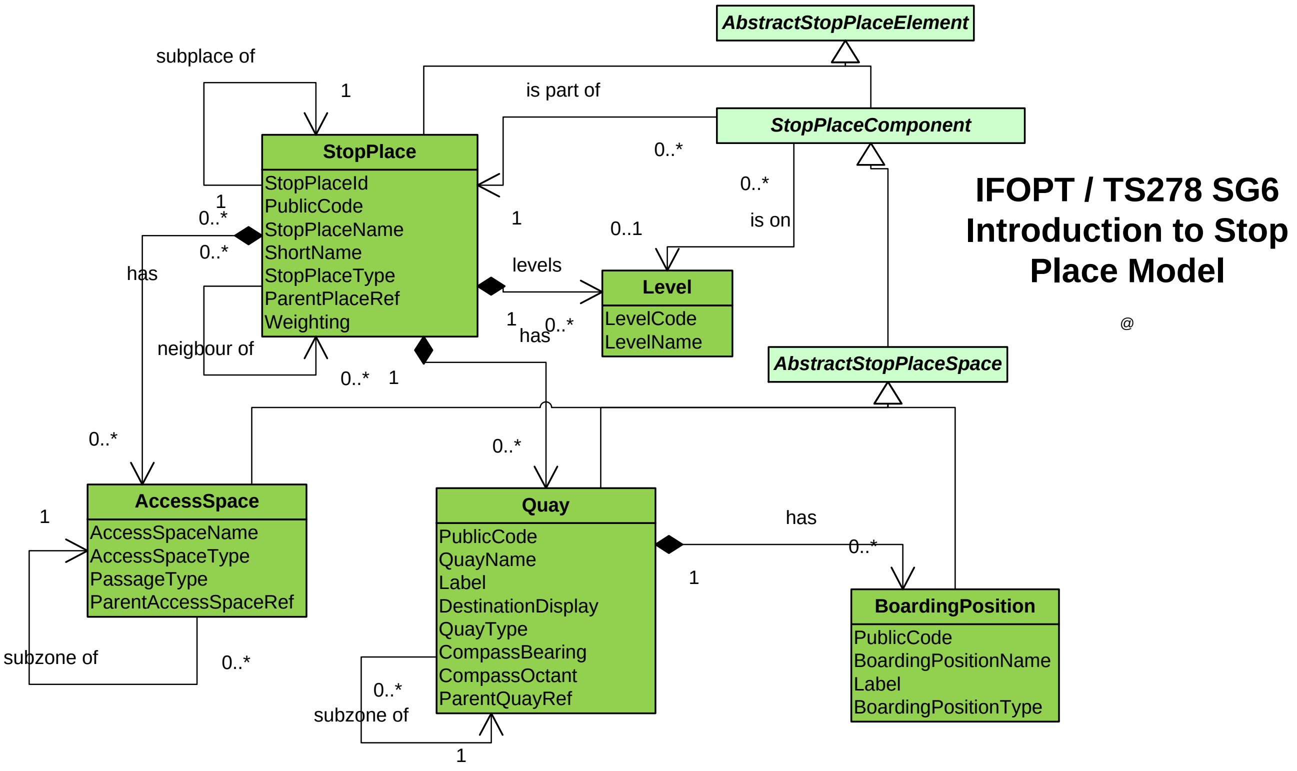


Figure 21 — Introductory Model to Stop Place

The fundamental elements of the basic model are as follows:

— A STOP PLACE contains QUAYs and ACCESS SPACEs, which are both types of ABSTRACT STOP PLACE SPACEs, connected by STOP PATH LINKs (see Figure 23).

— A QUAY is a point of access to transport, such as a platform. QUAY can contain BOARDING POSITIONs indicating a labelled point on a platform.

— A QUAY is recursive – it may be a subzone of another QUAY, as may an ACCESS SPACE be a subzone of another ACCESS SPACE. A subzone is physically contained within its parent. A QUAY is used to represent an on-street stop, paired with any matching QUAY using a STOP PLACE. A BEARING can be given for an on-street QUAY to indicate the direction of the street which it serves. This can be useful for distinguishing and labelling the stop.

— A LEVEL indicates a floor within a building. A STOP PLACE may contain many levels, and ACCESS SPACEs can be assigned to a level, as can the individual ends of STOP PATH LINKs.

— A STOP PLACE may be part of another STOP PLACE, and also be related to other STOP PLACEs by the *'is neighbour'* relationship which indicates the adjacent or nearby STOP PLACES. There may be zero, one or many neighbours.

Figure 22 elaborates Figure 21 to show enumerations that indicate the nature of the main STOP PLACE COMPONENTs. Note that for clarity in this and other introductory diagrams, some common super-types, such as DATA MANAGED OBJECT and other types are omitted – see Figure 26 for an expansion.

— A STOP PLACE ENTRANCE indicates a known point of access to a STOP PLACE or a STOP PLACE COMPONENT.

— Information about the impedances that may take place within a STOP PLACE such as ticketing, queues, bottlenecks, etc, may be associated with STOP PLACE COMPONENTs using a CHECKPOINT. See Figure 34 and Figure 47 for details.

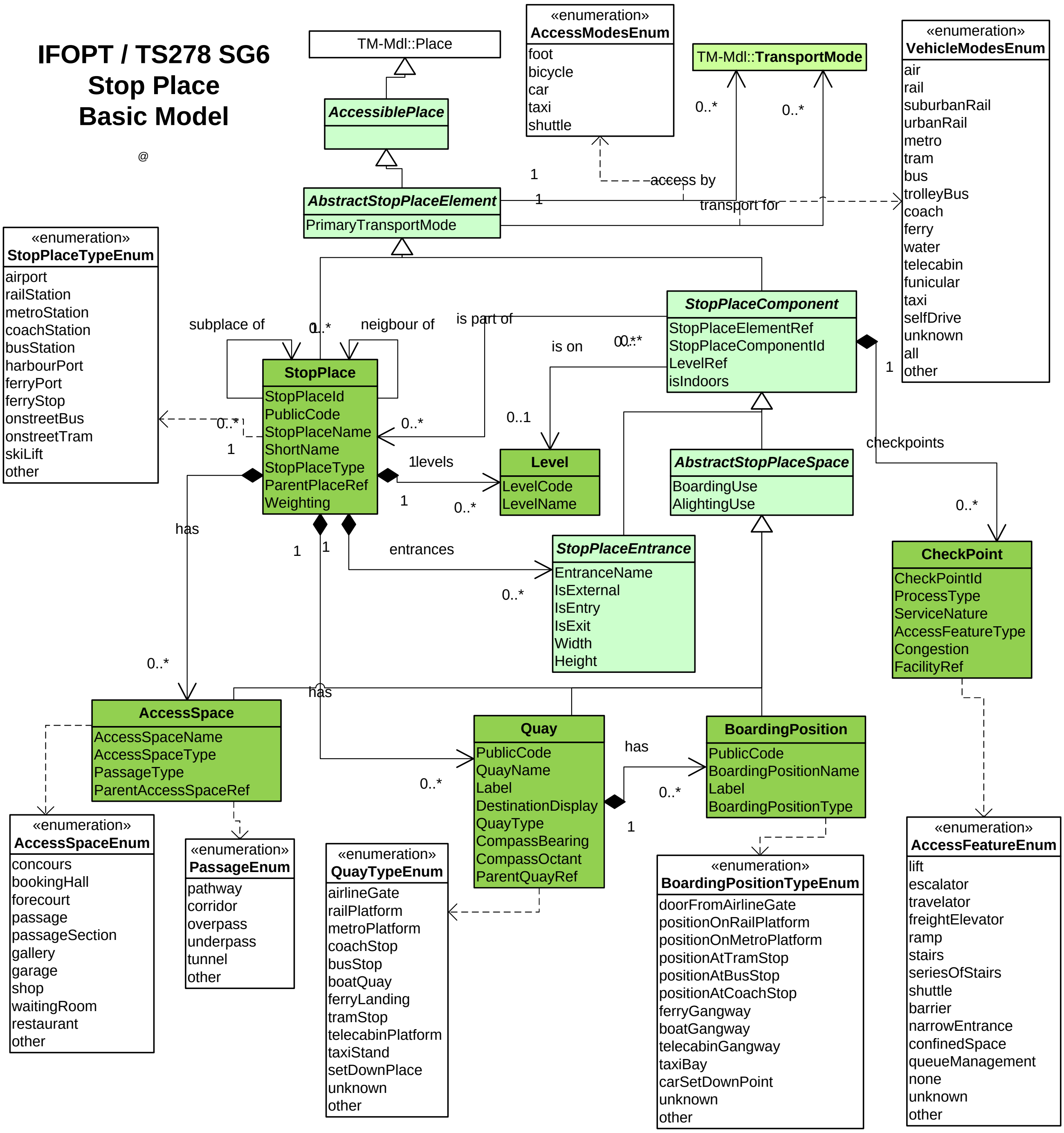


Figure 22 — Annotated Basic UML Model for Stop Place

IFOPT models the equivalent concepts for different modes of transport – station, airport, port, etc, or platform, berth, bus stop etc - with a single set of classes, thus a QUAY may be a rail platform, a bus stop etc. In most cases, the mode of a child element, e.g. a platform QUAY is inherited from the parent, e.g. a Rail station. Enumerated types can be used to indicate the specific nature for descriptive purposes. See Table 2 — Stop Place Component Types. IFOPT uses transport modes corresponding to the values of the TPEG PTI model – see 10.2.1.

Normally the type of a child element will be implicit in the type or transport mode of the parent, but for multimodal exchanges may be different.

Vehicle Mode	**StopPlaceType**	**QuayType**	**BoardingPositionType**
air	airport	airlineGate	doorFromAirlineGate
rail	railStation	railPlatform	positionOnRailPlatform
+urbanRail			
+suburbanRail			
+funicular			
metro	metroStation	metroPlatform	positionOnRailPlatform
coach	coachStation	coachStop	positionAtCoachStop
bus	busStation	busStop	positionAtBusStop
bus	onStreetBus	busStop	positionAtBusStop
+trolleyBus			
tram	onStreetTram	tramStop	
water	harbourPort	boatQuay	boatGangway
ferry	ferryPort	ferryLanding	ferryGangway
telecabin	skiLift	telecabinePlatform	telecabineGangway
other	other	other	other
AccessMode			
car		setDownPlace	setDownPoint
+selfDrive			
taxi		taxiStand	taxiBay

Table 2 — Stop Place Component Types

6.2.2 Paths within a Transport Interchange

A particular concern of IFOPT is to model the physical paths through the interchange that can be taken by passengers transferring between transport of the same or different modes. IFOPT follows the Transmodel POINT / LINK model; using PATH LINKs to connect nodes of different types.

— In IFOPT, the nodes *within* a STOP PLACE, that is ACCESS SPACEs and QUAYs are connected by STOP PATH LINKs, a type of STOP PLACE COMPONENT.

— Connections *external* to the interchange are represented by ACCESS PATH LINKs, which connect a ACCESSIBLE PLACE, typically a PLACE having a designated entrance or entrances such as a POINT OF INTEREST, STOP PLACE, ADDRESS or PARKING.

Figure 23 shows the basic path model.

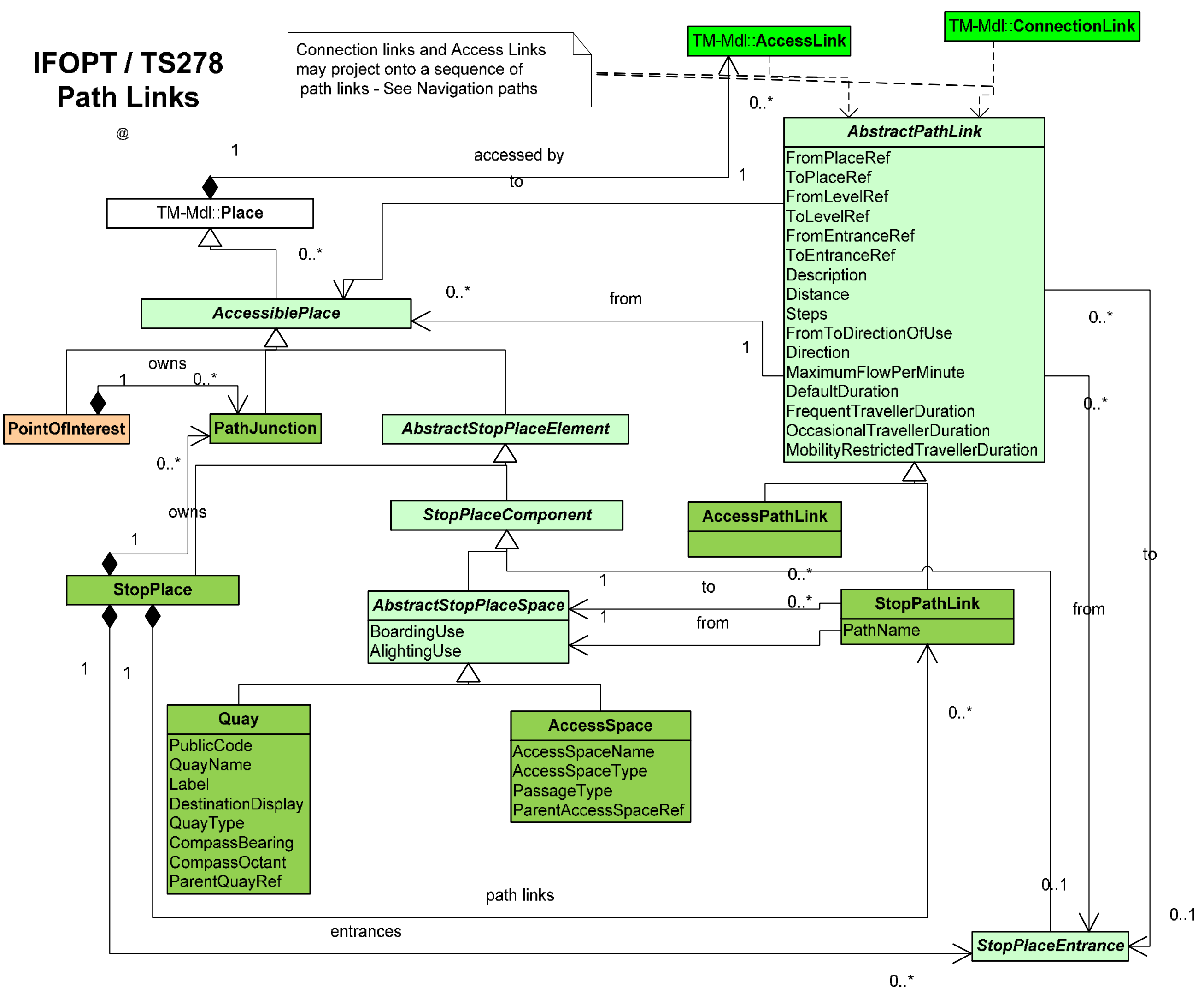


Figure 23 — UML Diagram of basic Path Links

Each individual STOP PATH LINK must connect two STOP PLACE SPACEs. Each end of a PATH LINK may also reference an ENTRANCE to indicate where the link connects. The STOP PATH LINK is thus designed so that it can be fully populated with data about ENTRANCEs if available, but can still be used in a partially populated form.

NOTE PATH LINKs are distinct concepts from Transmodel CONNECTION LINKs or Transmodel ACCESS LINKs and represent a different information layer. CONNECTION LINKs represent the possibility of interchange between two SCHEDULED STOP POINTS used by different journeys, without necessarily a precise indication of place. In contrast, STOP PATH LINKs and ACCESS PATH LINKs represent the possibility of navigation between specific located nodes of a STOP PLACE.

A SEQUENCE of ACCESS PATH LINKs can be projected onto a Transmodel ACCESS LINK - see NAVIGATION PATH in 6.3.

STOP PATH LINKs must be internal to a STOP PLACE. ACCESS PATH LINKs must be external and must connect to an external ENTRANCE of a STOP PLACE (an ACCESS SPACE ENTRANCE, or if the QUAY opens directly onto the street, a QUAY ENTRANCE).

This is illustrated in Figure 24 which shows; (i) two STOP PLACEs connected by an ACCESS PATH LINK and; (ii) a POINT of INTEREST connected by an ACCESS LINK. In both cases the link can be projected onto a more specific path comprising a sequence of path links.

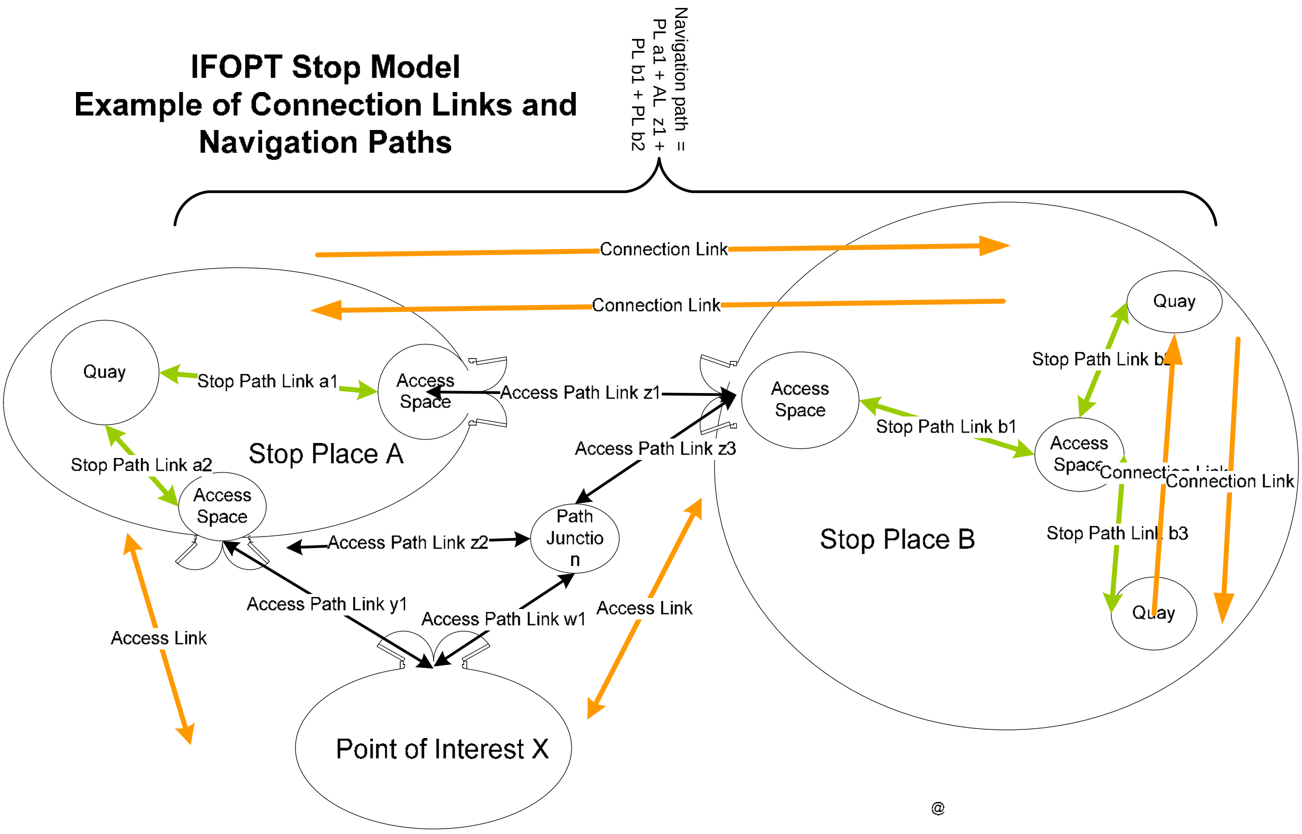


Figure 24 — Example of Connection Link, Path Link, Access Path Link and Access Link

Figure 25 shows the same example as Figure 24, but with two different Navigation paths marked as a sequence of path links. The Navigation Paths follow different sequences of links but share one path link in common.

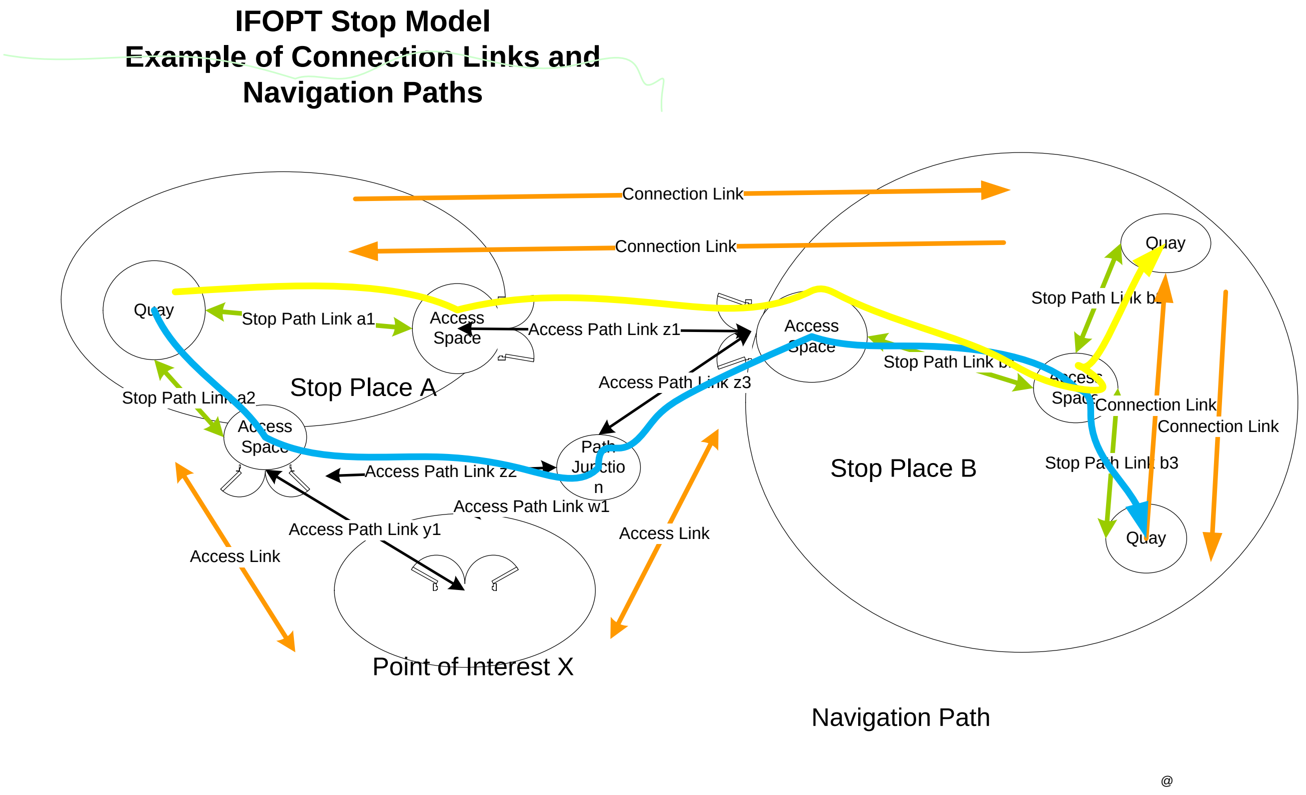


Figure 25 — Example with Navigation Paths

6.2.3 Basic Stop Place Model

Figure 26 shows a UML class diagram that elaborates slightly the main STOP PLACE entities.

The elements share common properties:

— ACCESS SPACE, QUAY, BOARDING POSITION, STOP PLACE ENTRANCE and STOP PATH LINK are all STOP PLACE COMPONENTs associated by an abstract IS PART OF relationship, as well as more specific concrete containment associations from their parent, such as: STOP PLACE *has* QUAY; QUAY *has* BOARDING POSITION; STOP PLACE *has* ACCESS SPACE, etc.

— A STOP PLACE and STOP PLACE COMPONENTs are all types of ABSTRACT STOP PLACE ELEMENTS.

— All ABSTRACT STOP PLACE ELEMENTS are Transmodel PLACEs, allowing them to be projected in space and furthermore are PLACES WITH DESIGNATED ENTRANCES, allowing them to have ADDRESSes. Address elements may be of use in explaining the location of the stop, as may the BEARING, which for on-street stops, indicates the direction of the street at which the vehicle passes the stop point, e.g. "North", See discussion of Geo-spatial projection below.

— All ABSTRACT STOP PLACE ELEMENTS are DATA MANAGED OBJECTs. See IFOPT Administrative Model.

— ABSTRACT STOP PLACE ELEMENTS can be associated with a TRANSPORT MODE in two different ways. The '*transport for*' relationship indicates the mode or modes of Public Transport (Rail, Coach, air etc) of the element. The '*access by*' relationship indicates the mode or modes of transport that may be used within the element, for example foot, cycle, etc. For most components, by default this will be pedestrian access, but other modes may be designated. It would be possible to have a completely nonpedestrian access STOP PLACE, for example a drive-on ferry. A PLACE may also be associated with a postal ADDRESS.

— ABSTRACT STOP PLACE ELEMENTS may also have multiple alternative names.

— STOP PLACE ENTRANCEs designate specific points of access to the STOP PLACE. There are concrete subtypes QUAY ENTRANCE, etc shown in later diagrams.

— ABSTRACT PATH LINK provides common properties of a PATH LINK, such as to which ENTRANCE and to which LEVEL the PATH LINK connects. It is itself a specialisation of a STOP PLACE COMPONENT and may be assigned a primary LEVEL even if it connects to others.

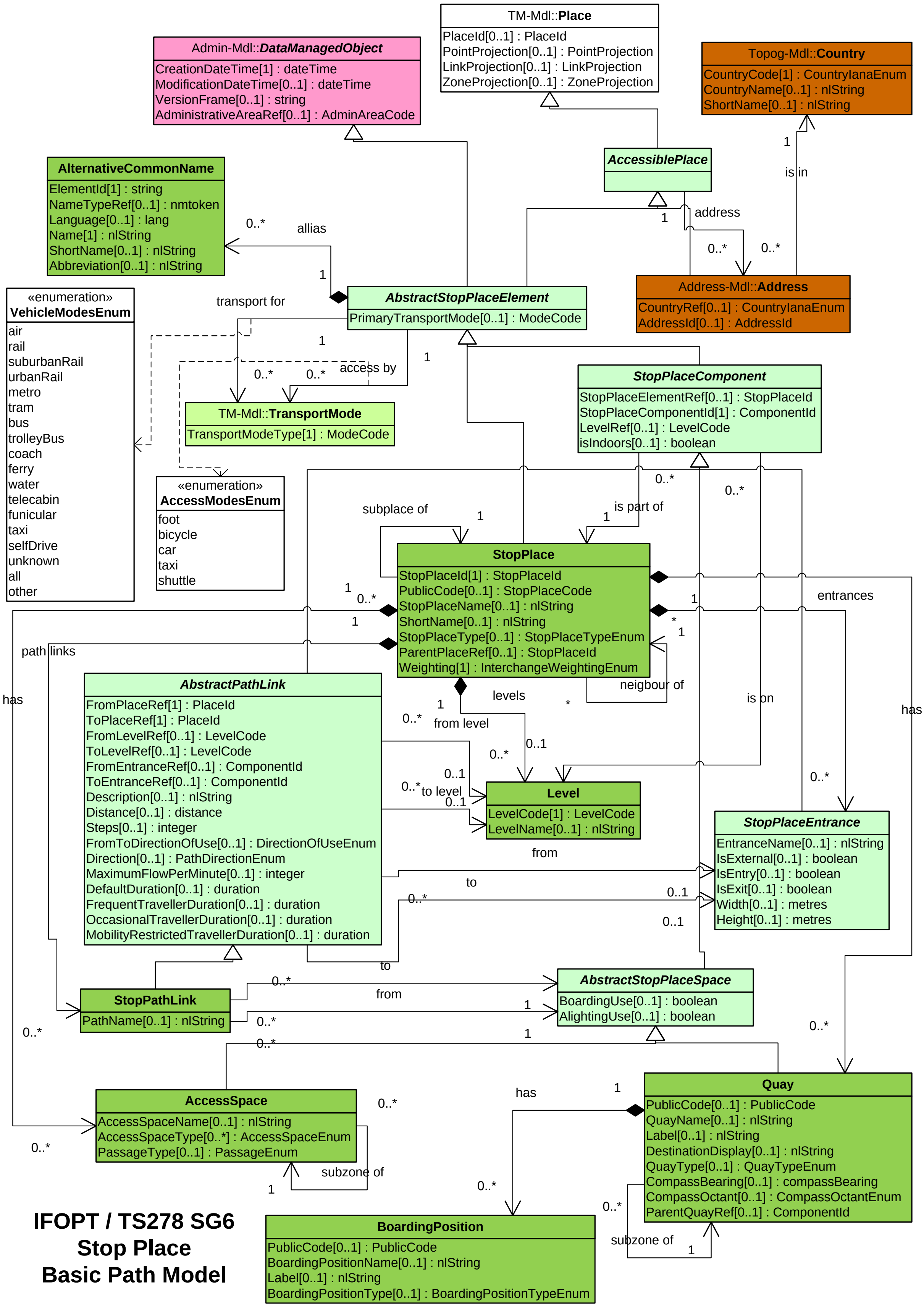


Figure 26 — UML Diagram for Stop Place Essential Model

6.2.3.1 Geospatial Projection & LOCATION

A Stop Place Model is a logical representation of the known topology of a station or interchange, that is, of its nodes and their physical connections. It should be possible to project each of the elements (points, zones and links) onto a three dimensional GIS model to provide a mapping representation, and to interface with general purpose GIS routing functionality, for example to compute external access links for which path data is not available in a given model.

The Transmodel concept of PLACE implies a geospatial projection. Stop Place Model components that have a geospatial projection conform to type PLACE, as shown in 10.1, Figure 67. PLACES may have a 0, 1, 2 or 3 dimensional projection.

Any implementation of IFOPT must represent the data sufficiently to associate specific geospatial shapes with specific model elements. IFOPT allows for standard GIS references to be used and the actual specific coordinate reference system or systems (e.g. WGS 84) can be metadata accompanying the data. The IFOPT model indicates the proposed geospatial projections that are needed for different object types as POINT, ZONE, or LINK projections. For example, a PATH LINK has a Link Projection to describe its points, a QUAY has a ZONE PROJECTION to indicate its area. An element may have a POINT PROJECTION, a LINK PROJECTION and a ZONE PROJECTION for use in different circumstances.

Depending on usage, both a ZONE PROJECTION and a POINT PROJECTION can be useful. The ZONE PROJECTION defines boundaries of a PLACE; the POINT PROJECTION can be used to indicate a preferred single point.

A second form of projection is with an ADDRESS. This is shown as a relationship to an Address entity. See Section 10 for discussion of the ADDRESS entity.

It is the role of IFOPT to act as the transition layer between a purely geographical representation of features such as roads, halls, corridors, etc, and a PT model of timetabled services, STOP POINTs, etc. For example, STOP PATH LINKs provide a means of relating the pathways that can be taken through a physical building to follow a CONNECTION LINK – the logical possibility of transferring between two STOP POINTs, this pathway may have a GIS projection. This is discussed further in 10.1.

Another purpose of the IFOPT Stop Place Model is to provide a precise means for a SITUATION model such as TPEG to reference any part of a transport interchange unambiguously.

6.2.3.2 Use of Abstract classes in IFOPT

The STOP PLACE and other IFOPT models contain a number of generic classes aimed at facilitating the modelling. For example, ABSTRACT STOP PLACE SPACE represents a super-type of QUAY, BOARDING POSITION and ACCESS SPACE. These classes are design artefacts used to avoid repetition of common properties. They make designs easier to understand and to implement. Properties of abstract classes are inherited by all their subtypes. In the UML diagrams, abstract classes are shown with names in italics and the inheritance arrow (Open white triangle) is used to indicate a subtyping relationship.

6.2.3.3 Populating Stop Place models

In the real world, the exact boundaries of a STOP PLACE may be indistinct or hard to decide in some situations, especially for large Transport Interchanges comprising a number of related Rail and Metro Stations. It may be possible to choose between several alternative ways of populating a model; either as a single large STOP PLACE, a hierarchy of many smaller STOP PLACEs, or an intermediate mix. For example, a station may have separate main line and local areas, or be treated as two distinct stations. Judgement needs to be applied to choose the scope of a STOP PLACE. The following are some useful criteria:

— **Transport Mod**e: Generally a STOP PLACE will have a single primary TRANSPORT MODE, e.g. rail, air, etc.

— **Physical Distinctness:** generally different STOP PLACEs are physically distinct with distinct external entrances. Only when it a single facility is partitioned into zones will a question arise. It must be possible to go between any of the zones of a STOP PLACE within a reasonably short time by the access mode (usually foot) for the transfer.

— **Name:** Generally a separate Stop Place will have a well-defined name for advising passengers. For example *Waterloo*, *Waterloo East and Waterloo International*.

— **Tariff Zones:** In some cases naming of areas of a station reflects the TARIFF ZONE structure and ticketing restrictions as well.

6.2.4 Stop Place Assignment Model

A primary objective of the Stop Place Model is to allow the logical stopping points of a VEHICLE JOURNEY to be related to the physical points of access such as stations or platforms. Figure 27 extends Figure 26 and shows the relationship of the STOP PLACE components to the timetabled stop, that is, scheduled STOP POINTs representing timetabled breaks in a VEHICLE JOURNEY. (Note that for brevity some super-types, such as STOP PLACE COMPONENT, PLACE and DATA MANAGED OBJECT are omitted from this diagram – see Figure 32 — UML Diagram for Stop Place Model Components.)

The main components of the STOP PLACE (QUAY, ACCESS SPACE, BOARDING POSITION, STOP PATH LINK) are related to the main elements of a timetable (SCHEDULED STOP POINT, CONNECTION LINK) via ASSIGNMENT elements. ASSIGNMENTs may be made at different levels (STOP AREA, STOP POINT, BOARDING POSITION), or dynamically using the DYNAMIC ASSIGNMENT. See further discussion below.

The Passenger stop place assignment model can be regarded as a specialised form of STOP PLACE VIEW that asserts some specific strong constraints on the meaning of the relationships between elements.

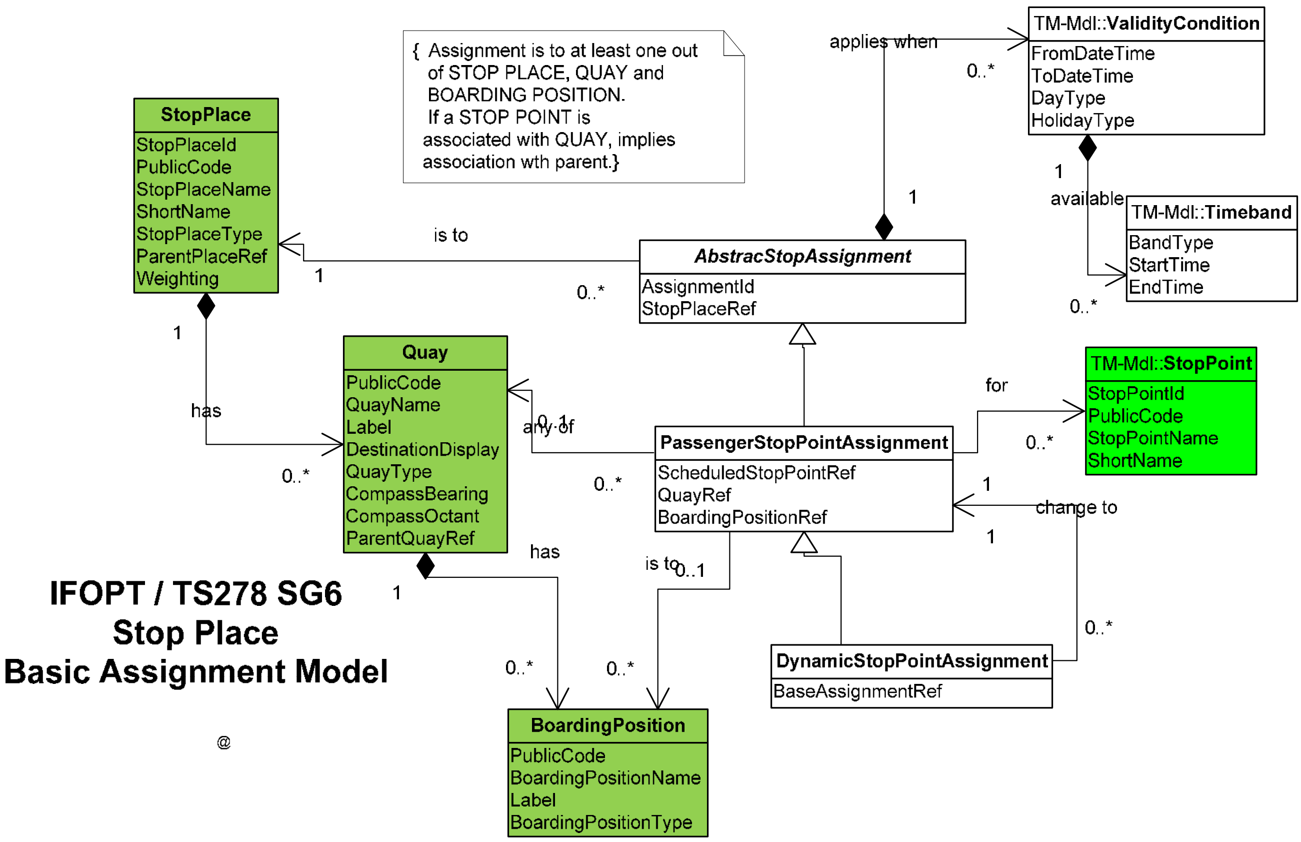


Figure 27 — UML Diagram for Basic Stop Place Assignment Model

Figure 28 elaborates the basic assignment model shown in Figure 27 to also include CONNECTION LINKs, TRAIN BLOCK PARTs, TRAIN ELEMENTs, and other details.

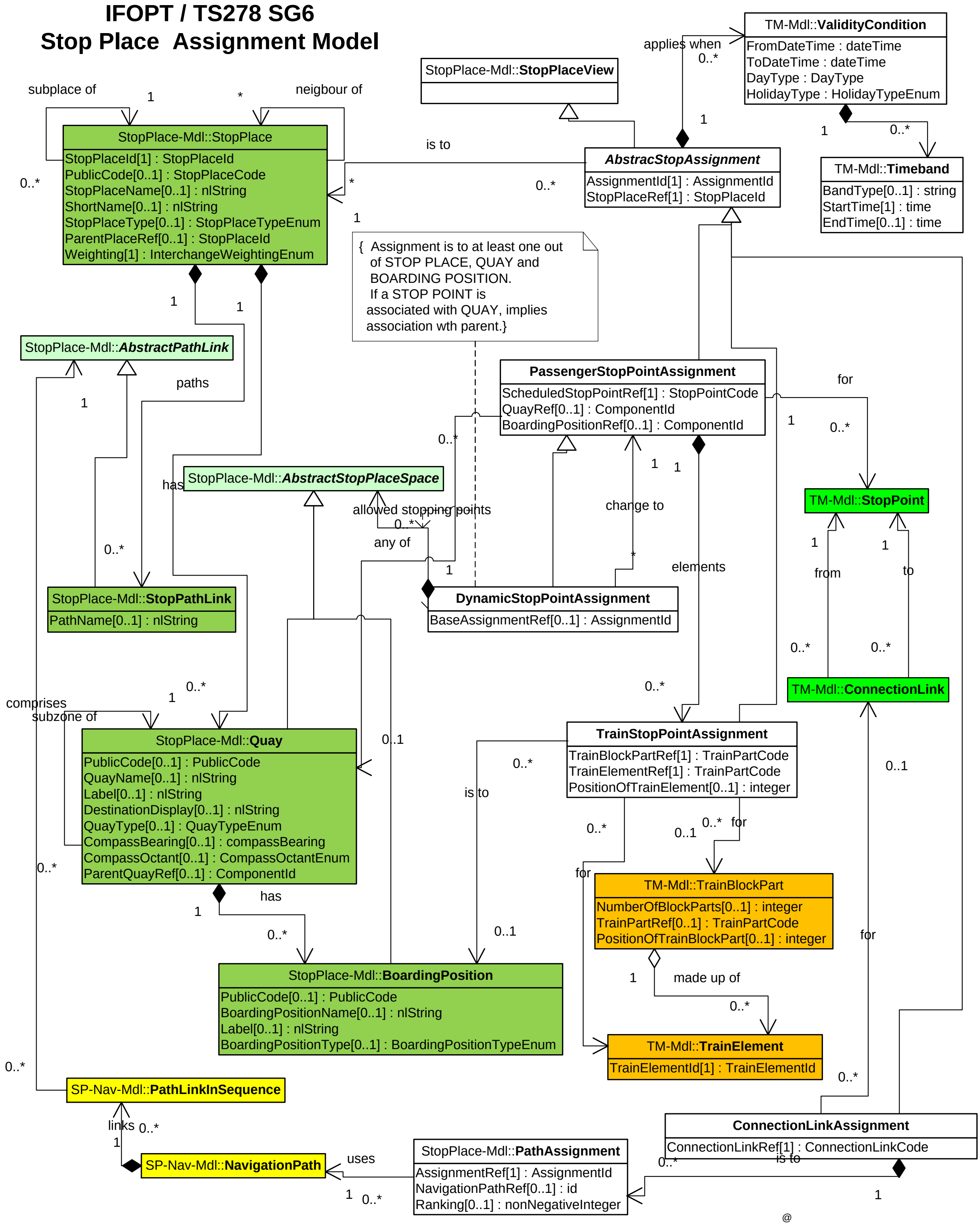


Figure 28 — UML Diagram for Stop Place Assignment Model

6.2.4.1 Assigning Scheduled Stop Points to the Stop Place Components

The Stop Place Model includes assignment entities to relate the Stop Place Model components with the scheduled timetable entities that identify a stopping point in a journey, that is, PASSENGER STOP POINT ASSIGNMENTs and CONNECTION LINK ASSIGNMENTs.

- Using a PASSENGER STOP POINT ASSIGNMENT, a SCHEDULED STOP POINT may be associated with a specific BOARDING POSITION, a specific QUAY, or just with the whole STOP PLACE. *Any association with a more specific entity also indicates association with the containing entity.*

  A general principle of **"Subsidiarity**" is upheld which asserts that association with a lower level component of a STOP PLACE (e.g. BOARDING POSITION) automatically implies association with the higher level component that is the parent of the lower level component (e.g. QUAY, STOP PLACE) that physically encompasses it. Thus, for example, an assignment to QUAY "*Waterloo Platform 9"* implies association to STOP PLACE "*Waterloo*" (but not vice versa). This principle allows the different levels to be used interchangeably as appropriate in presenting information.

- A SCHEDULED STOP POINT may **not** be directly associated with other STOP PLACE COMPONENTs that are not physical points of access to public transport e.g. an ENTRANCE or ACCESS SPACE. For example a Train may arrive only at a QUAY and/or BOARDING POSITION, not in an ACCESS SPACE

- In order for a journey planner to determine a NAVIGATION PATH through a STOP PLACE, a PASSENGER STOP POINT ASSIGNMENT **must** be associated with either a QUAY or a BOARDING POSITION. If the assignment is only to the STOP PLACE, then an exact path cannot be determined.

- A CONNECTION LINK may be associated with one or more specific NAVIGATION PATHs using a CONNECTION LINK ASSIGNMENT, which indicates that the interchange between journeys going to the SCHEDULED STOP POINTs of the CONNECTION LINK can or should be made using any of the NAVIGATION PATHs nominated by one or more PATH ASSIGNMENTs. Each NAVIGATION PATH comprises an ordered traversal of a set of STOP PATH LINKs or ACCESS PATH LINKs as specified by collection of PATH LINKs IN SEQUENCE. Detailed information about the equipment, accessibility and timings can be derived from the underlying STOP PLACE COMPONENTs and their properties. PATH ASSIGNMENTs may be ranked in order of preference.

- Alternatively a CONNECTION LINK may also be assigned to just a STOP PLACE or QUAY or BOARDING POSITION, to indicating the area within which it provides average connection times.

- A VALIDITY CONDITION may be associated with a stop assignment (inherited from ABSTRACT STOP ASSIGNMENT). There may be multiple assignments for the same STOP POINT to different QUAYs or BOARDING POSITIONs at different times.

6.2.4.2 Implicit Assignment of Stops

It should be noted that in many existing information systems, passenger (and vehicle) stop assignment is *implicit*: the same identifier is used for the SCHEDULED STOP POINT in the VEHICLE JOURNEY and for the concrete subtype of ABSTRACT STOP PLACE ELEMENT at which the VEHICLE JOURNEY stops (that is STOP PLACE, QUAY or BOARDING POSITION), and this correspondence is used to imply an assignment.

6.2.4.3 Change of Stopping Point Assignments

Even if there is normally in advance a fixed assignment of a SCHEDULED STOP POINT to an exact QUAY or BOARDING POSITION this may sometimes change at run time. This can be reflected in a modified PASSENGER STOP POINT ASSIGNMENT. Normally STOP ASSIGNMENTs will reflect a change of platform CONTROL ACTION made in an operational system.

6.2.4.4 Dynamic Assignment of Stops

In operational and AVMS systems that wish to support a dynamic allocation of services arriving at a stop place to the next available bay or platform, the assignment of the SCHEDULED STOP POINT to an exact QUAY or BOARDING POSITION is not fixed in advanced, but done in real-time. A DYNAMIC STOP POINT ASSIGNMENT is used to represent this, which may indicate also a prior set of STOP POINTs from which the real-time allocation may be made.

6.2.4.5 Assignment of Train Elements

The allocation of single element VEHICLEs such as buses to QUAYs can be handled with a single assignment element. Some TRAINs, however, are composite and different sections of the train may undertake multiple COUPLED JOURNEYs at the same time. In order to be in the right carriage it may be important that passengers board a particular part of the train from a particular BOARDING POSITION. Boarding is also more efficient if passengers are pre-positioned in the right part of the platform, especially if seats are pre-assigned. This potentially requires multiple assignments.

A composite train is represented in Transmodel as a TRAIN BLOCK, comprising a series of TRAIN BLOCK PARTS. Both TRAINs and TRAIN BLOCK PARTs comprise multiple TRAIN ELEMENTs. It is possible to assign specific TRAIN ELEMENTs and TRAIN BLOCK PARTs to specific QUAYs and BOARDING POSITIONs using a TRAIN STOP POINT ASSIGNMENT.

6.2.5 Vehicle Stopping Places & Assignment

The Stop Place Model also includes elements designating the fixed objects relevant for vehicles, including stopping points and equipment elements. Figure 29 introduces a view of the vehicle related elements of the Stop Place model.

NOTE For brevity some super-types, such as STOP PLACE COMPONENT, PLACE and DATA MANAGED OBJECT are omitted from this diagram – see Figure 32.

— A STOP PLACE can contain VEHICLE STOPPING PLACEs each of which may have one or more VEHICLE STOPPING POSITIONs.

— A VEHICLE STOPPING PLACE will serve a QUAY, or sometimes two QUAYs either side. The association can be explicitly represented by a VEHICLE QUAY ALIGNMENT.

— A VEHICLE POSITION will cause a VEHICLE to align with BOARDING POSITION or positions; this can be explicitly represented by a VEHICLE POSITION ALIGNMENT.

This model allows the expression of the stopping points that need to be observed by the driver in order to align the VEHICLE with a particular QUAY(s) and specific BOARDING POSITION(s).

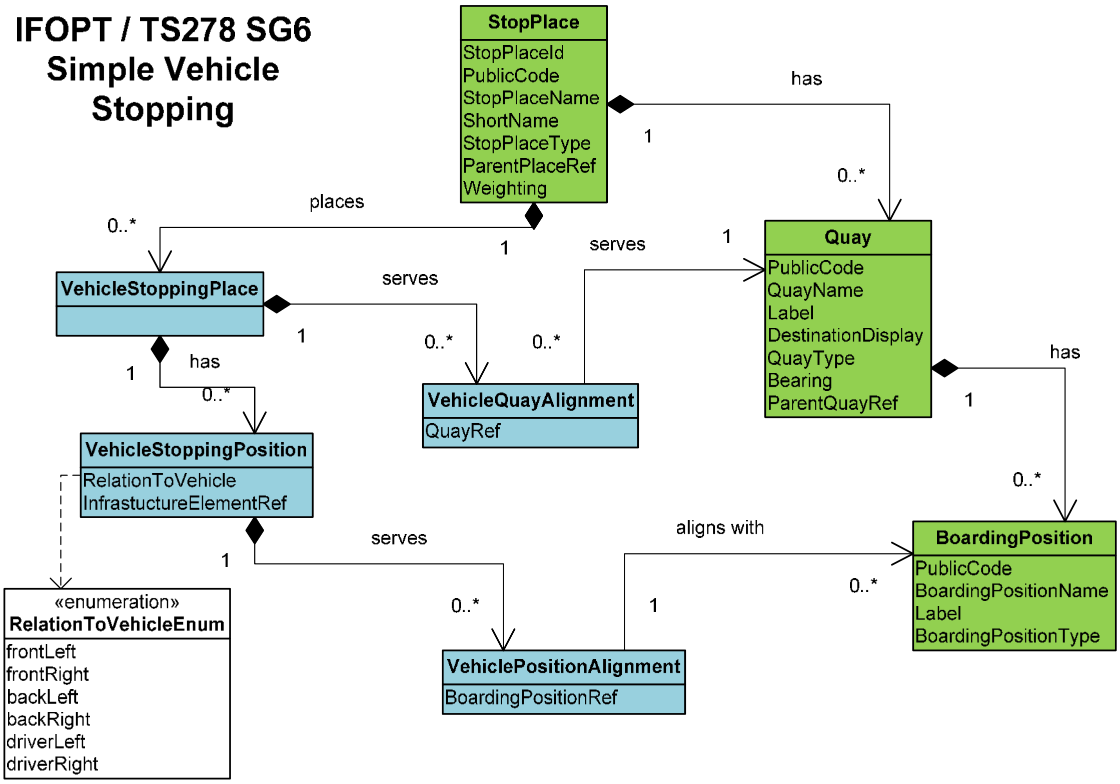


Figure 29 — UML Diagram of Vehicle Stopping Positions

Figure 30 elaborates the UML diagram of the vehicle related elements of the Stop Place model.

— The STOP PLACE may have designated ENTRANCEs FOR VEHICLES indicating the points by which VEHICLEs enter the STOP PLACE.

— Vehicles may have ENTRANCEs TO VEHICLEs which can be aligned to specific BOARDING POSITIONs: for Trains this may involve multiple correspondences: see discussion of Vehicle Assignment below.

— VEHICLEs can contain VEHICLE EQUIPMENT.

— VEHICLE STOPPING POSITIONs will be located on the PT network and can be associated with elements from other models which describe this INFRASTUCTURE. For rail, VEHICLE STOPPING POSITIONs will lie on a RAILWAY ELEMENT. For buses VEHICLE STOPPING POSITIONs will lie on a ROAD ELEMENT.

— The allowed path of the vehicle through the STOP PLACE is described by INFRASTRUCTURE LINKs and INFRASTRUCTURE POINTs. These are part of Transmodel rather than the Stop Place model. For Rail the vehicle track is described by RAILWAY ELEMENTs and RAILWAY JUNCTIONs. For bus the vehicle track is described by ROAD ELEMENTs and ROAD JUNCTIONs.

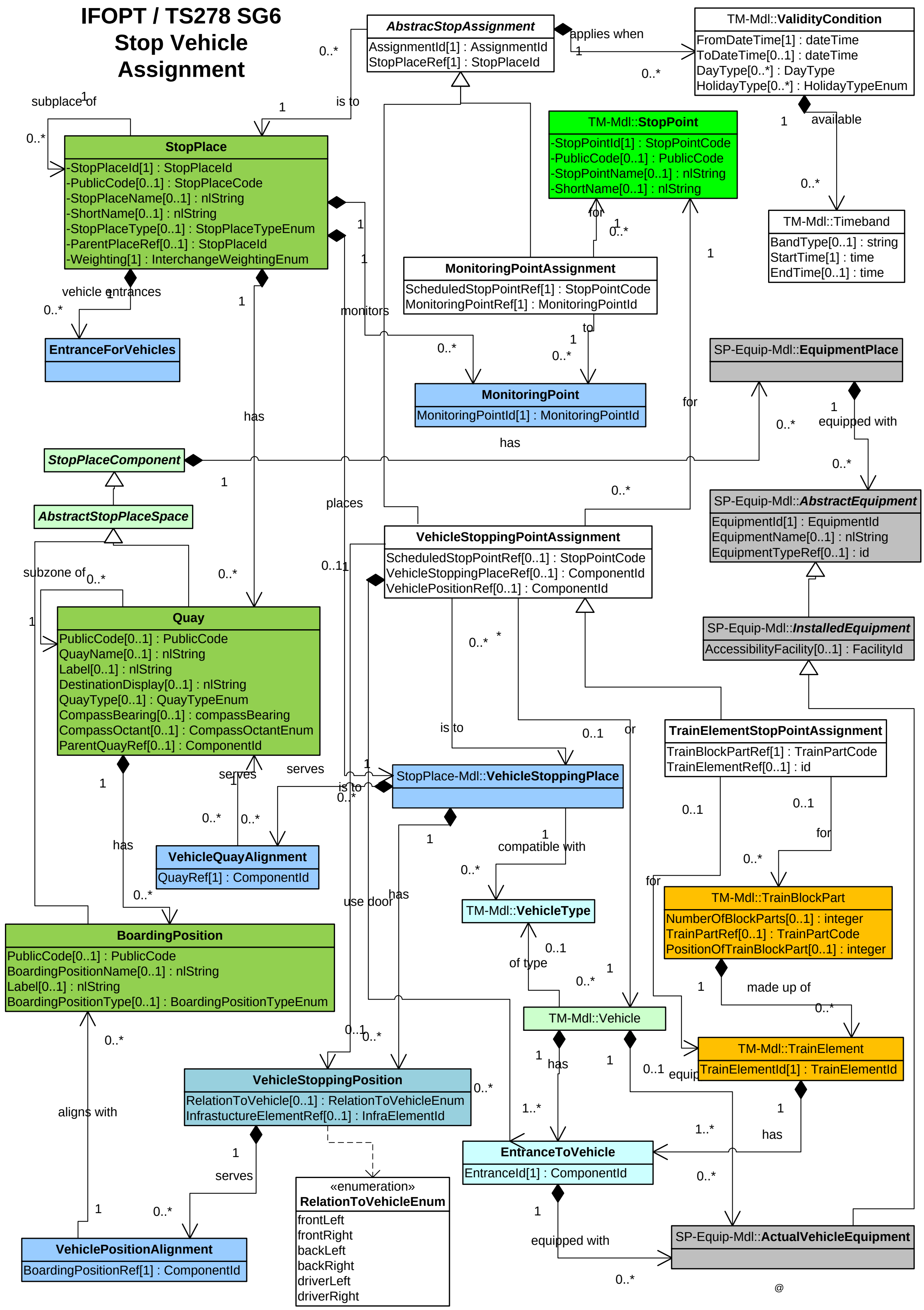


Figure 30 — Vehicle Stopping Positions and Assignment

6.2.6 Vehicle Assignment

Vehicles undertaking a VEHICLE JOURNEY and arriving at a SCHEDULED STOP POINT may be assigned to a physical position to stop within the trackway infrastructure of the STOP PLACE.

— A VEHICLE STOPPING POINT ASSIGNMENT is used to associate a SCHEDULED STOP POINT with a specific VEHICLE STOPPING PLACE and VEHICLE STOPPING POSITION. Association with a STOPPING POSITION automatically implies association with the STOP PLACE that physically encompasses it.

— A VALIDITY CONDITION may be associated with a VEHICLE STOPPING POINT ASSIGNMENT, and there may be multiple assignments for the same STOP POINT to different VEHICLE STOPPING PLACEs and VEHICLE STOPPING POSITIONs at different times.

— It is possible to assign specific TRAIN ELEMENTs and TRAIN BLOCK PARTs to specific stopping positions on the track using a TRAIN ELEMENT STOP POINT ASSIGNMENT.

— A MONITORING POINT ASSIGNMENT is used to associate a MONITORING POINT with a specific STOP POINT.

6.2.7 Assignment Coordination

The same CONTROL ACTION may give rise to a PASSENGER STOP POINT ASSIGNMENT, a VEHICLE STOPPING POINT ASSIGNMENT and multiple assignments of TRAIN ELEMENTs.

6.2.8 Vehicle Monitoring Points

AVL systems may have designated MONITORING POINTs associated with VEHICLE STOPPING POSITIONs, ENTRANCEs FOR VEHICLES or other points relative to the STOP PLACE. These are used to monitor the real-time progress of the vehicle. Such points constitute a layer independent of the Stop Place Model, but may of course reference STOP PLACE COMPONENTs as appropriate.

— The designated stop MONITORING POINTs used by AVL systems to monitor progress of vehicles will usually correspond to a STOP PLACE or a designated VEHICLE STOPPING PLACE within a STOP PLACE. Often they will be given the identifier of the STOP PLACE or an associated QUAY.

6.2.9 Stop Place Components

Figure 32 shows additional detailed elements of the Stop Place Model.

The structural components of a STOP PLACE are of three main types: *spaces*, *entrances*, and *paths*, reflected in the type hierarchy by ABSTRACT STOP PLACE SPACE, ABSTRACT STOP PLACE ENTRANCE and ABSTRACT PATH LINK entities, all of which share certain common properties as STOP PLACE COMPONENTs.

Common properties of a STOP PLACE COMPONENT include.

— Associations with LEVELs, CHECKPOINTs, EQUIPMENT PLACEs.

— Elements to project the component as a 0,1,2 or three dimensional shape onto geospatial coordinates, inherited from the PLACE type.

— The ability to be linked by path – and so usually have a designated entrance, inherited from the abstract ACCESSI PLACE element.

— A validity condition describing the availability of the component.

— Association with references to one or more default TARIFF ZONEs.

STOP PLACE and STOP PLACE COMPONENT are both types of ABSTRACT STOP PLACE ELEMENT.

Common properties of an ABSTRACT STOP PLACE ELEMENT inherited from the DATA MANAGED OBJECT abstract type include:

— Data management attributes, including ADMINISTRATIVE AREA, VERSION etc.

— Associations with INFO LINKs, providing URLs for arbitrary on-line resources.

— Associations with TRANSPORT MODEs, and ACCESSIBILITY LIMITATIONs that specify ACCESSIBILITY properties of the QUAY, BOARDING POSITION, ACCESS SPACE, PATH LINK etc, such as whether the element is wheelchair accessible.

Only components of type ABSTRACT STOP PLACE SPACE may be linked with a STOP PATH LINK, and the usage should reflect the real world physical structure of the STOP PLACE COMPONENTs that are to be linked.

6.2.9.1 Type Hierarchy of Stop Place Components

The Stop Place Model element type *inheritance* hierarchy can be summarised textually as follows:

DATA MANAGED OBJECT

- ACCESSI PLACE
  - ABSTRACT STOP PLACE ELEMENT
    - STOP PLACE
    - STOP PLACE COMPONENT
      - ABSTRACT STOP PLACE SPACE
        - QUAY
        - ACCESS SPACE
        - BOARDING POSITION
      - ABSTRACT STOP PLACE ENTRANCE
        - QUAY ENTRANCE
        - ACCESS SPACE ENTRANCE
        - BOARDING POSITION ENTRANCE
        - ENTRANCE FOR VEHICLES
      - EQUIPMENT PLACE
      - VEHICLE STOPPING PLACE
      - VEHICLE STOPPING POSITION
      - [PATH LINK]
        - STOP PATH LINK

Figure 31 – Type Hierarchy for Stop Place

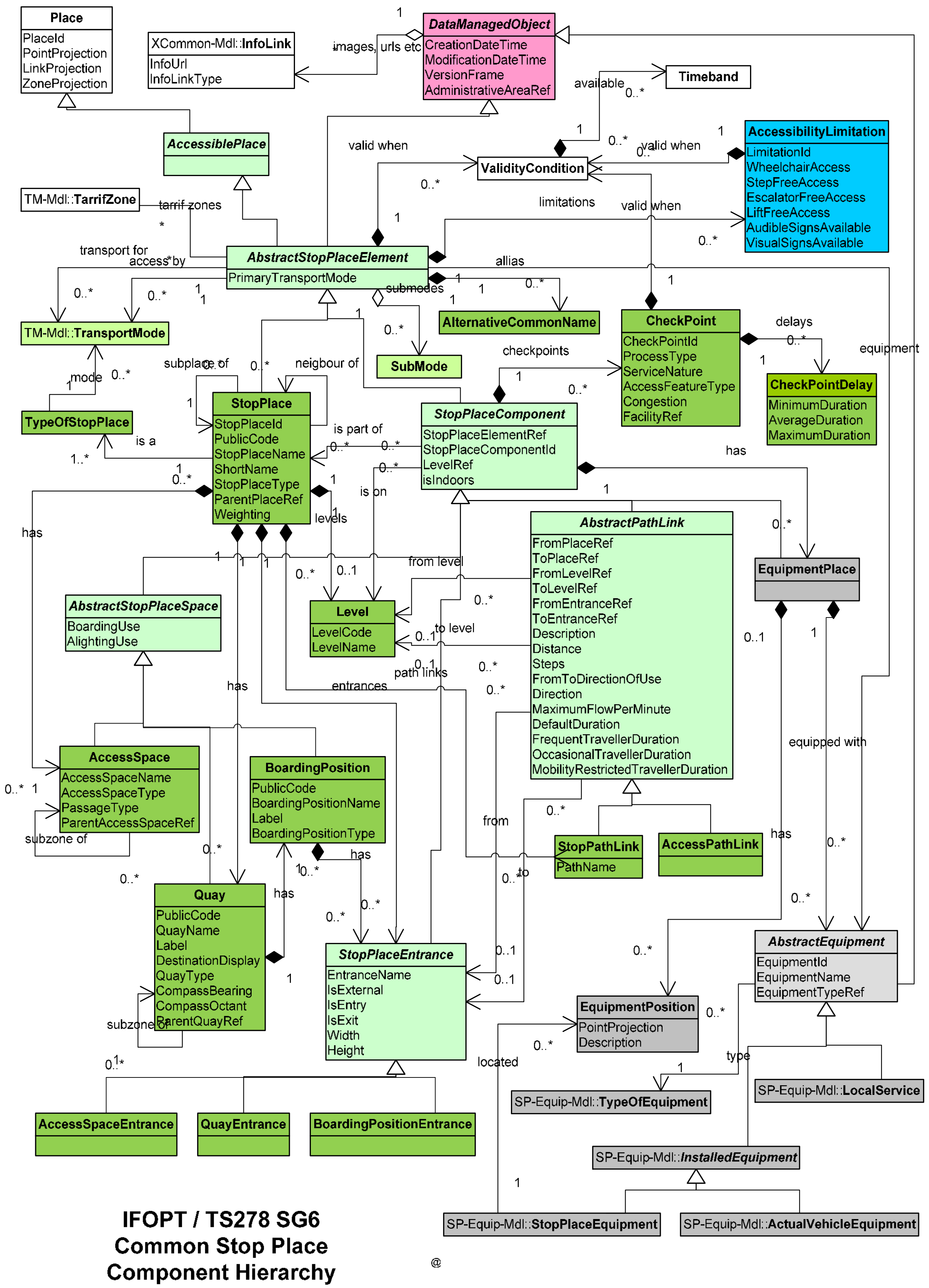


Figure 32 — UML Diagram for Stop Place Model Components

6.2.9.2 Containment Hierarchy of Stop Place Components

The Stop Place Model defines a *containment* hierarchy, corresponding to the structural relations of the physical elements in the real world, using the various relationships shown in Figure 29, Figure 30, Figure 32, and Figure 33. These can be summarised textually as follows:

STOP PLACE

- *has* 0:* QUAY
  - *has* 0:* BOARDING POSITION
    - has 0:* BOARDING POSITION ENTRANCE
  - *has* 0:* QUAY ENTRANCE
- *has* 0:* ACCESS SPACE
  - *has* 0:* ACCESS SPACE ENTRANCE
- *has* 0:* ENTRANCE FOR VEHICLES
- *has* 0:* VEHICLE STOPPING PLACE
  - *has* 0:* VEHICLE STOPPING POSITION
- *has* 0:* STOP PATH LINK
- *has* 0:* ACCESS PATH LINK

Figure 33 — Containment Hierarchy for Stop Place

6.2.10 Use of Entrances

STOP PATH LINKs may also indicate an ENTRANCE of the ACCESS SPACE or QUAY to use. Any ENTRANCE specified on an end of the STOP PATH LINK must belong to the same STOP PLACE SPACE at the same end.

Entrances may be marked as internal only, or for external access (that would be a point on the STOP PLACE that may be use to connect external journey walking routes). ACCESS PATH LINKs may only connect to external entrances.

ENTRANCEs mark points of entry for passengers and may be for a designated MODE or MODEs of access, as specified by the access by relationship – normally foot, but other modes cycle or passenger car are also possible.

An ENTRANCE FOR VEHICLES represents a fixed entrance to the STOP PLACE for public transport VEHICLEs (and should not be confused with an ENTRANCE TO VEHICLE, which is part of the VEHICLE) and provides access for passengers to the vehicle.

ENTRANCEs are STOP PLACE COMPONENTs and so may have STOP PLACE EQUIPMENT associated with them.

6.2.11 Equipment

The STOP PLACE Model can describes many detailed aspects of the STOP PLACE such as lifts, customer services, etc as EQUIPMENT that is located within an ACCESS SPACE, QUAY or other STOP PLACE COMPONENT.

6.2.11.1 Overview of Stop Place Equipment and Local Services

Figure 34 provides a UML diagram of the main equipment elements.

Each STOP COMPONENT can have one or many EQUIPMENT PLACEs associated with it. Each EQUIPMENT PLACE can have specific types of STOP PLACE EQUIPMENT located in it describing fixed equipment such as Lifts, Stairs, Seats etc, or LOCAL SERVICE, for example porterage, that is available at the PLACE.

Within an EQUIPMENT PLACE, STOP PLACE EQUIPMENT may have an EQUIPMENT POSITION.

STOP PLACE EQUIPMENT & LOCAL SERVICE are broken down into separate sub hierarchies under a common ABSTRACT EQUIPMENT type. The same types of INSTALLED EQIPMENT may also be located on a VEHICLE.

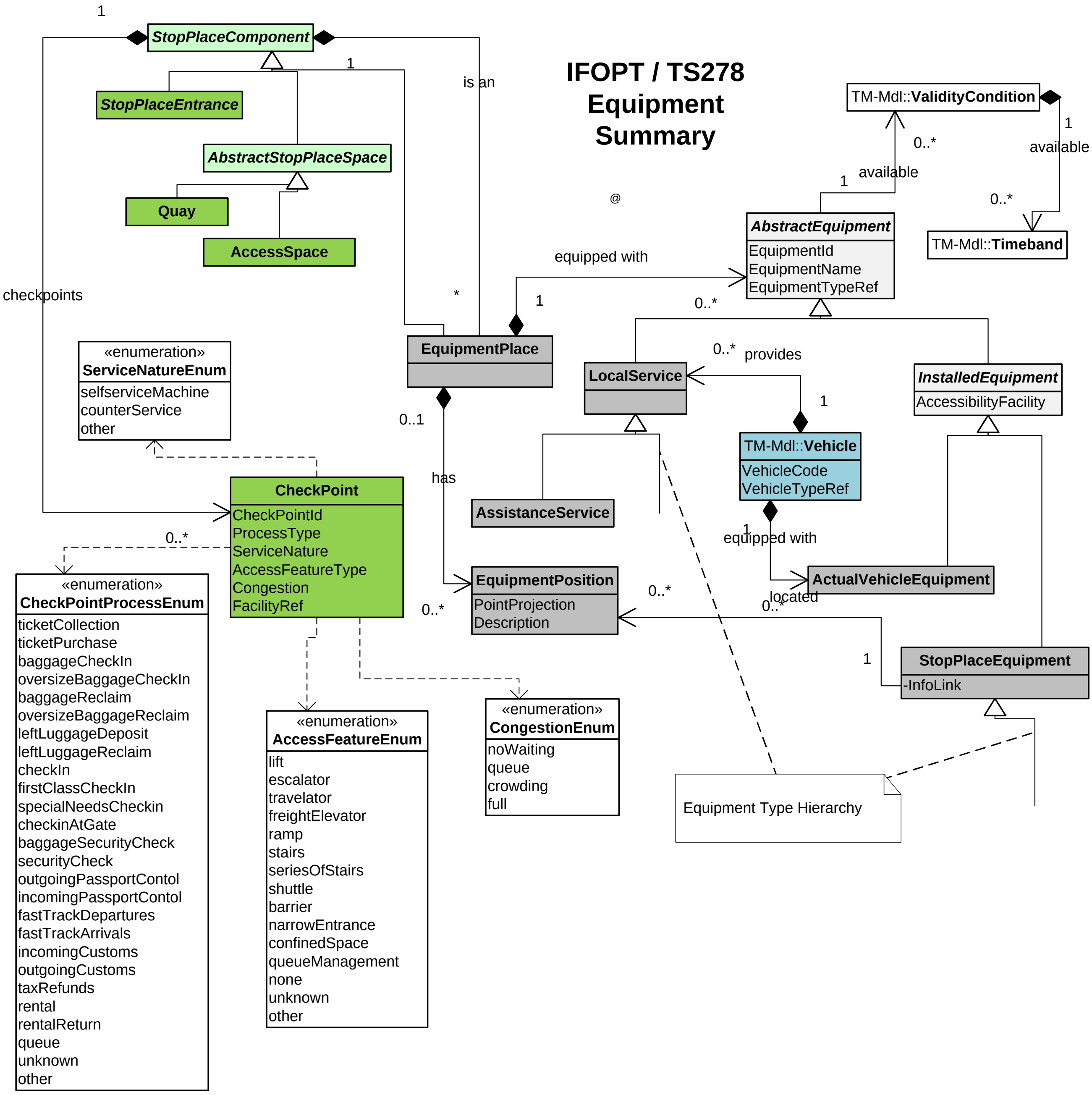


Figure 34 — UML Diagram of Equipment Summary

6.2.11.2 Installed Stop Place Equipment

STOP PLACE EQUIPMENT describes the different types of INSTALLED EQUIPMENT, that is, LOCATED equipment that may be associated with the STOP PLACE COMPONENTs.

Figure 35 and Figure 36 show example equipment hierarchies for STOP PLACE EQUIPMENT, Each different type of equipment may have attributes and characteristics that are specific to its nature.

Some of these may in particular be relevant for accessibility (indicated by a Yellow Star).

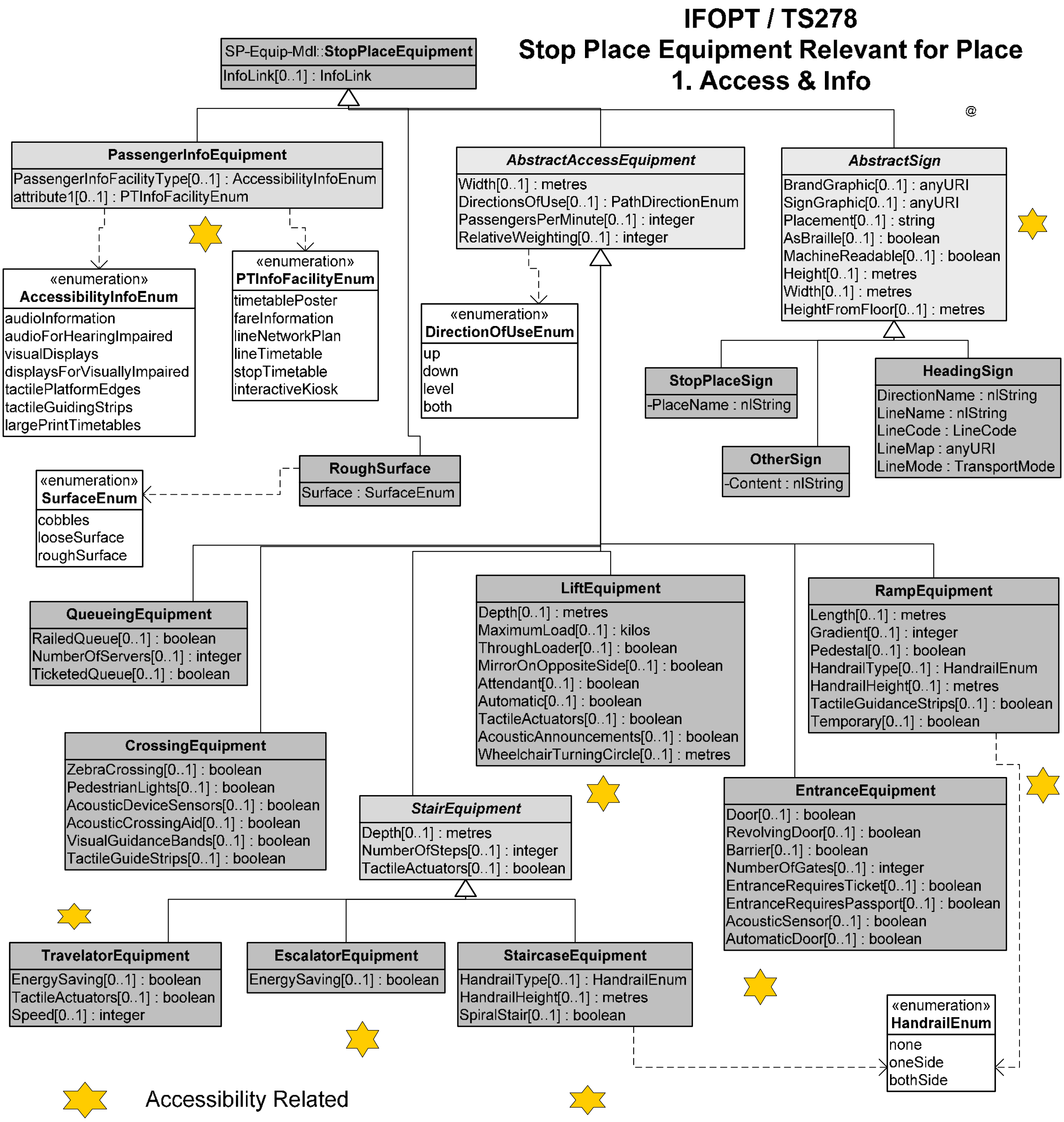


Figure 35 — UML Diagram of Stop Place Equipment – 1. Access and Passenger Info

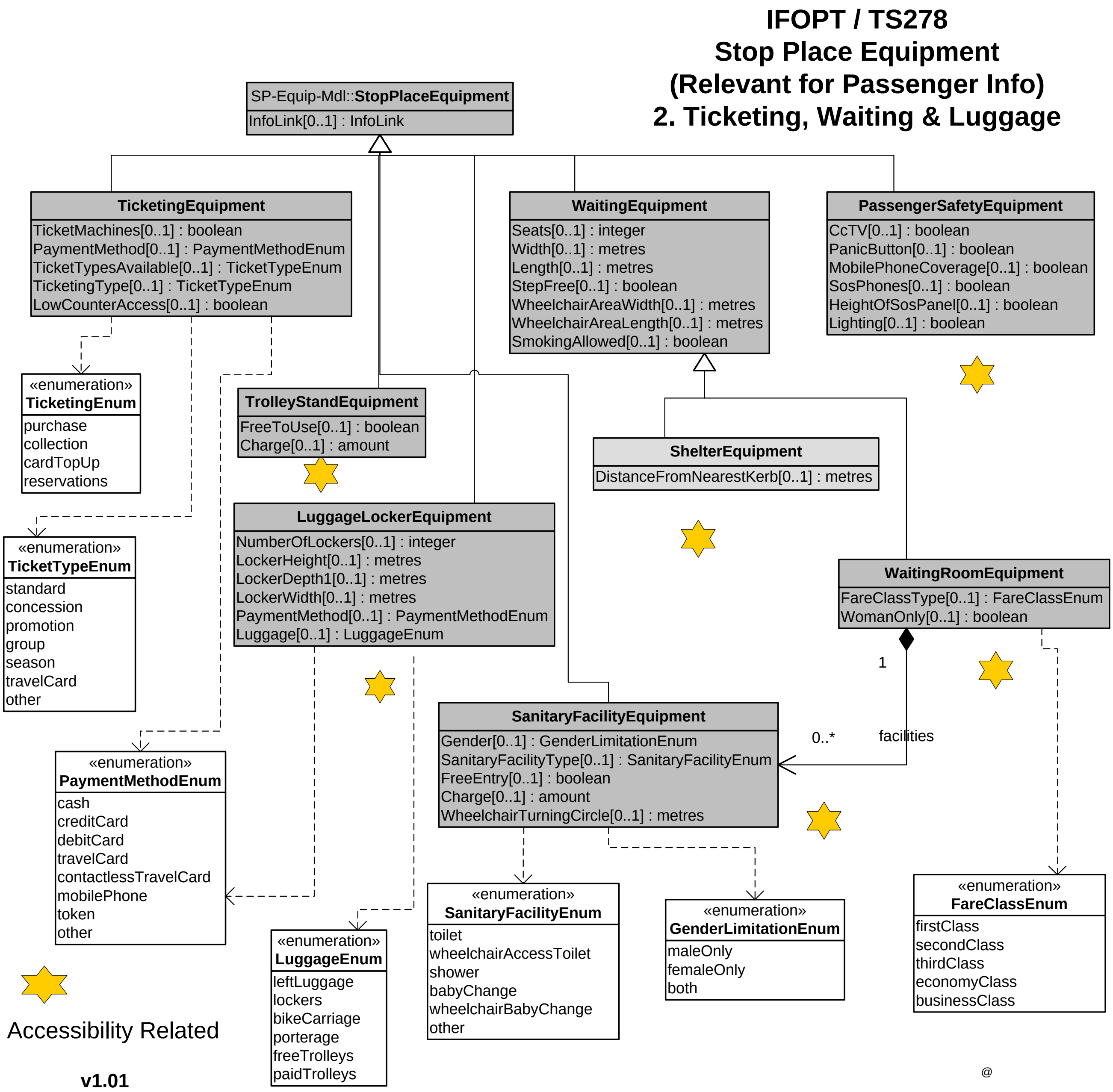


Figure 36 — UML Diagram of Stop Place Equipment Elements – 1. Ticketing Waiting and Luggage

6.2.11.3 Local Service Equipment

LOCAL SERVICEs describe some different types of unlocated EQUIPMENT that may be associated with the STOP PLACE COMPONENTs.

Figure 37 and Figure 38 show equipment hierarchies for LOCAL SERVICES EQUIPMENT.

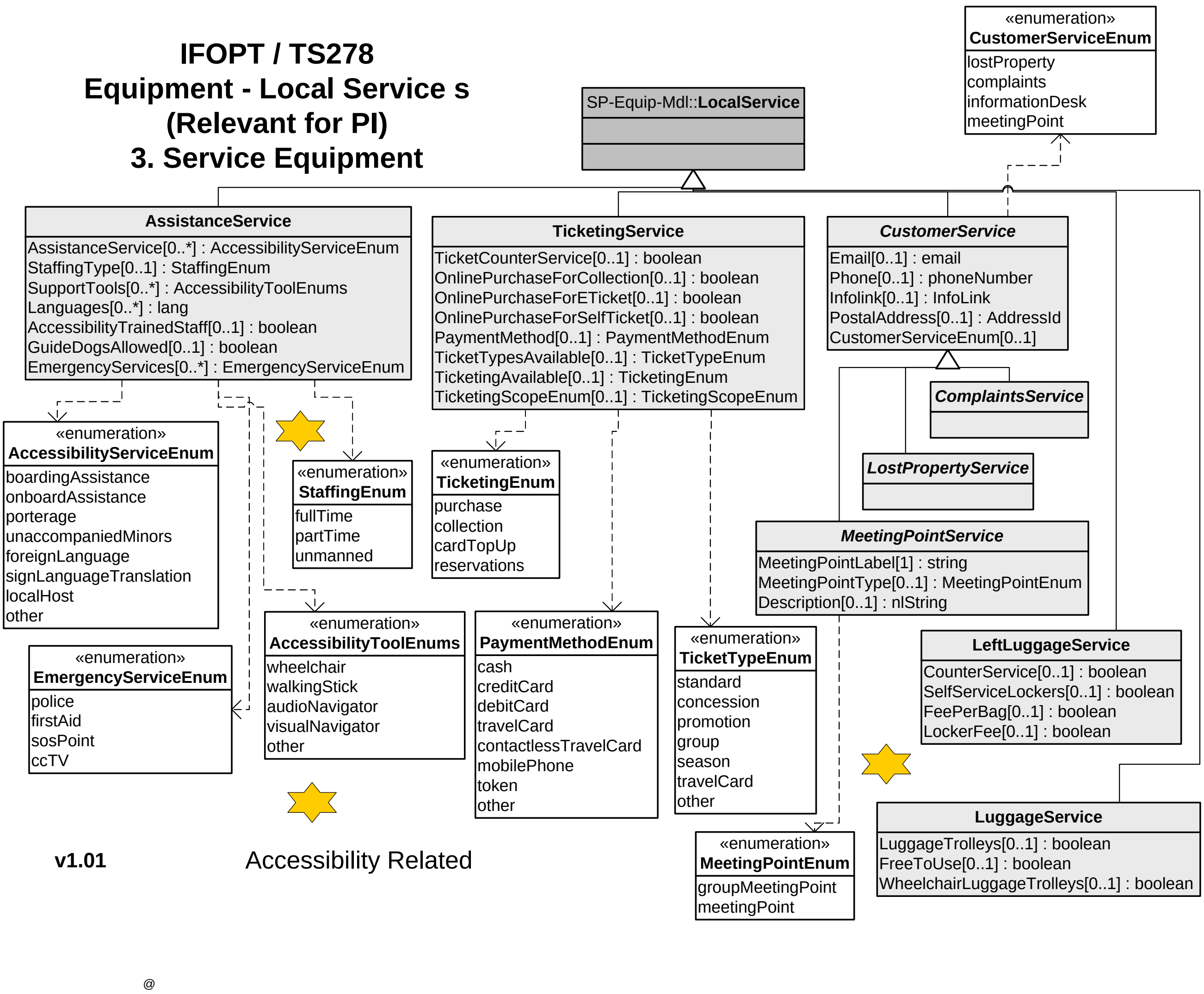


Figure 37 — UML Diagram of Stop Place Equipment Elements – 3. Local Services

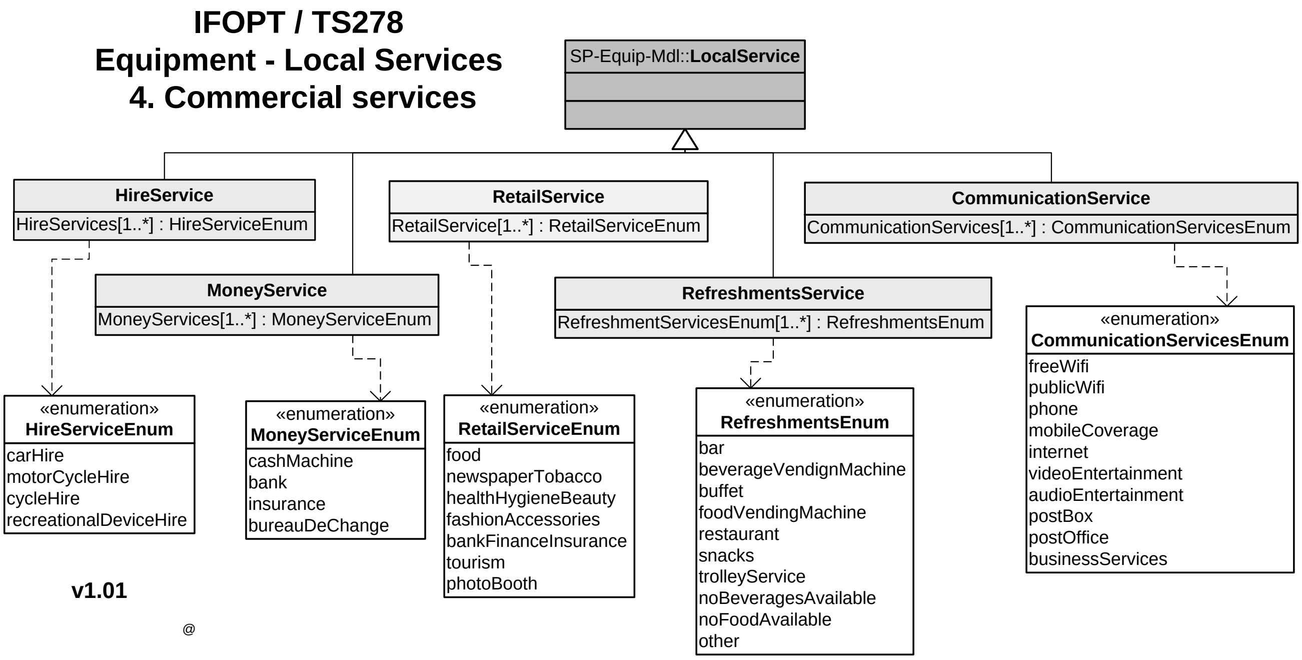


Figure 38 — UML Diagram of Stop Place Equipment Elements – 4. Commercial Services

6.2.11.4 Vehicle Equipment Types

VEHICLE EQUIPMENT describes the different types of equipment that may be associated with a VEHICLE that relate to access or use by passengers boarding from a STOP PLACE.

Figure 39 shows example equipment hierarchies for VEHICLE EQUIPMENT.

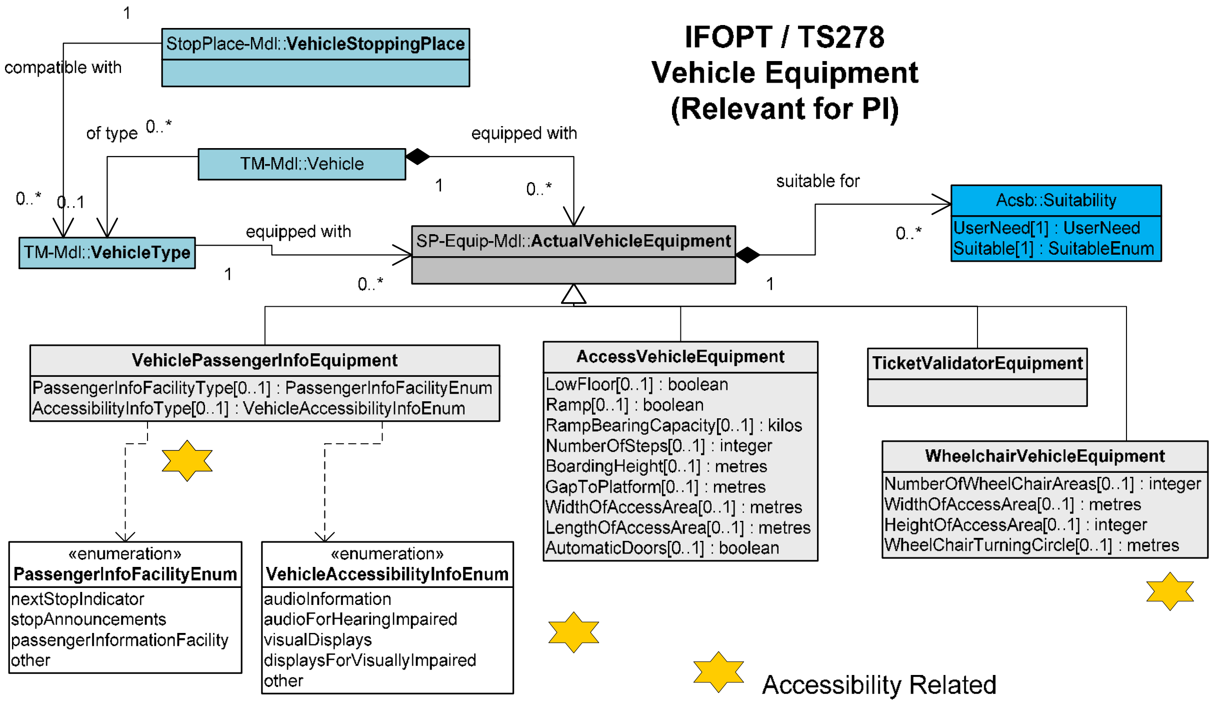


Figure 39 — UML Diagram of Vehicle Equipment Elements

6.2.12 Hierarchy of Vehicle Related Elements

Figure 40 shows the organisation of vehicle related elements in relation to data administration and PLACE.

VEHICLE STOPPING PLACE and VEHICLE STOPPING POSITION are types of STOP PLACE SPACE. VEHICLEs are not components of a STOP PLACE.

ENTRANCE FOR VEHICLES denotes the point at which the VEHICLE enters the interchange from the road and is a type of STOP PLACE ENTRANCE.

A VEHICLE may have one or more ENTRANCE TO VEHICLE elements describing the nature of the entrance (e.g. low floor).

A VEHICLE has a VEHICLE TYPE. This may include associated default EQUIPMENT for the vehicle type. It may also have ACTUAL VEHICLE EQUIPMENT.

The VEHICLE STOPPING PLACE may be marked as compatible with a VEHICLE TYPE.

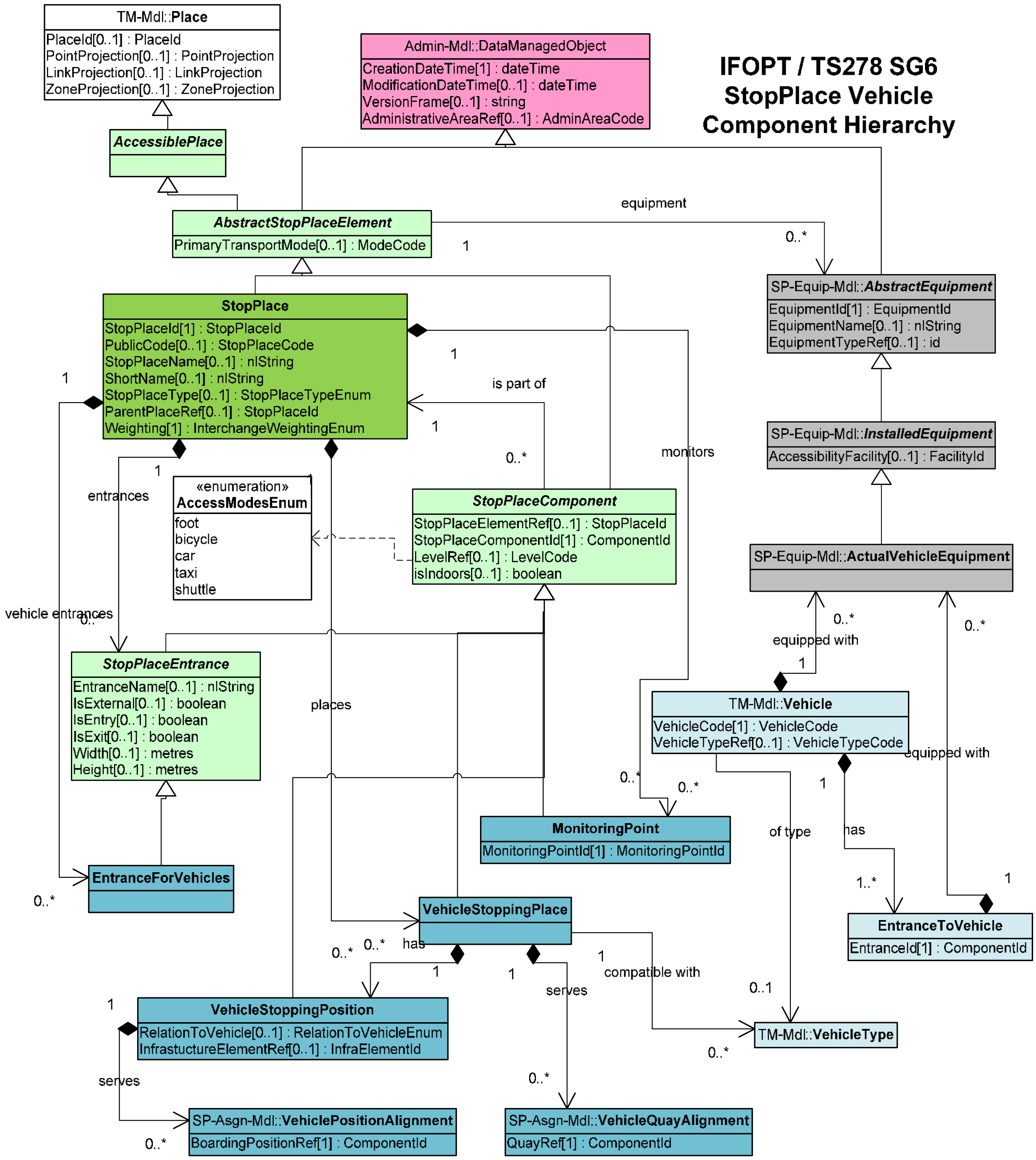


Figure 40 — Hierarchy of Vehicle Related Elements

6.3 Navigation Paths

A journey planner needs to be able to choose the best navigation path through a complex interchange in order to provide accurate information on the transfer route and the time required to make it. It must not be computationally too expensive to do this in an implementation derived from data exchanged in IFOPT format.

The STOP PLACE Model includes elements to define such paths.

Within a STOP PLACE, a NAVIGATION PATH is a specified path through the graph of STOP PATH LINKs and STOP PLACE SPACEs that constitute the primary components of a STOP PLACE. Typically a NAVIGATION PATH will be chosen to be optimal for transfer time and accessibility – see next section.

If there is more than one path possible between the same start and end point, then there will be separate NAVIGATION PATHs with different sequences of links, possibly with different ACCESSIBILITY LIMITATIONs. A journey planner will typically evaluate a number of paths and then select the best fit according to the specified search constraints. A NAVIGATION PATH may contain link sequences that are branches within it, say to use a lift or a staircase as alternatives, but must always have a single origin and a single destination.

Figure 41 and Figure 42 introduce the navigation model. They show that a NAVIGATION PATH may be represented as an ordered series of PATH LINKs IN SEQUENCE. Each PATH LINK IN SEQUENCE references a PATH LINK. PATH LINKs may be of two types; STOP PATH LINKs, connecting QUAYs and ACCESS SPACEs within the interchange, and ACCESS PATH LINKs (see Figure 42) connecting any type of external PLACE to the STOP PLACE. A further “glue” element, the PATH JUNCTION, allows PATH LINKs of either type to be connected outside a STOP PLACE.

The same ACCESS LINK may be reused in many different NAVIGATION PATHs.

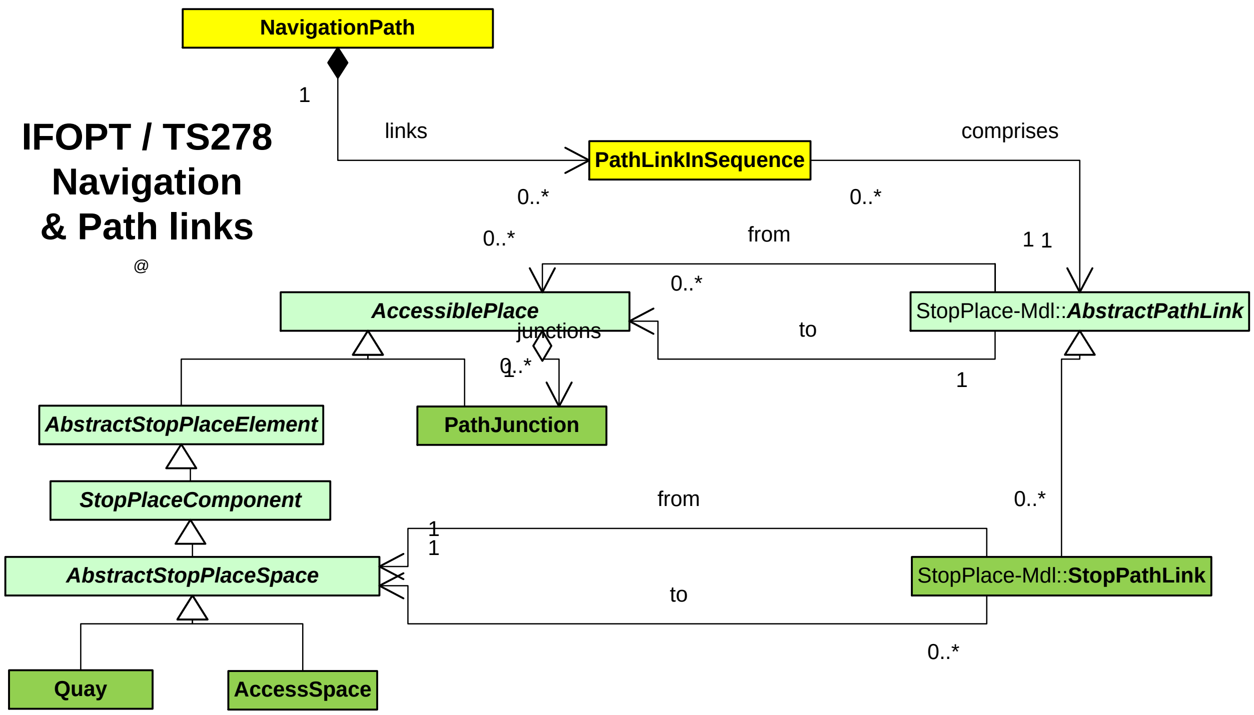


Figure 41 — UML Diagram with outline of Path Links

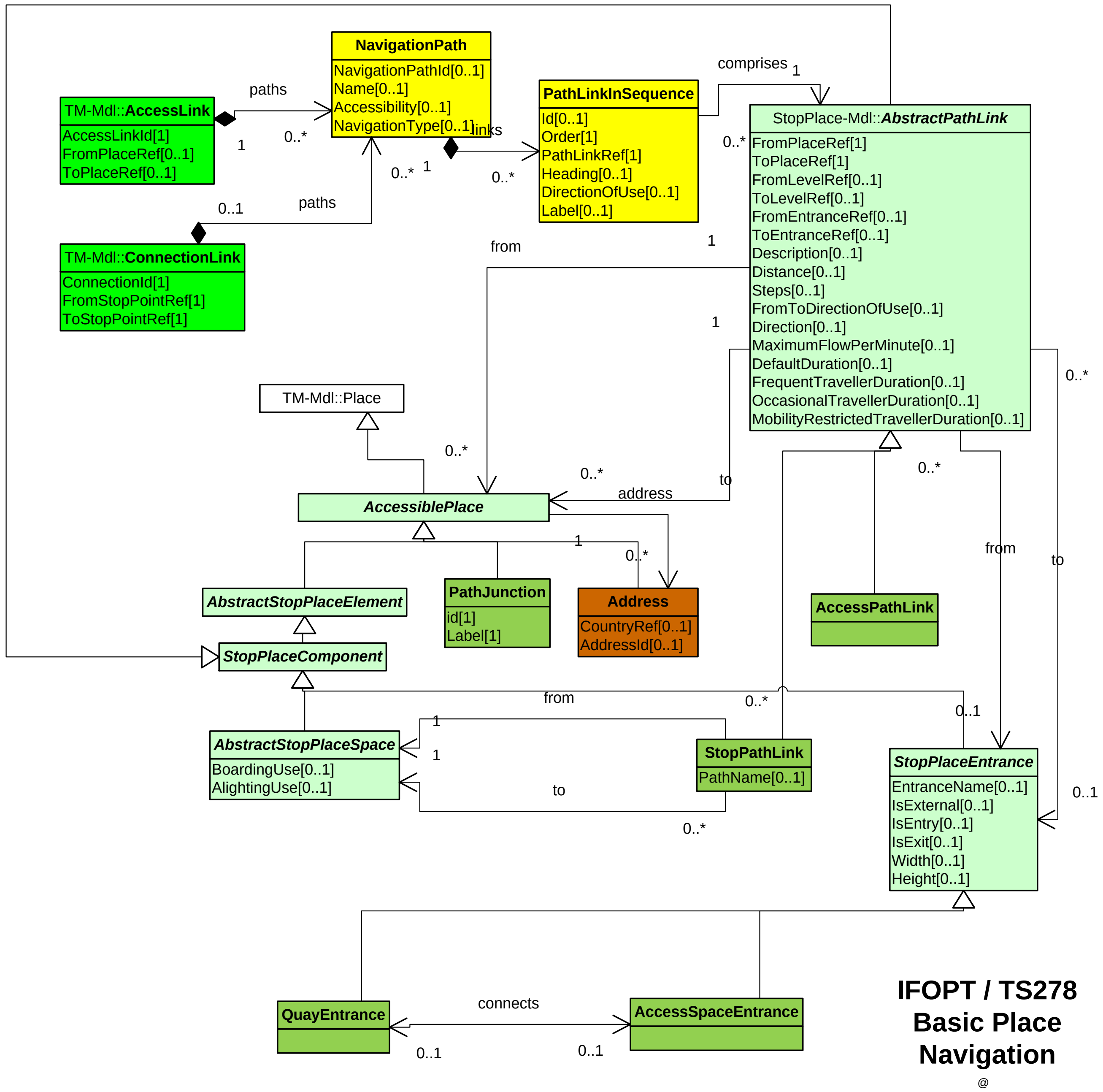


Figure 42 — UML Diagram of Overview of Navigation Path Model

6.3.1 Navigation Path Elements

Figure 43 shows details of the NAVIGATION PATH elements. It also summarises the STOP PLACE Model elements which are relevant for assessing and displaying NAVIGATION PATHs. See Figure 47.

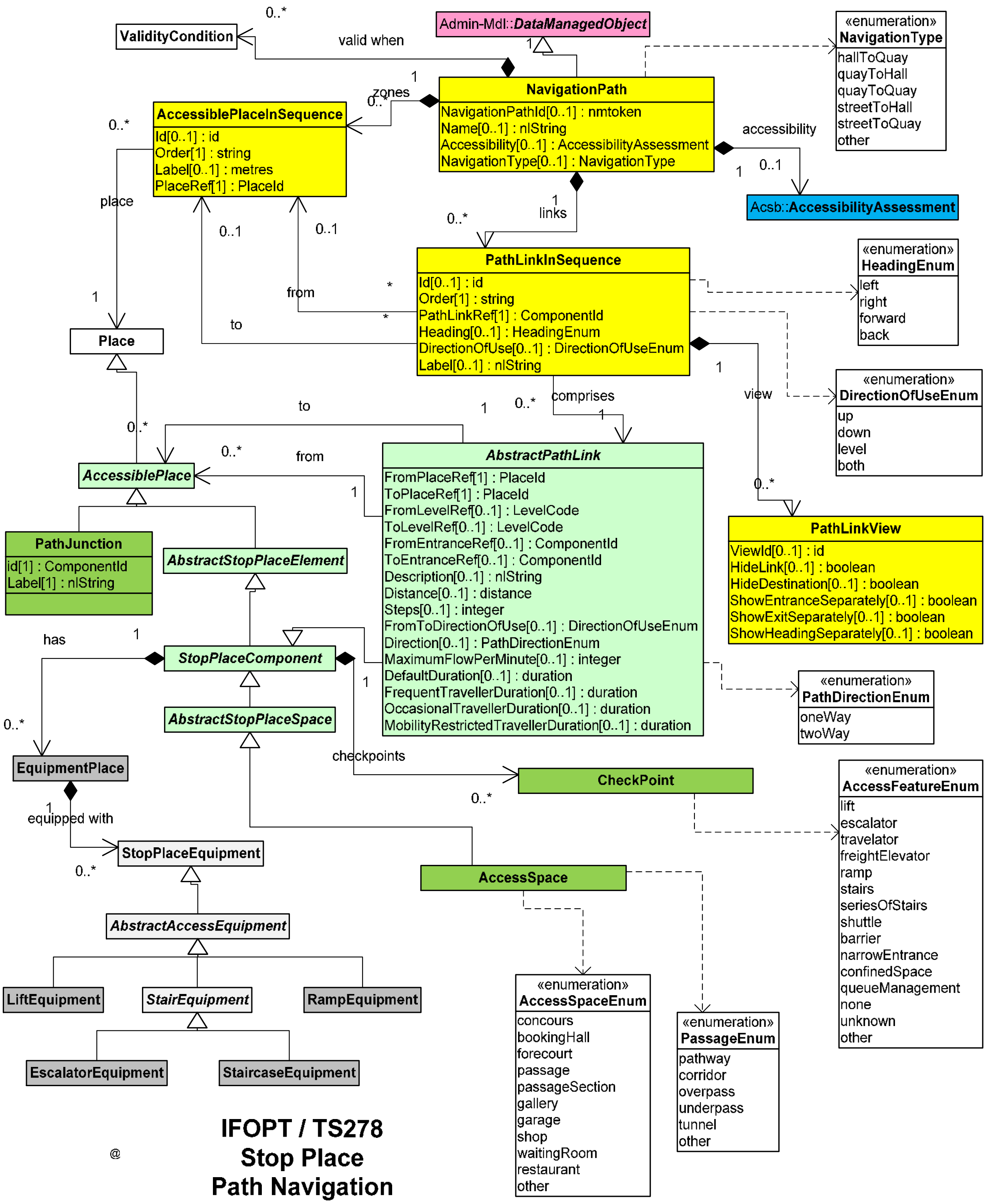


Figure 43 — UML Diagram of Navigation Path Model

The PATH LINK IN SEQUENCE element holds information about the traversal of a link that depends on the context of the NAVIGATION PATH, rather than on the individual PATH LINKs it references – for example, that stairs are being used in the up direction, or that the user must turn left or right relative to the previous link.

STOP PLACE COMPONENTs can have descriptive feature types – for example *lift, escalator*, *ticketHall* associated with them. EQUIPMENT elements can be used to provide further quantitative details about the nature of the feature, e.g. ramp gradient, lift dimensions, etc.

CHECKPOINTs can be used to specify delays associated with specific steps in the path.

The PATH LINK VIEW allows the path to specify which elements are to be included in any step by step narrative of the underlying representation. This view might choose to suppress links or link ends.

EXAMPLE Bash Street Entrance ➔Ticket Hall ➔Ticket Barrier ➔Down 5 steps ➔5M Landing ➔Down Escalator ➔Landing ➔Circle Line Eastbound (Platform 1)).

6.3.2 Comparison of Path Links with Access Links and Connection Links

The classic Transmodel scheduling model representation of a journey interchange uses a CONNECTION LINK with a single average connection time, for example:

a) SCHEDULED STOP POINT - CONNECTION LINK - SCHEDULED STOP POINT

This is a timetable model describing the possibility of an interchange between journeys. In IFOPT, this can be augmented by a more elaborate representation describing the actual physical route and times needed to make the transfer within the STOP PLACE. For a given CONNECTION LINK there may be one or more NAVIGATION PATHs of individually timed and plotted instances of intermediate ACCESS PLACE and QUAY nodes connected by STOP PATH LINKs, as follows (where * indicates repetition):

b) QUAY – [STOP PATH LINK - ACCESS SPACE – STOP PATH LINK] * – QUAY

Or even in greater detail (where each STOP PATH LINK may specify entrances, and all elements may having CHECKPOINT and ACCESSIBILITY properties).

c) QUAY
- **[STOP PATH LINK**
  - (QUAY ENTRANCE)
  +(CHECKPOINT, ACCESSIBILITY LIMITATION)
  - (ACCESS SPACE ENTRANCE)
- **ACCESS SPACE** or PATH JUNCTION
  (+CHECKPOINT, ACCESSIBILITY LIMITATION)
- **STOP PATH LINK**
  - (ACCESS SPACE ENTRANCE)
  (+CHECKPOINT, ACCESSIBILITY LIMITATION-)
  -(QUAY ENTRANCE)] *
- **QUAY**

The representation b) above is the minimum needed to be able to compute an exact navigation path.

CONNECTION LINKs and PATH LINKs should be regarded as complementary information layers representing different concerns. The CONNECTION LINK is concerned with modelling the logical possibility of transfers between timetabled services (but independently of a specific service). The PATH LINK is concerned with the possible physical transitions that can be made through or between a transport interchange (STOP PATH LINKs within the STOP PLACE; ACCESS PATH LINKs outside). The two may be projected together for a number of useful purposes – for example to identify the sequences of PATH LINKs that may be used to follow any given CONNECTION LINK, but remain discrete information layers. If the relationship between the timetable model and the Stop Place Model changes, for example for a platform change that reassigns a given SCHEDULED STOP POINT to a different QUAY, then a different set of STOP PATH LINKs will be used to follow the same CONNECTION LINK.

Similarly, ACCESS LINKs should be regarded as belonging to a separate but complementary information layer to that of PATH LINKs. An ACCESS LINK is concerned with the modelling the logical transfers possible between a STOP PLACE and a POINT OF INTEREST or other external PLACE. The ACCESS PATH LINK (is concerned with the possible physical transitions that can be made through or between a transport interchange. The two may be projected together for a number of useful purposes – for example to identify the sequences of ACCESS PATH LINKs that may be used to follow any given ACCESS LINK, but remain discrete information layers.

6.3.3 Navigation Paths & Accessibility Limitations

Figure 47 introduces ACCESSIBILITY LIMITATIONs and other details that are relevant for evaluating, choosing and presenting NAVIGATH PATHs.

Figure 47 also shows that a NAVIGATION PATH may be represented as either an ordered sequence of PATH LINKs IN SEQUENCE (as above), or an ordered sequence of ACCESSIBLE PLACEs IN SEQUENCE, or both. Which representation is preferred will depend on the application.

Since they are STOP PLACE COMPONENTs, both STOP PLACE SPACEs and STOP PATH LINKs may have both ACCESSIBILITY LIMITATIONs and CHECKPOINTs associated with them.

ACCESSIBILITY LIMITATIONs describe impediments that affect different types of PASSENGER ACCESSIBILITY NEED. See discussion of Accessibility Navigation in 6.4 below.

Busy public transport interchanges often have impediments to progress imposed either by the physical structures, such as narrow corridors and other bottlenecks, or by processes performed at particular stages of travel such as baggage check-in, baggage reclaim, security, customs, or immigration. CHECK POINTs can be associated with different STOP PLACE COMPONENTs to describe such impediments. These may be subject to a VALIDITY CONDITION. A time penalty can be specified as a CHECK POINT DELAY. This can be varied for different types of day.

A NAVIGATION PATH may also be computed to connect a PLACE outside an interchange, such as a POINT OF INTEREST or an ADDRESS, with a STOP PLACE. In this case the path links are ACCESS PATH LINKs and provide a detailed projection of a Transmodel ACCESS LINK.

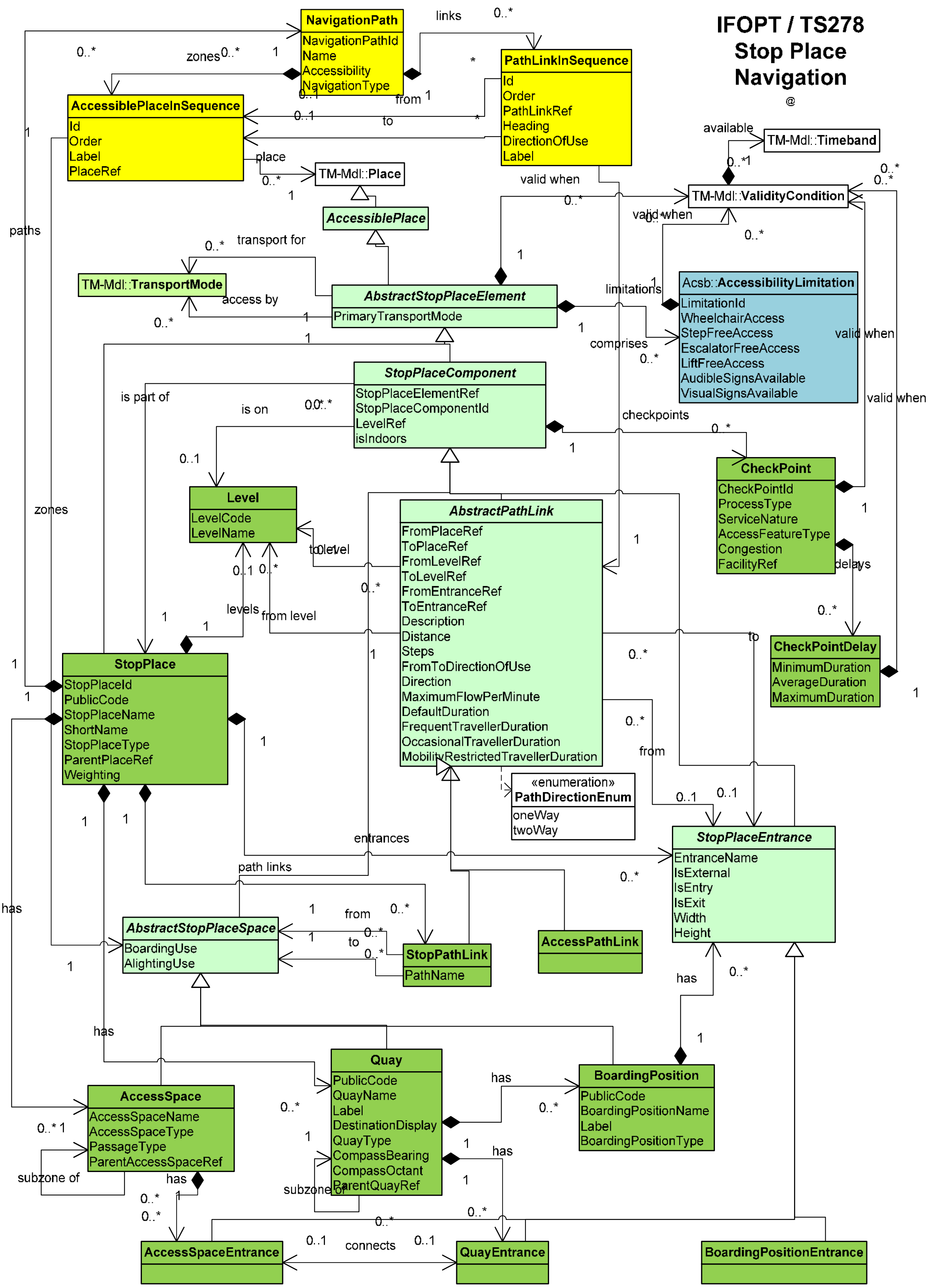


Figure 44 — UML Diagram for Navigation Path and Stop Place Elements

6.3.4 Example of Navigation Paths for a Station

Figure 45 shows an example of a list of named navigation paths for a single station (Blackfriars in London).

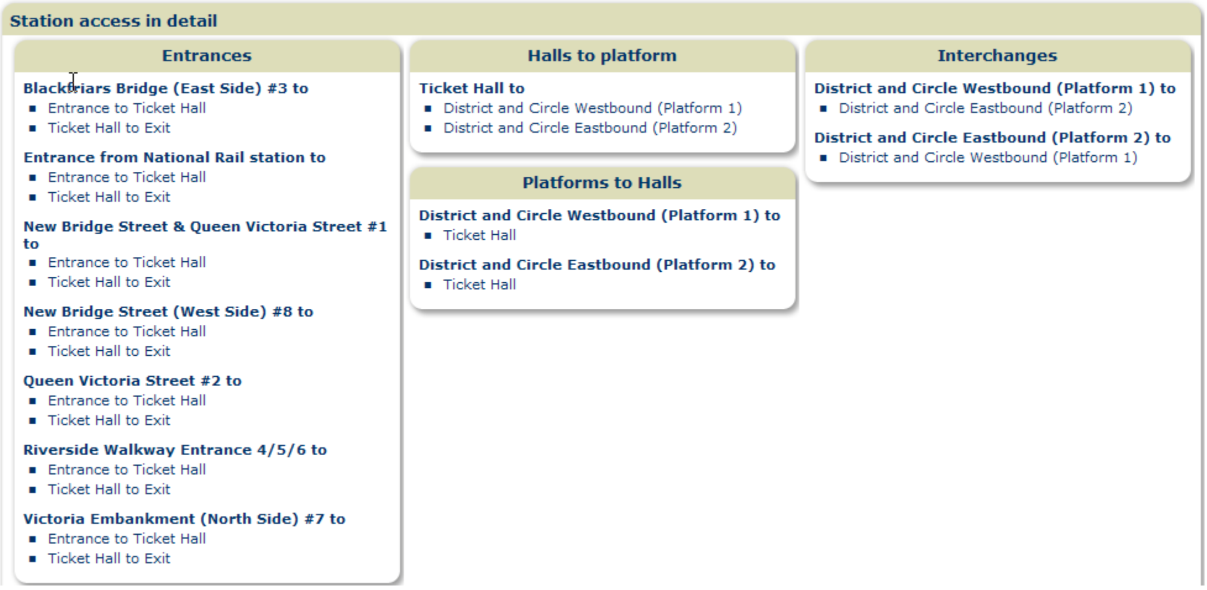


Figure 45 — Example list of Navigation Paths (Courtesy of directenquiries.com)

Figure 46 shows an example of an individual NAVIGATION PATH as it might be presented to a user so as to show the steps of a route in both textual and graphic forms.

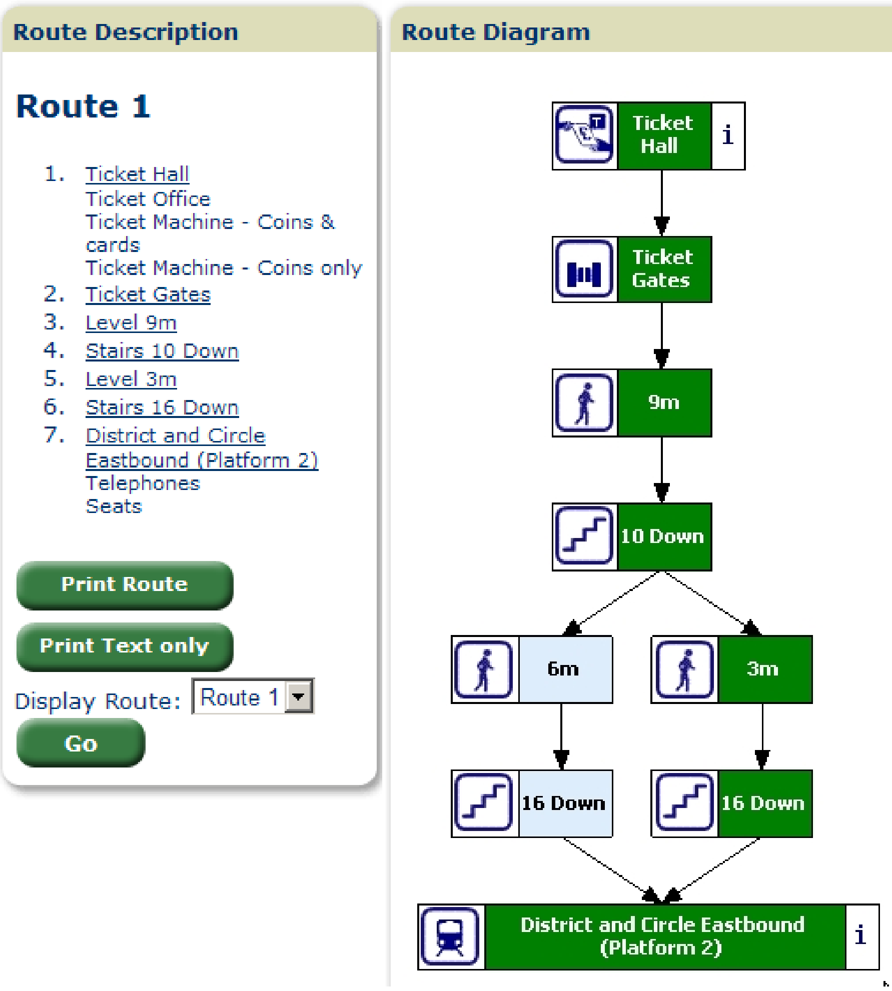


Figure 46 — Example of a Navigation path as presented to a user (Courtesy of directenquiries.com)

6.3.5 Efficient Computation of Navigation Paths

STOP PATH LINKs must be defined in order to be able to compute a detailed path within an interchange. NAVIGATION PATHs may either be dynamically computed, or may be predefined. It is not the purpose of IFOPT to define the algorithms to use to perform the computation, but merely to provide a uniform model for collecting and exchanging data for systems that undertake such computations.

The IFOPT model is intended to support the efficient computation of navigation paths by allowing the run time journey search to be performed between a small subset of nodes (rather than say between the larger population of every single STOP PLACE component and individual; is a POINT). Thus SCHEDULED STOP POINTs are associated with a QUAY, and NAVIGATION PATHs are computed between the QUAYs, rather than individual BOARDING POSITIONs. This allows journey planners (if they wish to) to statically pre-compute a point-to-point transition table using the relatively small number of QUAYs and ACCESS SPACEs, as opposed to the potentially much larger number of BOARDING POSITION to BOARDING POSITION transitions, or the even large number of paths between GIS coordinate points.

6.4 Accessibility Navigation

A specific concern of the Fixed Object model is to support ACCESSIBILITY navigation for users with special needs, such as disability, heavy luggage, etc. The Fixed Object model categorises accessibility properties of a STOP PLACE into a uniform set of ACCESSIBILITY LIMITATIONs that describe the ACCESSIBILITY characteristics of nodes and paths within the STOP PLACE. This allows accessibility data to be systematically captured, sufficient to support the computation by journey planners of paths optimized for accessibility. (Note that other data of relevance to disabled users, for example, special displays for the deaf or visually impaired are covered by the Equipment part of the Fixed Object model. The import to the user of such other Equipment is primarily *informative*, rather than *affecting the computation of viable journey plans* for the user.)

The Fixed Object accessibility model aims to support consistent data capture such that computation can be performed over the model to determine which paths are usable by disabled users.

In practice, there may be significant differences in the level of precision to which information about accessibility is known for different stop places. Some systems may hold only a single flag indicating “whether disabled access is possible”; others may record detailed values for different categories of impaired access. For example, not only wheelchair accessibility, but also whether there is *step-free access* (which may still not necessarily be suitable for wheelchair use, and might involve either ramps or lifts), or whether *use of lifts is required* (which may be relevant for claustrophobics), etc. It is important to be able to support both limited and rich data sets, and both might be encountered during the computation of a single journey plan. To do this certain principles are needed for capturing and transforming accessibility data consistently.

At the same time it needs to be recognized that there are differences in the requirements of accessibility legislation and degree of adoption of best practices for accessibility in Europe. IFOPT therefore divides accessibility into two parts.

— Guidelines for basic capture of ACCESSIBILITY LIMITATIONs. These are part of the Normative IFOPT Technical Standard.

— Guidelines for EQUIPMENT, USER NEEDs and for relating needs to the ACCESSIBILITY LIMITATIONs of a STOP PLACE and its components. These are informative. ANNEX A provides an informative list of medical classifications of USER NEEDs relating to disability from Sweden.

6.4.1 Principles for Basic Accessibility data (Normative)

a) Where possible the accessibility data should include values for at least the four basic physical ACCESSIBILITY LIMITATION attributes that are relevant for the computation of NAVIGATION PATHs.

   — *Wheelchair Access*: Whether the NAVIGATION PATH can be followed, or STOP PLACE COMPONENT visited, *by someone in a wheelchair*.

   — *Step-Free Access*: Whether the NAVIGATION PATH can be followed, or STOP PLACE COMPONENT visited *without the need to go up or down fixed steps.*

   — *Lift-Free Access*: Whether the NAVIGATION PATH can be followed, or STOP PLACE COMPONENT visited, *without the need to go in a lift*.

   — *Escalator-Free Access*: Whether the NAVIGATION PATH can be followed, or STOP PLACE COMPONENT visited, *without the need to go on an escalator*.

   — If only one category is given, this should be WHEELCHAIR ACCESS.

b) Any general category of disabled access - as say, used in ISO DIS 19134 for the attribute “*disabledAccessible*” - should be treated to mean wheelchair accessibility.

c) In capturing accessibility data, care should be taken to avoid recording values that would lead to “False positives”: for example, a path should only be described as wheelchair accessible if definitely known to be accessible - i.e. this should **not** be inferred from the mere fact that it has **not** been marked as *inaccessible* by wheelchair. Similarly, a route should only be described as STEP-FREE if it is actually known to be step-free. To avoid false positives a three valued logic should be used (i.e. *true, false, unknown*). If the accessibility is unknown it should be described as *unknown* and not be assigned to a positive or negative category.

d) The ACCESSIBILITY LIMITATION data can also indicate whether a component has facilities affecting visually impaired or deaf users.

— *Audible Signals Available*: Whether audible signals and/or announcements are available (that will help the visually impaired)

— *Visual Signs Available*: Whether visual passenger displays are available (that will help the hearing impaired).

6.4.2 Aggregation of Accessibility Limitations (Normative)

The IFOPT model allows Accessibility information to be captured at a detailed level for every element of a STOP PLACE. However, often it is necessary to be able to summarise accessibility information at a less detailed level. For example, a station may be given an overall rating of "*Wheelchair Accessible*" even though certain non-essential parts of it are not accessible. Accessibility information may be specified at any level in the hierarchy, e.g. STOP PLACE, QUAY or BOARDING POSITION. *Any value on the containing parent element should be regarded as a summary of the aggregate of its child components.*

6.4.3 Accessibility & Mobility Related Elements (Normative)

Figure 47 summarises those Stop Place Model elements which relate to accessibility.

a) The limitations on accessibility at any STOP PLACE COMPONENT can be specified using an ACCESSIBILITY LIMITATION and or an ACCESSIBILITY ASSESSMENT: these can be attached to any type of STOP PLACE ELEMENT. If attached to an element that is a STOP PLACE, they represent the overall limitations for the STOP PLACE. On a STOP PLACE the use may be discretionary and depend on expert evaluation, for example, if some components of a STOP PLACE are wheelchair accessible, then the STOP PLACE may or may not be classified as accessible.

b) The ACCESSIBILITY LIMITATION specifies whether an element allows particular types of use relevant for deciding access by different categories of ACCESSIBILITY impaired user. The ACCESSIBILITY ASSESSMENT relates the LIMITATIONs to specific categories of USER NEED. Often these will be derived programmatically from the LIMITATIONs.

c) Any impediments on traversing any STOP PLACE COMPONENT can be specified using a CHECK POINT, which can be attached to any type of STOP PLACE COMPONENT. The CHECKPOINT explains the nature and likely delays for traversing a given point from a process such as checking in, immigration, etc.

d) An EQUIPMENT type can be attached to any type of STOP PLACE COMPONENT to specify details about accessibility related properties, including quantitative attributes such as maximum loads, width, height etc. These may include both LOCAL SERVICEs such as boarding assistance and fixed infrastructure such as PLACE EQUIPMENT.

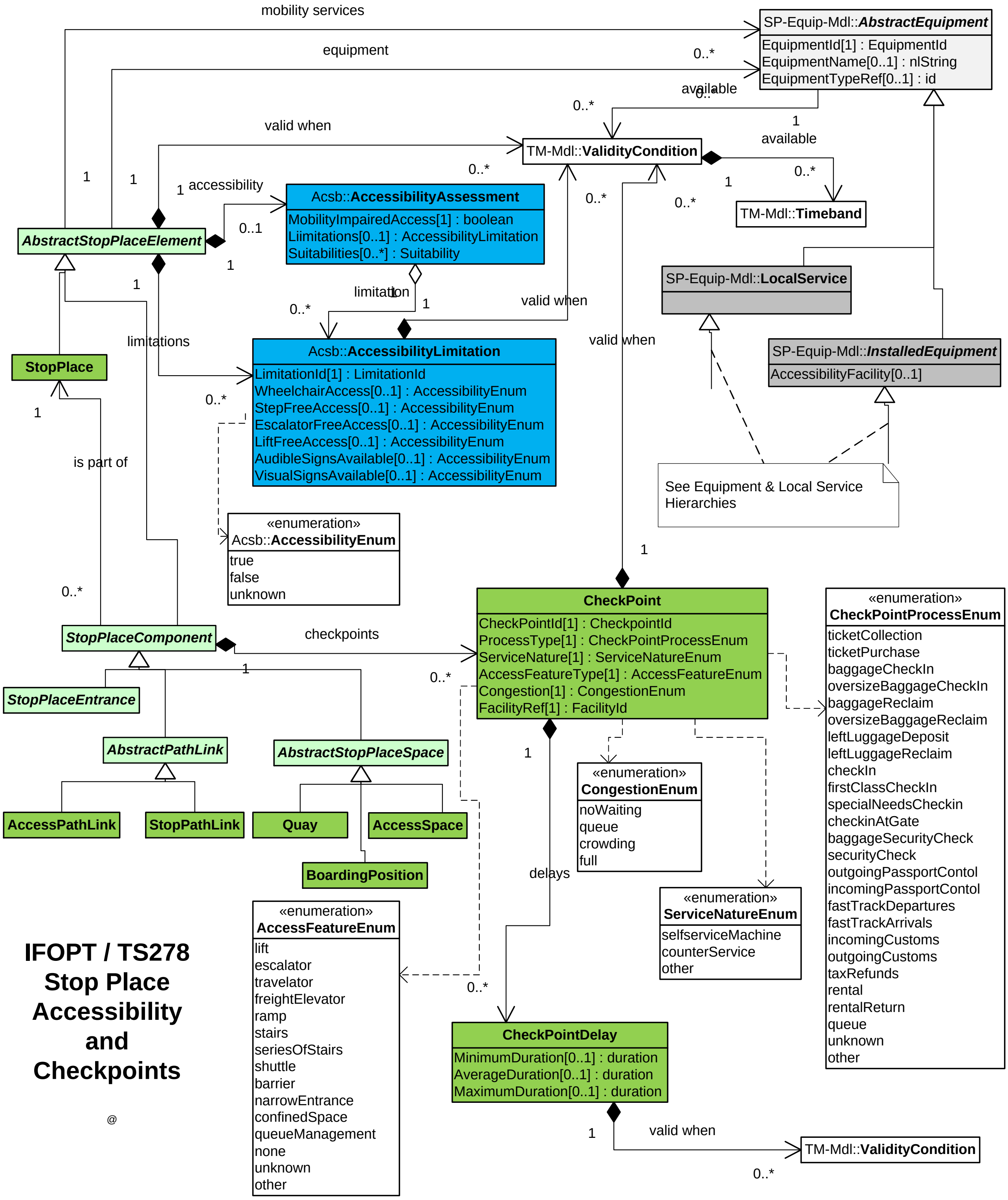


Figure 47 — UML Diagram of Accessibility Related Elements

6.4.4 User Accessibility Needs (Informative)

Travellers who use a Stop Place may have particular accessibility requirements. For example;

— Wheelchair users.

— People who cannot readily climb stairs (e.g. with push chairs, baggage, poor health, etc).

— People who cannot use lifts (e.g. claustrophobics

A set of PASSENGER ACCESSIBILITY NEEDS characterises the needs of passengers. Multiple USER NEEDs may be specified for a passenger. Figure 48 shows the allowed values.

A SUITABILITY is a statement of whether a particular USER NEED can be met. It can be used to state whether a facility of place will be accessible to someone with a user need.

An ACCESSIBILITY ASSESSMENT associates one or more ACCESSIBILITY LIMITATIONs of a STOP Place with a set of SUITABILITies. It thus provides mechanism to represent a stated set of accessibility limitations as well as other accessibility factors based on PLACE EQUIPMENT etc.

Certain ACCESSIBILITY LIMITATIONs imply a corresponding SUITABILITY, however the mapping of a limitation and other factors of a STOP PLACE COMPONENT (such as equipment) to a SUITABILITY is not one-for-one and is dependent on application and business rules.

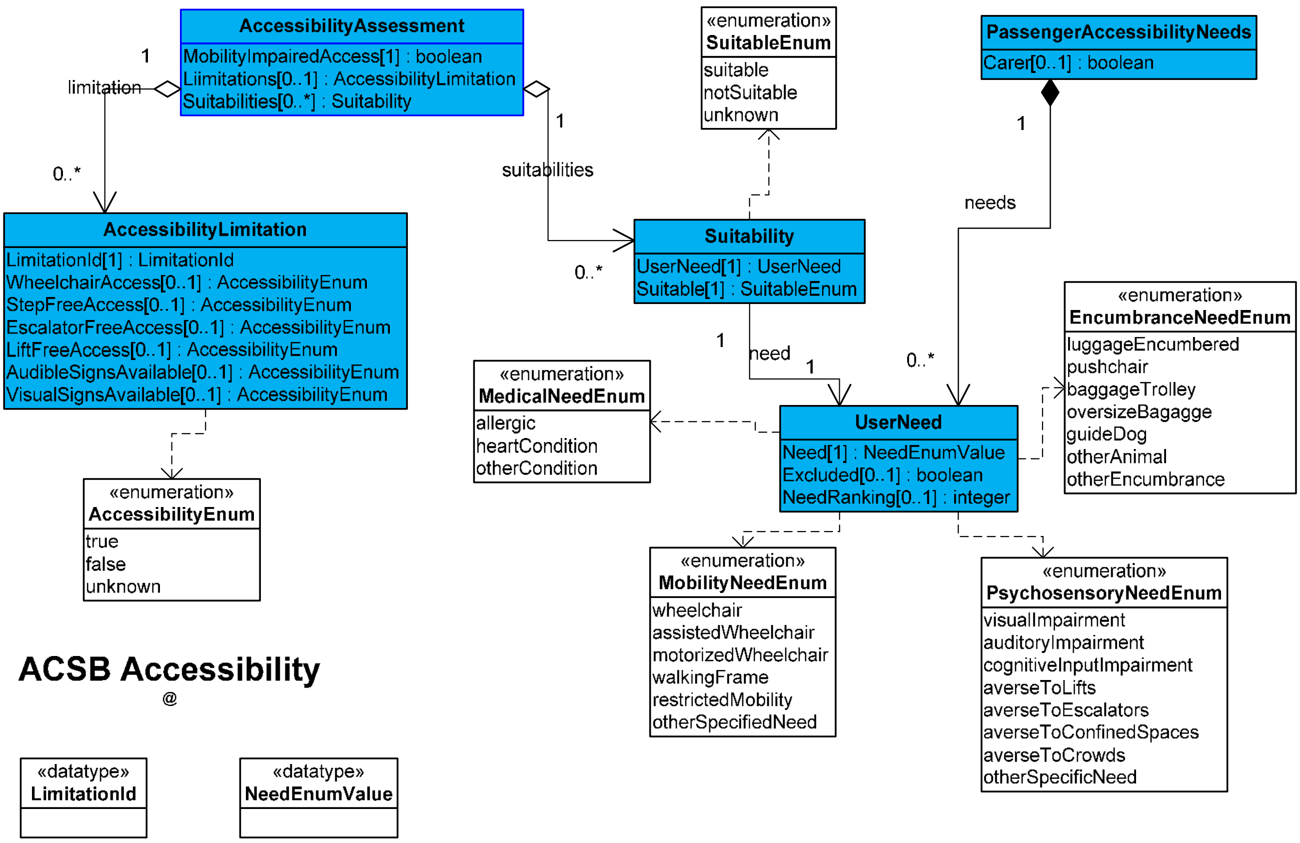


Figure 48 — UML Diagram of Accessibility types

Table 3 — Passenger Need values summarises different types of USER NEED,

Need Group	Value
MedicalNeed	allergic
	heartCondition
	other
MobilityNeed	wheelchair
	assistedWheelchair
	motorizedWheelchair
	walkingFrame
	restrictedMobility
	other
PsychosensoryNeed	visualImpairment
	auditoryImpairment
	cognitiveImpairment
	averseToLifts
	averseToEscalators
	averseToConfinedSpaces
	averseToCrowds
	other
EncumbranceNeed	luggageEncumbered
	pushchair
	baggageTrolley
	oversizeBaggage
	guideDog
	otherAnimal
	other

Table 3 — Passenger Need values

Figure 49 shows an example of accessibility categories that relate to various USER NEEDs, EQUIPMENT, LOCAL SERVICES and ACCESIBILITY LIMITATIONS, as used in a real system.

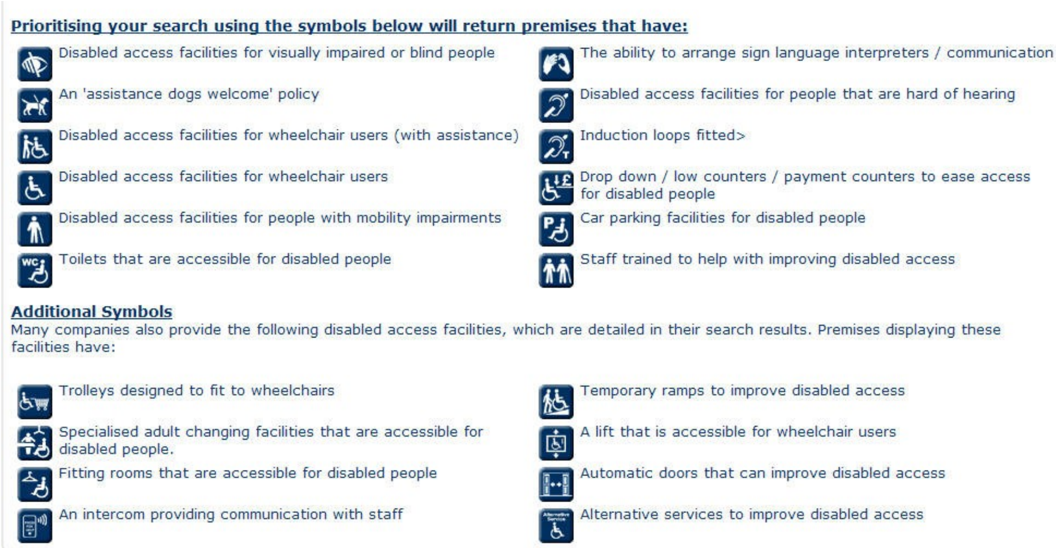


Figure 49 — Example of list of accessibility needs (Courtesy of directenquiries.com)

6.4.5 Computation of Accessibility from Limitations using Mobility Constraints (Informative)

A journey planner computing a path should be able to assess a route for navigability according to the PASSENGER ACCESSIBILITY NEEDS specified as input to the journey planning query. This provides a list of USER NEEDs which can be used to derive an accessibility constraint that can be matched with the ACCESSIBILITY LIMITATIONs specified on the ACCESS PATH LINK or STOP PATH LINK. For example, a set of PASSENGER ACCESSIBILITY NEEDS with a USER NEED of wheelchair or motorized wheelchair might give a constraint of *wheelchairAccess*. This would be matched simply with the values for the wheelchair access of an ACCESSIBILITY LIMITATION.

For the ACCESSIBILITY LIMITATIONs a three-valued logic is suggested for each of the main ACCESSIBILITY LIMITATIONs described above. A journey planner computing a journey may use the LIMITATION to deduce whether the accessibility constraint is met as shown in Table 4 — Use of Accessibility Constraints.

— Where the constraint corresponds exactly to the ACCESSIBILITY LIMITATION, the accessibility may be directly deduced. For example, *step free access* can be assessed from the value (***stepFreeAccess* | *stepUseRequired* | *stepUseUnknown***).

— In some cases the ACCESSIBILITY LIMITATION value may also be inferred indirectly from another LIMITATION value even if there is no value available. For example, ***stepUseRequired*** may also be used to infer ***noWheelchairAccess***. An arrow (→) is used to indicate derived values.

— For simplicity of use, most journey planners will present users with just one or two possible USER NEEDs to select. A journey planner may either just directly expose the values, or support more elaborate policies for deriving constraints from different types of need. For example, a planner could just show “No Lifts” (i.e. *averseToLifts*) and simply derive ***liftFreeAccess*** as the constraint, or instead present specific medical needs such as ***heartCondition,*** which might be mapped to a constraint for both ***stepFreeAccess*** and ***escalatorFree*** access.

	PASSENGER ACCESSIBILITY NEED	**wheelchair, motorizedWheelchair**	**Wheelchair, restrictedMobility, luggage Encumbered**	**averseToLifts**	**averseTo-Escalators, restricted Mobility, oversize-Baggage**
		→	**→**	**→**	**→**
	Accessibility constraint (Search Criteria)	**wheelchairAccess**	**stepFreeAccess**	**liftFreeAccess**	**escalator-FreeAccess**
		→	**→**	**→**	**→**
	ACCESSIBILITY LIMITATION (Value)	**wheelchairAccess**	**stepFreeAccess**	**liftFreeAccess**	**escalator-FreeAccess**
Wheel-chair	***suitableFor-WheelChairs***	Wheelchair access	→Step-Free access)	(Unknown)	→Escalator Free Access
	notSuitableFor-WheelChairs	**No Wheelchair access**	→No Step-Free access)	(Unknown)	(Unknown)
Steps	***stepFreeAccess***	(Unknown)	**Step-Free access**	(Unknown)	→Escalator Free Access
	stepUseRequired	→No Wheelchair access	**No Step-Free access**	(Unknown)	(Unknown)
	stepUseUnknown	→No Wheelchair access	**No Step-Free access**	(Unknown)	(Unknown)
Lifts	***liftFreeAccess***	(Unknown)	(Unknown)	**Lift-Free access**	(Unknown)
	liftUseRequired	(Unknown)	(Unknown)	**No Lift-Free access**	(Unknown)
	liftUseUnknown	(Unknown)	(Unknown)	**No Lift-Free access**	(Unknown)
Escalators	**escalatorFreeAccess**	(Unknown)	(Unknown)	(Unknown)	**Escalator-Free access**
	escalatorUse-Required	→No Wheelchair - Free access	→No Step-Free access	(Unknown)	**No Escalator - Free access**
	escalatorUse-Unknown	(Unknown)	(Unknown)	(Unknown)	**No Escalator - Free access**

Table 4 — Use of Accessibility Constraints

6.4.6 Mobility Related Equipment (Informative)

In addition to the ACCESSIBILITY LIMITATIONs, there are certain types of EQUIPMENT and LOCAL SERVICE that are of particular interest to disabled users. Other detailed properties of equipment, including for example the details of access widths, ramp gradients, number of steps, etc. Table 5 — Accessibility Related Equipment properties shows some relevant EQUIPMENT types.

	Disability	Equipment		Property
Local service	Mobility	**AssistanceService**	AccessibilityService	boardingAssistance
				onboardAssistance
			AccessibilityTools	
		LuggageService	Luggage	
Equipment	Mobility	**AccessEquipment**	TactileGuidanceStrips	
		StairEquipment	NumberOfSteps	
			HandrailHeight	
		LiftEquipment	WheelchairTurning	
			MaximumLoad	
		RampEquipment	Gradient	
		EntranceEquipment	AcousticSensors	
			AutomaticDoor	
	Visually Impaired	**PassengerInfo-Equipment**	AccessibilityInfo	audioInformation
				displaysForVisuallyImpaired
				tactilePlatformEdges
				tactileGuidingStrips
				largePrintTimetables
	Hearing Impaired	**PassengerInfo-Equipment**	AccessibilityInfo	visualInformation
				audioForHearingImpaired

Table 5 — Accessibility Related Equipment properties

6.4.7 Example of Passenger Accessibility Needs for a Station

Figure 50 shows and example of a input form to capture PASSENGER ACCESSIBILITY NEEDS. It allows users to specify a ranking for different types of User need and Equipment

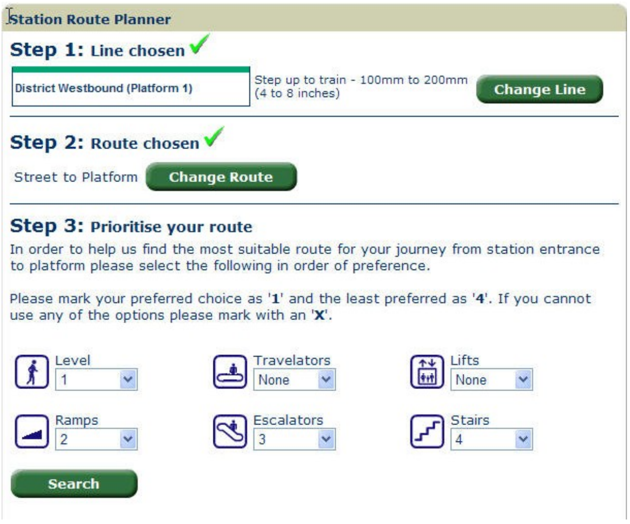


Figure 50 — Example of a User Need based accessibility input using a ranking (Courtesy of directenquiries.com)

6.5 Stop Place Model Views

The stop assignment and the navigation submodels shown above represent specific functional views of the stop place model that require specific additional constraints to be true of the use of components; for example that entrance doors are associated with specific ACCESS SPACEs or QUAYs; or that if a SCHEDULED STOP POINT is associated with a platform, then it is also associated with the station that contains the platform. The constraints correspond to real-world properties of the STOP PLACE as a physical location embedded in the real world.

Other more general views will be needed by other types of application. A generic correspondence between STOP POINTs and STOP PLACE COMPONENTs (or groups of components) according to a functional purpose is necessary and can be stated using the generic concept of STOP PLACE VIEW.

Figure 51 shows a UML diagram for an arbitrary general stop view.

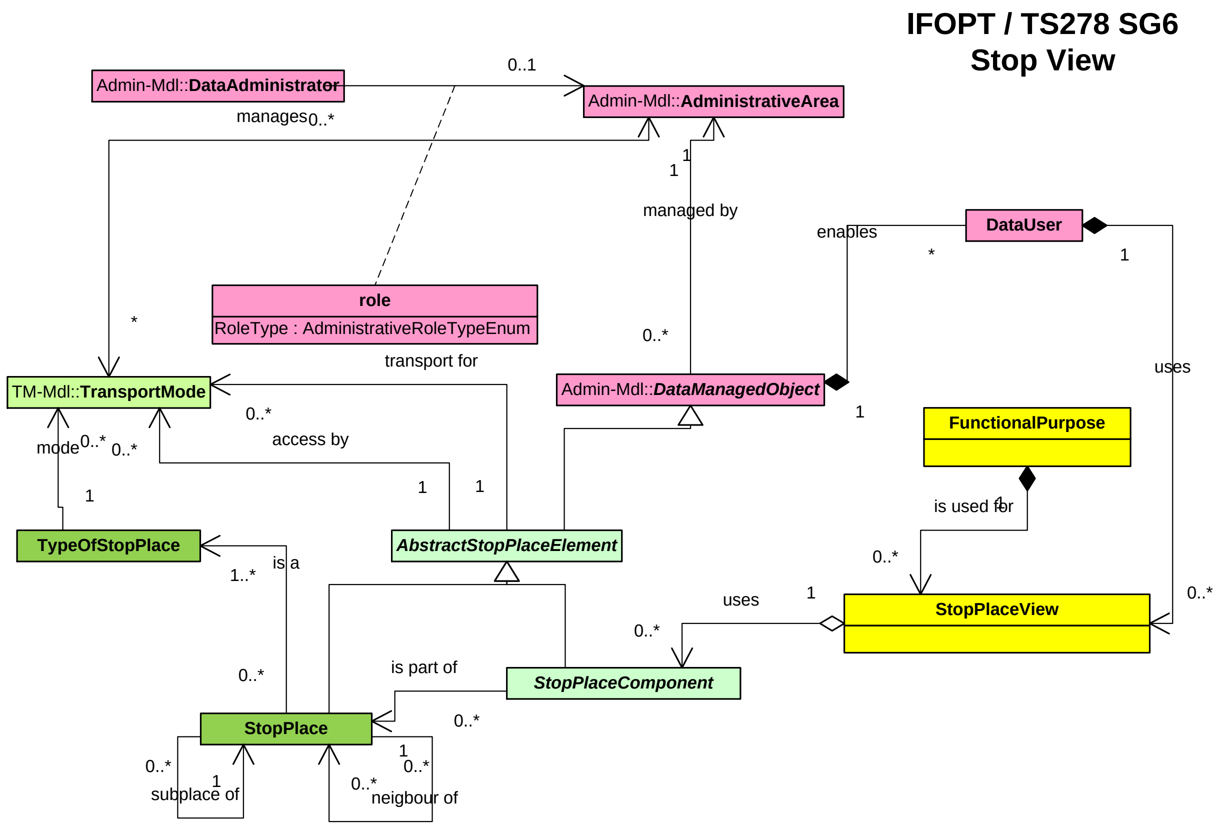


Figure 51 — UML Diagram for General Stop View

6.6 On-Street Stop Place View

Figure 52 shows a subset of the Stop Place Model selecting the main elements relevant for the representation of on street stops. STOP PLACE and QUAY are the primary elements and would suffice for most cases.

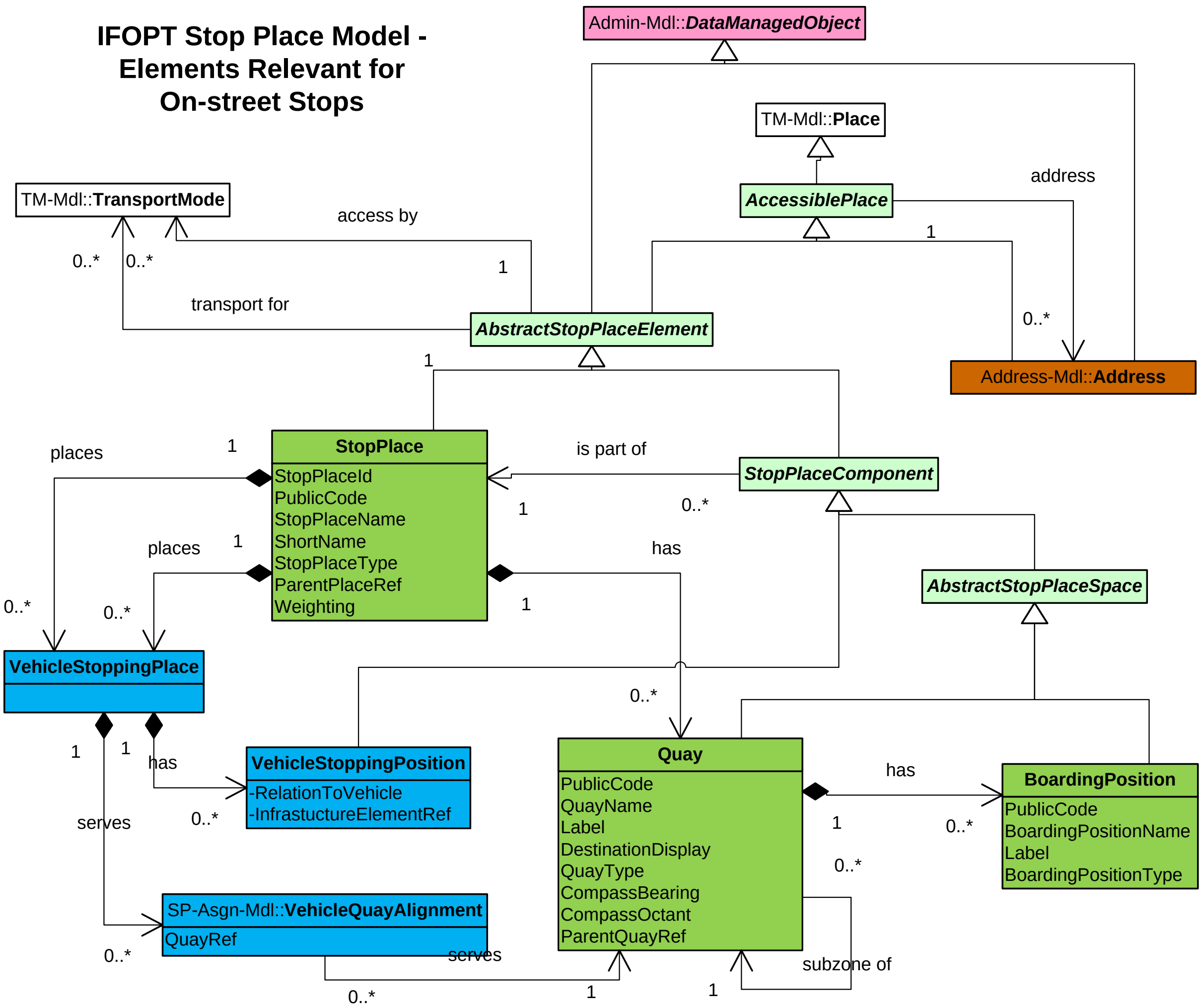


Figure 52 — Stop Place Elements relevant for On-Street Stops

6.7 Parking

Information about the available parking and the relationship of the parking to the STOP PLACE is of relevance to passengers who arrive or depart by road transport. To represent Parking requires a complex model in its own right to describe the many different types of parking and their properties, such as the terms of use, the types of user, the capacity for different vehicle types, the payment methods allowed, whether there is booking, etc. IFOPT does not currently provide a detailed model of a car park, but sets out only a simple outline PARKING model that can be used to record the existence of parking and the relationship of the entrances and exits to other STOP PLACE COMPONENTs.

A PARKING describes a car or other vehicle park. A PARKING can exist independently of a STOP PLACE.

A PARKING may have designated PARKING PASSENGER ENTRANCEs and a PARKING ENTRANCE FOR VEHICLEs. Within a PARKING there may be PARKING AREAs containing individual PARKING BAYs, as well as smaller PARKING AREAs.

PARKING PROPERTies can be used to indicate specific capabilities such as parking for the disabled.

PATH LINKs may be used to link PARKING AREAs, PARKING BAYs, and other STOP PLACE COMPONENTs

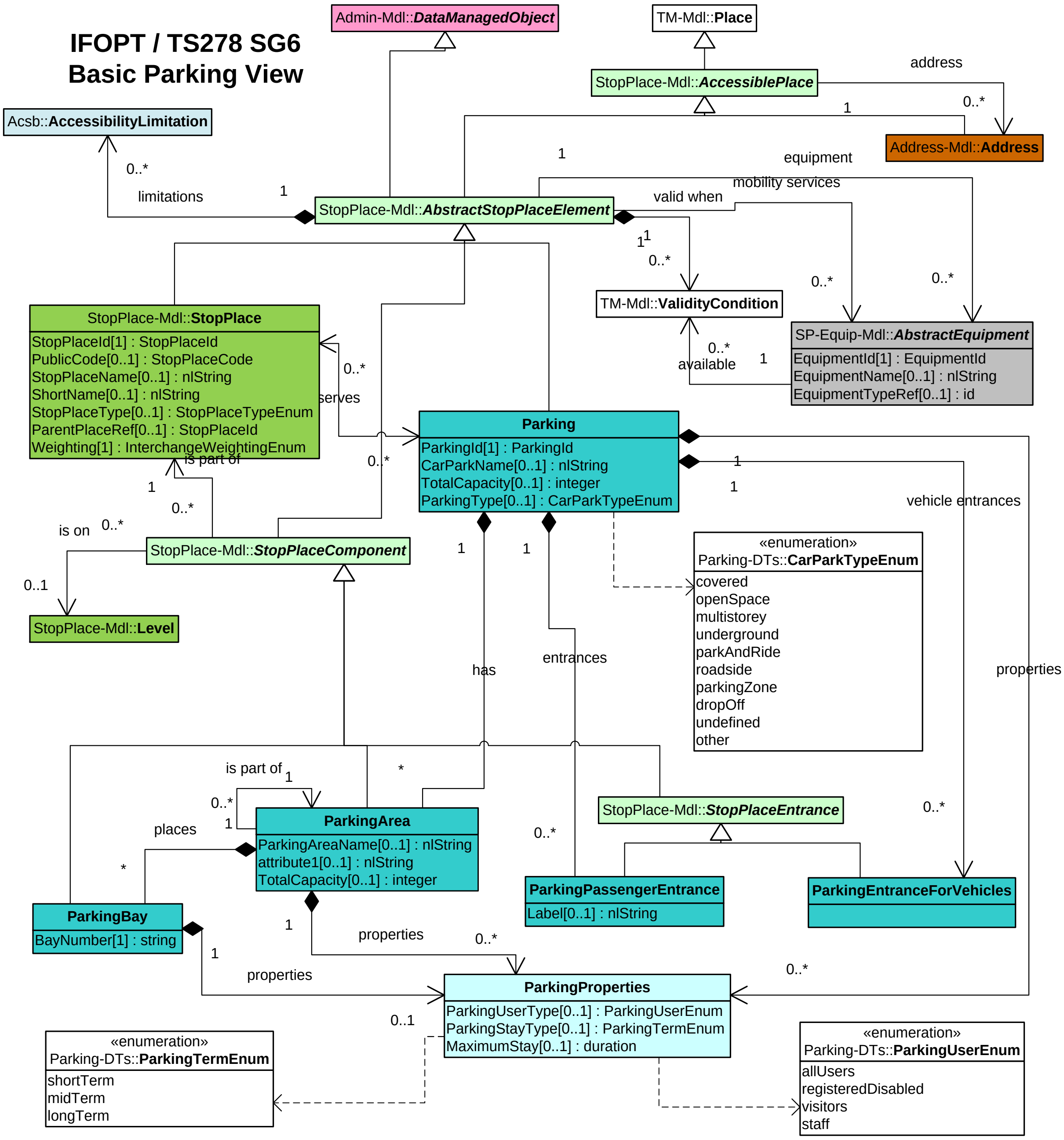


Figure 53 — UML Diagram of Basic Parking Elements

6.8 Stop Place Model Summary View

Figure 54 shows just those elements relating to the main STOP PLACE element. For many purposes, for example stop finding, the STOP PLACE, and its relation to the surrounding context will be the primary object of interest. The diagram also shows an ALTERNATIVE COMMON NAME to allow the use of arbitrary alternative names for a place.

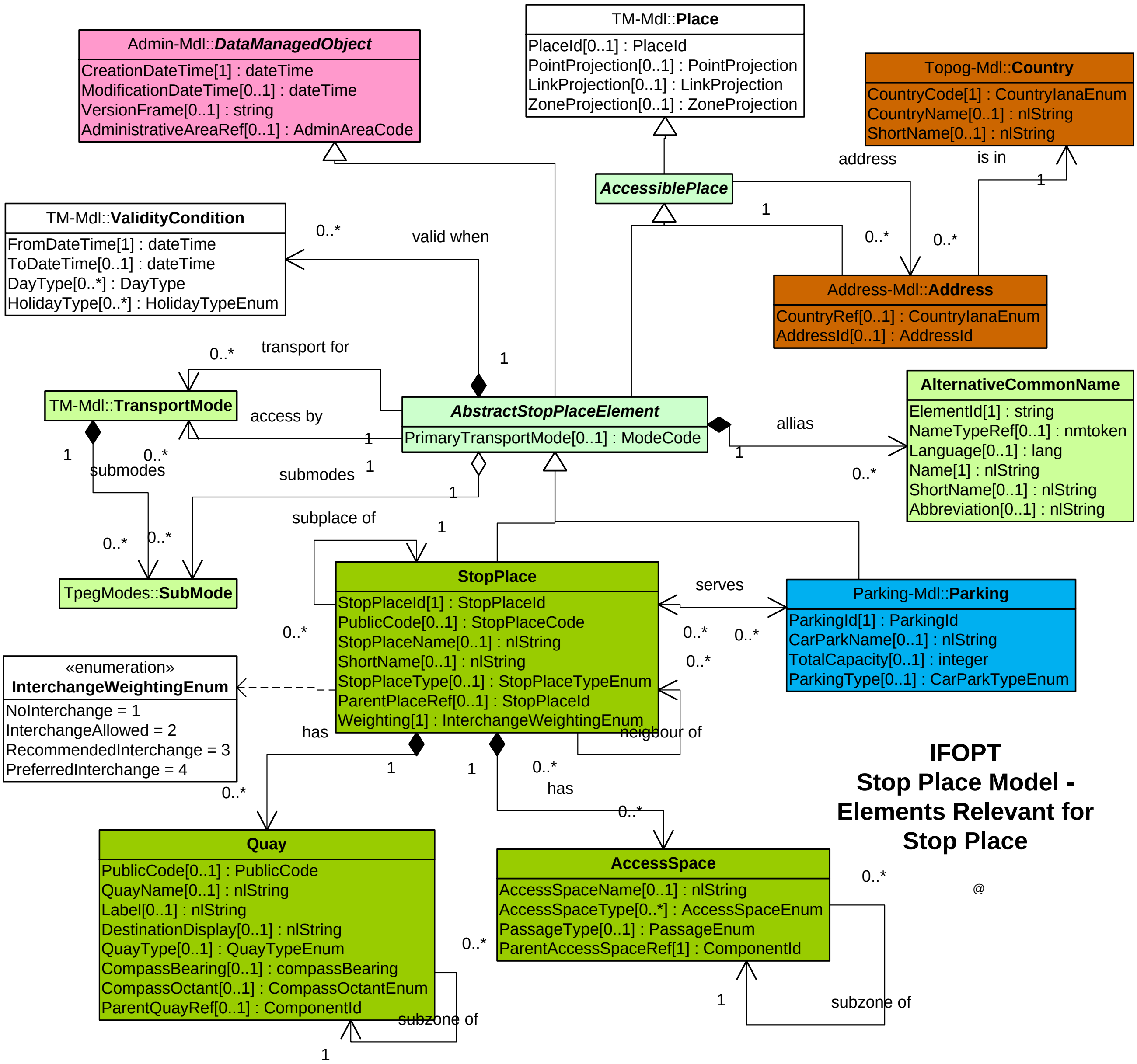


Figure 54 — UML Diagram of Stop Place Elements

6.9 Stop Identification

An important purpose of a Stop Place Model is to support the systematic identification of stops by both humans and computers.

6.10 Types of Stop Identifier

In effect, there are three quite distinct sets of identifiers that may be associated with a stop element:

a) **Unique System Identifiers:** Different federated systems, such as distributed journey planners, need to be able to use a unique identifier that will unambiguously reference a specific stop place component. Such identifiers are for computer use and do not need to be passenger friendly, but may need to meet certain technical constraints, for example to be a single token from a restricted character set, and not overly verbose. Such identifiers are also subject to legacy data constraints in that it must be possible to migrate large data sets of existing identifiers into any wider harmonised system.

b) **Public Labels:** Certain Stop Place components need to be labelled so that humans can recognized them, for example Stations, Platforms, Bus Stops. Different labels for the same entities may be appropriate in different circumstances.

c) **Public Codes.** Certain Stop Place components may also be given a short code for easy input by humans using a computer interface such as a mobile phone or web site For example Airports, Stations, some Bus Stops. Such codes need to be ergonomic, such that they are easy to read, to input on devices, and to remember. We note that some new wireless technologies, such as Near Field Communication (NFC) may reduce the need to use Public codes in some contexts since they allow the user to interact directly with the environment, for example simply by touching a mobile device to a bus stop, or route map, rather than to enter a code manually.

The sections below describe each of these identifiers in more detail.

6.11 Principles for Issuing Stop Identifiers

Comparison of existing National and regional systems of stop identifiers reveals many similarities; it is possible to establish normative principles for how stop identifiers need to be constructed and managed to allow for pan-European (and indeed global) systems, and these are stated as part of the IFOPT standards. At the same time, it is noted that certain implementation details, such as the length of code elements, do not need to be harmonised at a European level and indeed it would be difficult to do so because of the need to migrate legacy identifiers and because of differences in the size of countries, etc. We therefore organise discussion of Stop Identifiers in IFOPT into two sections (a) normative principles to be followed in allocating system identifiers and (b) informative discussion on the use of stop identifiers, stop labels and public codes.

6.12 Principles for Stop Place Identifiers (Normative)

a) Stop Place identifiers & Stop Component Identifiers should be unique within each country. A country prefix should be used to ensure global uniqueness.

b) Within each country, the system must allow for a distributed model, with the allocation of stop identifiers being delegated to multiple stakeholders, each responsible for an area and mode(s) and being allocated a name space, i.e. administrative identifier within which it can issue its own range of identifiers..

c) The recommended structure of unique identifier for Stop Places is:

   1) *Country Code + Administrative Area Identifier + Stop Place Identifier*

Administrative Area identifier should be unique within the country. It may represent either an Administrative area or a transport mode or both.

d) The recommended structure of unique identifier for Stop Place Component is within Stop Place, i.e.:

   1) Country Code + Administrative Area Identifier + Stop Place Identifier + Stop Place Component Identifier

e) Once allocated, Stop Place identifiers should not be reused, because other systems may hold historically useful data associated with the historic stop identity.

f) It should be possible to render the identifiers into commonly user character sets for the purposes of data exchange as serial files.

g) Identifiers are distinct from public labels and public codes; for usability the latter might be chosen to be unique within a country for a given mode.

6.13 Discussion of Stop Identifiers, Codes and Labels (Informative)

6.13.1.1 Unique System Identifiers for Stop Places & Stop Place Components

Computer systems supporting a national or international context require a globally unique identifier with which to exchange references to stop elements. Stop data will typically be originated and managed by a number of different data administrators, each with authority over different subsets of data, and so a distributed method of allocating stop identifiers is needed. The IFOPT administrative model can be used to coordinate the allocation of stop identifiers.

6.13.1.2 Ergonomic & Efficiency Requirements for Unique System identifiers

Since system Identifiers are for computer use, they may be fairly long and have a complex format. The primary concern is to ensure uniqueness of reference. However large numbers of stops may need to be exchanged at a time, so for efficiency it is desirable to be able to use a partial qualified reference.

6.13.1.3 Derivation of Stop Place Component System Identifiers from a Model

The use of an IFOPT model to represent stops allows clarity in the derivation of unique system stop identifiers for different purposes. The rules to construct the identifiers can be described as a path (in the technical computer sense) over certain model relationships and elements, using the notation

Entity/*attribute* ***: Entity/****attribute* ***: Entity/****attribute*

Where each ***Entity*** is an attribute of an element connected by a relationship. For example, one way to assign Unique system identifiers is as follows:

Country/*CountryCode:* ***AdministrativeArea/****AdministrativeAreaNameSpaceCode* ***: Mode/****ModeCode****:***
StopPlace*/SystemIdentifier* ***: StopPlaceComponent*** */SystemIdentifier*

EXAMPLE 1 +uk: 410 1: 564567: 0

In this case the Administrative identifier is composed of the Administrative area plus a mode identifier.

Another way would be simply:

Country/*CountryCode:* ***AdministrativeArea/****AdministrativeAreaNameSpaceCode* ***:***
StopPlace*/SystemIdentifier* ***: StopPlaceComponent*** */SystemIdentifier*

EXAMPLE 2 +uk: 410: 564567: 0

6.13.1.4 Globally Unique System Identifiers

In order to achieve unique European (and Global) System identifiers, it suffices to prefix all names with a unique code indicating the country. The other components of the system identifier may be chosen on a *regional basis.*

Country /CountryCode: Entity: Entity, etc

For IFOPT, the IANA code is preferred as the Country code, e.g. se, fr, de,

EXAMPLE +fr: 49 1: 564567: 0

6.13.1.5 Alternative System Identifiers

For some applications other types of unique system identifier may need to be associated with a stop element; these may have a different name scope. For example, to support AVMS cleardown, using direct vehicle-to-display wireless communication for which only short bit codes are practical. Short identifiers may not need to be nationally unique.

Entity/attribute: Entity/AlternativeIdentifier: AlternativeIdentifier

EXAMPLE uk: 410: 1: 22

6.13.2 Public Labels for Stop Places & Stop Place Components

Stop Places and stop place elements need to be *labelled* for reference by human beings on timetables, vehicles displays, journey planners, printed itineraries and so forth.

Different label names may be required in different circumstances. For example, *'Gare de Lyon',* and *'Paris, Gare de Lyon'*: the relevant version will depend on both what the user already knows (e.g. "am I in Paris?") and the available space in the presentation media. For example a web browser might show "Waterloo International, Platform 13b", a mobile device "Waterloo Int, Plt 13b", and a sign on the platform just "13b".

There may also be different aliases for a stop, for example based on the Point of Interest or related Stop Place, or in different National languages. These are allowed through the ALTERNATIVE STOP NAME.

For bus stops, a public indication of the ROUTE or LINE is often a significant part of the signage associated with a stop. Strictly speaking in Transmodel, the ROUTEs or LINEs associated with by a stop are not a property of the Stop Place Model, but rather of the Timetable Model, since they depend on the association of the stop with specific JOURNEY PATTERNs and VEHICLE JOURNEYs of the timetable - and may change without alteration to the stop. However the signage on the stop, which may provide a public indication of the ROUTE or LINE and change if the routes change, can be part of the EQUIPMENT associated with a STOP PLACE COMPONENT.

The purpose of a name is to distinguish a thing from another similar thing sufficient to discriminate between the two in a particular context: similarly, stop place labels need to provide the information needed to discriminate the stop from other similarly named stops. The choice of label to use in a specific context will reflect the discriminations to be made in that context. For example, when displayed in lists in place finders within a national context, stop place names will typically need to be prefixed by a topographic place name in order and to distinguish the stop name from other similar names (and perhaps to provide users with a context within which to recognise the name).

EXAMPLE 1 If you enter '*High Street'* without a town name, there might be many possible candidates, so the locality may be added as a prefix, *'Oxford, High Street'.* When displayed in a more local context, the locality name may not be needed. If there is only one *High Street* in Oxford, and if the context is just Oxford, it is a sufficient label.

EXAMPLE 2 As a further example, here are some suitable labels for ‘Church End’, a real UK place name in three different contexts:

a) Within a UK national Context

Church End (Finchley), Greater London
Church End (Haddenham), Haddenham (Bucks), Buckinghamshire
Church End (N Yorks), North Yorkshire
Church End (Nr Chorleywood), Hertfordshire
Church End (Nr Little Hadham), Hertfordshire
Church End (Nr Shustoke), Warwickshire
Church End (Nr Upton upon Severn), Upton upon Severn, Worcestershire
Church End (Nr Weston), Hertfordshire
Church End, Over, Cambridgeshire
Church End (Pitstone), Buckinghamshire
Church End (Willesden), Greater London
Church End (Woodwalton), Wood Walton, Cambridgeshire
Church End, Basingstoke, Hampshire
Church End, Catworth, Cambridgeshire
Church End, Edlesborough, Buckinghamshire
Church End, Eltisley, Cambridgeshire
Church End, Long Crendon, Buckinghamshire
Church End, Parson Drove, Cambridgeshire
Church End, Steeple Claydon, Buckinghamshire
Church End, Swavesey, Cambridgeshire
Haynes Church End, Bedfordshire
Kempston Church End, Bedfordshire

b) Within the Context of the County of Buckinghamshire

Church End, Haddenham
Church End, Pitstone
Church End, Edlesborough
Church End, Long Crendon
Church End, Steeple Claydon

c) Within the Context of the Town of Haddenham,

Church End

6.13.2.1 Ergonomic & Efficiency Requirements for Stop Place Component Labels

Labels must be human readable – that is textual, and be designed to be easy to use. They should use consistent order and format, and use consistent typographical conventions, abbreviations, etc, so that, when presented in lists or on signs, they are easy to comprehend.

On media with only a limited presentation space, such as tickets or SMS messages, short or abbreviated forms of the label may be needed.

6.13.2.2 Derivation of Stop Labels from Model

Labels can be derived from the model in many different ways. IFOPT does not need to prescribe the preferred format, but is intended to provide a model to contain all the necessary elements for flexibly constructing names in different circumstances. Some of the most useful are given by the following path expressions:

— Full National Context

Country/*name:* ***[Topographical Place] *: Stop Place Long Name: [:StopPlaceComponent]***

EXAMPLE 1 *France, Paris, Gare de Lyon*
France, Paris, Gare de Lyon, Quay 3

— Disambiguation Context

When using a stop finder in a journey planner or other system, the user may often enter a name or partial name without being aware whether it is ambiguous. The user will need:

Stop Place Long Name: Topographical Place (Parent Topographical Place)]

EXAMPLE 2 *Church End (Nr Chorleywood), Hertfordshire*
Church End (Nr Little Hadham), Hertfordshire

— Stop Place Context

In the context of a Stop Place, the requirement would be:

Stop Place Long Name: Quay name

EXAMPLE 3 Gare de Lyon, Platform 5

6.13.3 Public Codes for Stop Places & Stop Place Components

Short codes for STOP PLACEs and SCHEDULED STOP POINTs should be both easy to use by humans, and resolvable by a computer into a unique reference. The codes will typically be allocated by mode. A well known example is the set of IATA airport codes, e.g. LHR, JFK.

The requirements to be unique, short and memorable are to some extent conflicting and a trade-off has to be made. There may be cultural considerations to accommodate too, for example in Germany there is a well established system of numeric Rail Station identifiers used in ticket machines.

6.13.3.1 Ergonomic & Efficiency Requirements

To be easy to use by humans, stop identifiers should be ergonomic, that is they should be designed to allow for well known cognitive aspects of Human Computer Interaction (HCI). HCI Factors include being easy to memorise, and suitability for use on a specific device such as a mobile phone keypad, keyboard or Voice Recognition system

— For example, there is extensive evidence from Experimental Physical Psychology to suggest that the most memorable codes are Rule based. Name allocations using elements familiar to the user e.g. e.g. country, mode, and name related mnemonics (e.g. KGX for Kings Cross) will be easier to remember than arbitrary strings of numbers or characters. Human short term memory limits codes to be no more than 7 chunks for most people.

— For input on a phone pad, characters should be alphanumeric, from a limited character set and avoid successively repeating characters.

— Alphabetic codes can be shorter and more meaningful than purely numeric codes – at least for those familiar with the Latin alphabet.

The size of the discrimination space has a direct bearing on the viability of finding mnemonics that are both short enough and meaningful. On the National scale of a European State, it is generally feasible and useful to allocate meaningful mnemonics to Airports, Ports, and Railway Stations, which correspond in general to major settlements and towns., but not to bus stops which are more numerous and only unique in a local context.

6.13.3.2 Derivation of Stop Codes from Model

It will be desirable to adopt a uniform approach to devising public stop codes as this will allow users to understand the coding system in many different contexts.

This is likely to be based on unique system identifiers that can be assigned as follows:

Country/*CountryCode:* ***Mode: [ModeCodeNameSpace] /****ModeCode*

EXAMPLE

- Rail
  - Fr.rail.gdn
  - 33.1.gdn
  - uk.rail.kgx
  - 44.1.kgx
- Air
  - uk.air.lhr
  - 44.4.lhr
- Bus
  - Uk.bus.man.adapt
  - 44 2 626 23278

7 Point of Interest Model

Passengers making a journey will often be travelling to reach an attraction or other destination of interest, not simply to visit a bus stop or station. The exact relationship of such Points of Interest is therefore of strong relevance to journeys and other passenger information systems.

The Point of Interest Model is used for journey planning to describe these destinations and their immediate environs to a sufficient level of detail to allow the creation of accurate detailed journey plans for passengers.

7.1 Physical Models

Figure 55 shows a typical use of a point of interest in a journey planner. The British Museum is a recognised POINT OF INTEREST with street access points and also a main POINT OF INTEREST ENTRANCE used to represent it on a map at lower levels of resolution. (This entrance point is a distinguished point and not necessarily its centroid). A specific journey planning request will identify the appropriate entrance to use and relate it to other queries. Other Points of interest are also shown as named items on the map.

— The POINT OF INTEREST model comprises POINTs OF INTEREST, each of which is a type of PLACE with one or more distinguished ENTRANCEs

— The POINT OF INTEREST is associated with a POINT OF INTEREST CLASSIFICATION. The CLASSIFICATION is used to index it according to well defined categories that can be used to search for type of point, for example museums, parks, swimming pools, prisons, post offices.

— The POINT OF INTEREST may be associated with an ADMINISTRATIVE AREA responsible for various ADMINISTRATION ROLEs such as gathering, maintaining and/or distributing data for a designated region of a country or region.

7.1.1 Illustrations of Actual Points of Interest

Some real-world examples of points if interest on maps at different scales show particular aspects of the Point of Interest Model in a realistic context.

— Figure 55 shows a POINT OF INTEREST (The British Museum) and its access point.

— Figure 56 shows a view of a large POINT OF INTEREST with multiple access.

— Figure 57 shows a complex Point of Interest (The Sahlgrenska Hospital) with access paths.

— Figure 58 shows the use of a POINT OF INTEREST CLASSIFICATION hierarchy.

— Figure 59 shows the use of a map view of POINT OF INTEREST CLASSIFICATION.

— Figure 60 shows the use of an alternative POINT OF INTEREST CLASSIFICATION hierarchy than the one in Figure 59.

7.1.2 Modelling the entrance to a building

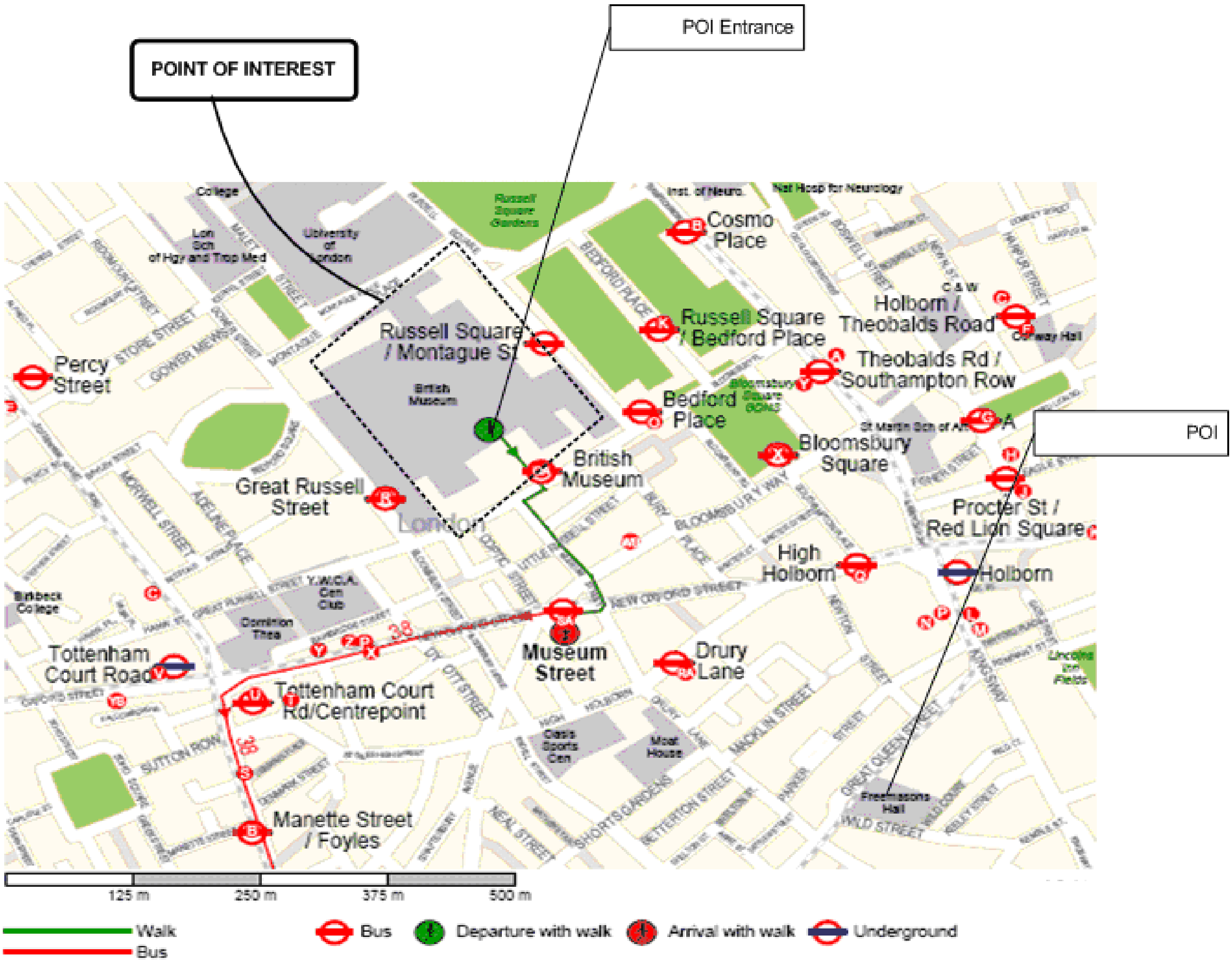


Figure 55 — Point of Interest Example: Building entrance (Courtesy of TfL)

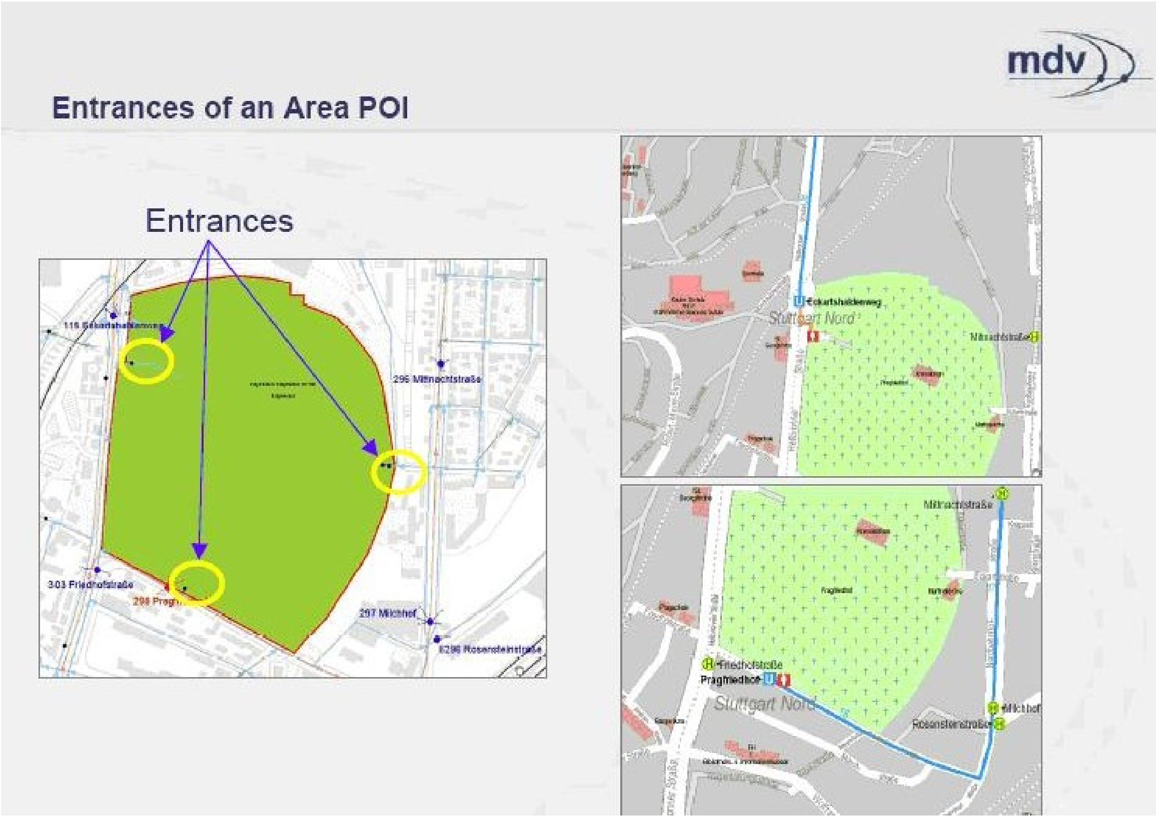


Figure 56 — Point of Interest Example: Park Entrance (Courtesy of MDV)

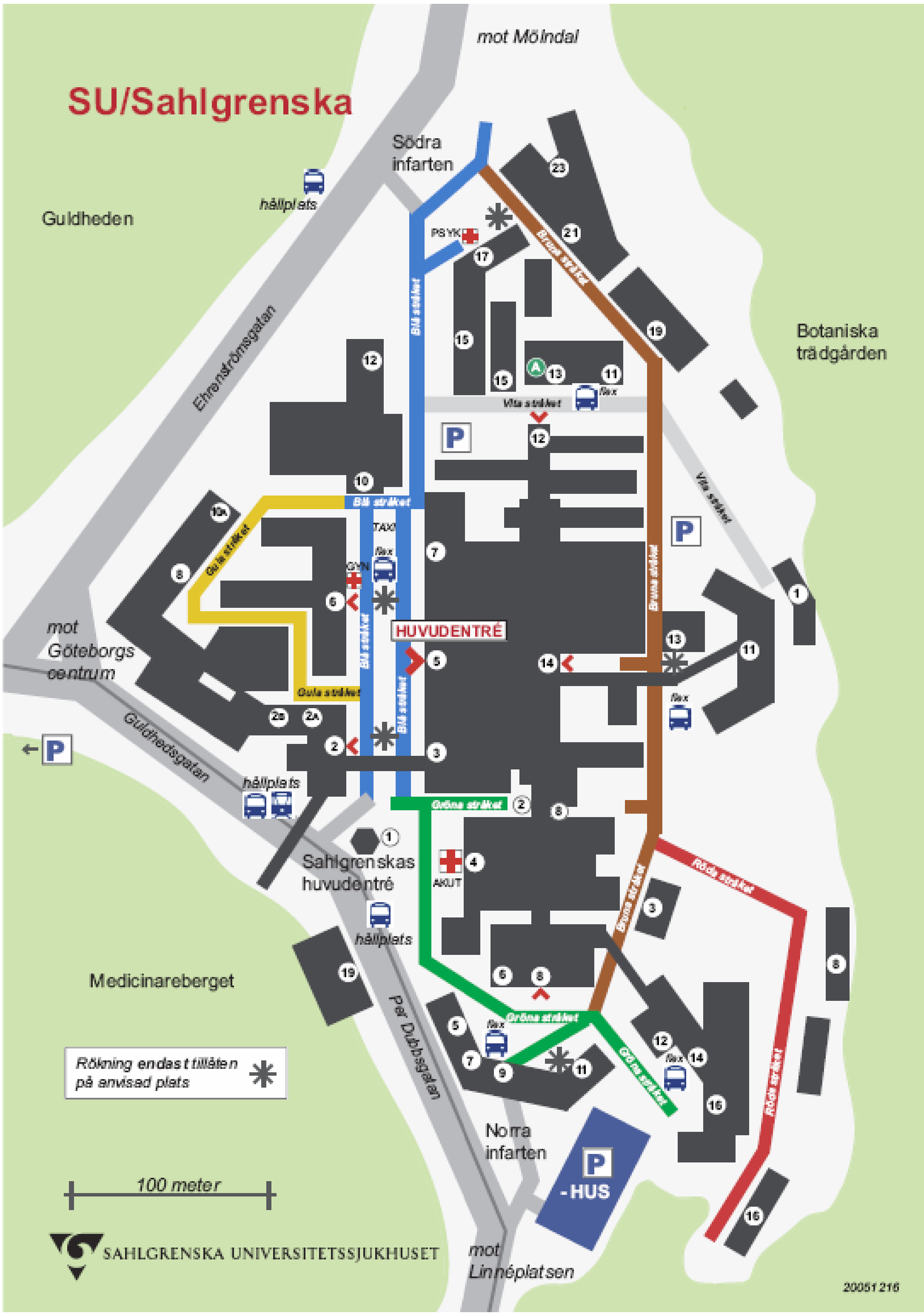


Figure 57 — Point of Interest, example of a hospital (Courtesy of Sahlgrenska Universitetssjukhuset)

7.1.3 Classifications of Actual Points of Interest

mdv

POI Classification into Categories and Subcategories

POI Group	Top-level	Sub 1	Sub 2	Sub 3	Text
SET	A				**Accommodation**
SET	A	A			Bed & Breakfast
SET	A	B			Hotels & Guest Houses
SET	A	C			Camping, Caravans, Self-cate.
SET	A	D			Hostels
SET	B				**Attractions**
SET	B	A			Botanical and Zoological
SET	B	B			Historical and Cultural
SET	B	C			Recreational and Scenic
SET	B	E			Tourist Attractions
SET	C				**Sport And Entertainment**
SET	C	A			Outdoor Pursuits
SET	C	B			Sports Complexes
SET	C	C			Venues, Stage And Screen
SET	D				**Education**
SET	D	A			Primary and Nursery
SET	D	B			Secondary, Middle a. Indepe.
SET	D	C			Colleges and Universities
SET	D	D			Recreational

POI Group	Top-level	Sub 1	Sub 2	Sub 3	Text
SET	E				**Public Infrastructure**
SET	E	A			Police and Court Service
SET	E	B			Local Services
SET	E	C			Other Government Services
SET	E	D			Public Facilities
SET	F				**Health**
SET	F	A			Surgeries (Dental & Doctor)
SET	F	B			Clinic & Health Centres
SET	F	C			Hospitals
SET	F	D			Nursing and Care Homes
SET	G				**Eat and Drink**
SET	H				**Retail**
SET	H	A			Convenience Stores
SET	H	B			Department Stores
SET	H	C			Markets
SET	H	D			Retail Centres
SET	H	E			Supermarkets

Figure 58 — Example Point of Interest Classifications (1) List (Courtesy of MDV)

POINT OF INTEREST CLASSIFICATIONs can vary depending on usage even in the same region, so multiple classifications of the same points need to be supported. Figure 59 shows County POI Information with a focus on: Tourism/Recreation, Cultural, Environment, Nature Conservation, Public Health/Hospitals and Public Service attractions. Similarly 60 — Point of Interest Classification (Courtesy of Göteborg & Co/Göteborgs Turistbyrå) shows classifications for a Tourist organisation for part of the same area, with a focus on Hotels, Food, Activities, Tourist Attractions, Terminals, Arenas, Restaurants and Cafés.

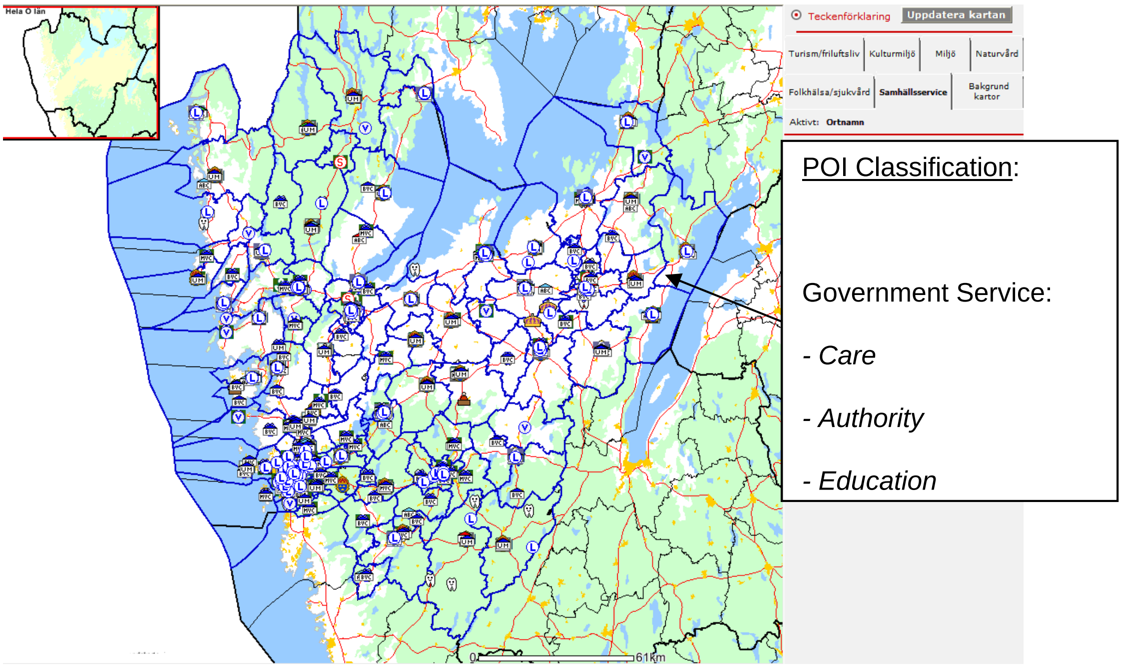
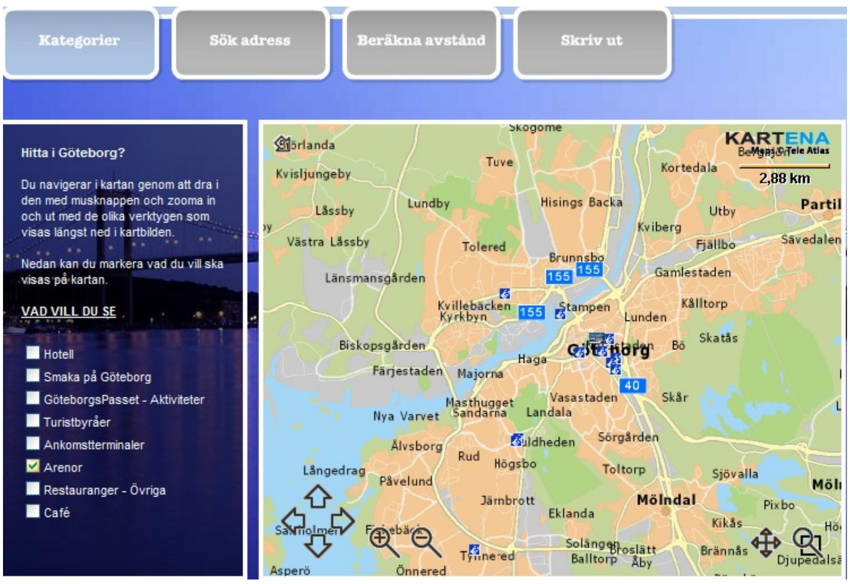


Figure 59 — Point of Interest Classification (2) Tourist (Courtesy of Västra Götalandsregionen)



POI Classification:

- *Hotel*
- *A tast of Goteborg*
- *Discount Card -venues*
- *Tourist information*
- *Terminals*
- *Arenas*
- *Restaurants - other*
- *Cafés*

Figure 60 — Point of Interest Classification (Courtesy of Göteborg & Co/Göteborgs Turistbyrå)

7.2 UML Model of Point of Interest Model

Figure 61 introduces a basic Point of Interest Model.

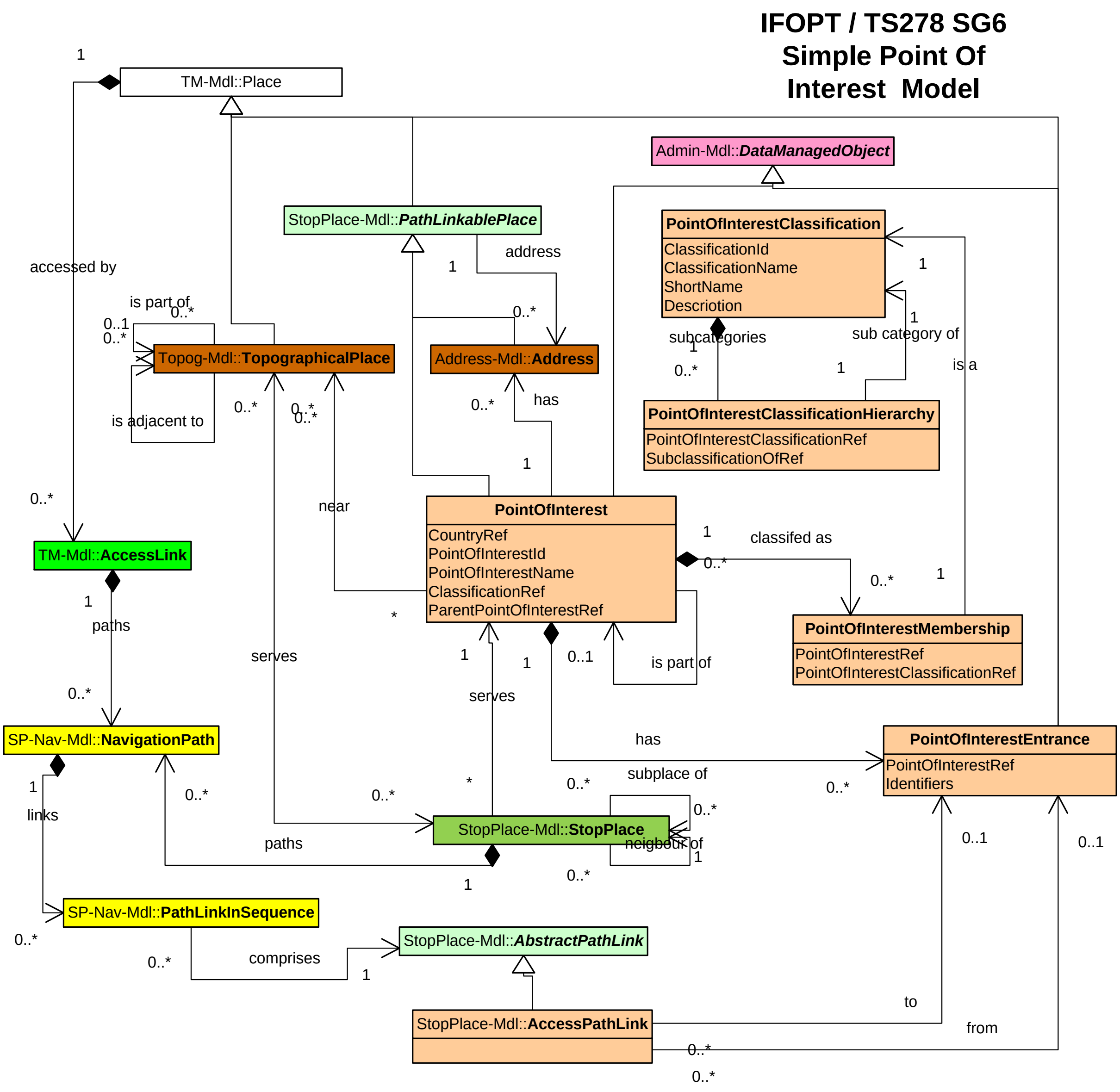


Figure 61 — UML Diagram of Basic Point of Interest Model

The fundamental entities of the Point of Interest Model are as follows:

- A POINT OF INTEREST represents a named place that may be a destination or origin of travel.
- A POINT OF INTEREST is a recursive entity and may be part of a larger parent POINT OF INTEREST.
- A POINT OF INTEREST may be associated as being near or within one or more TOPOGRAPHICAL PLACEs.
- A POINT OF INTEREST may be associated with one or more STOP PLACEs that serve it.

— A POINT OF INTEREST may have one or more POINT OF INTEREST ENTRANCEs.

— An ACCESS LINK can be used to describe a specific connection between a POINT OF INTEREST and a STOP PLACE. An ACCESS LINK may specify one or more NAVIGATION PATHs describing a detailed sequence of PATH LINKs.

— A POINT of INTEREST may have one or more POINT OF INTEREST CLASSIFICATIONs.

— The POINT OF INTEREST CLASSIFICATION and POINT OF INTEREST CLASSIFICATION MEMBERSHIP are used to encode a hierarchy of classifications to index and find different types of POINT OF INTEREST. For example, *Educational Building → School → Primary School,* or *Cultural Attraction → Museum → Art Museum.*

— POINT OF INTEREST CLASSIFICATION MEMBERSHIP does not have to be disjoint, i.e. the same category may appear in more than one CLASSIFICATION.

— A POINT OF INTEREST may have a POINT OF INTEREST ALTERNATIVE NAME.

In addition Points of Interest share common properties:

— POINT OF INTEREST is a PLACE and may have both a Zone Projection and a Point Projection.

A POINT OF INTEREST and a POINT OF INTEREST ENTRANCE may be associated with an ADDRESS.

Figure 62 refines Figure 61 to show further details about the POINT OF INTEREST entities.

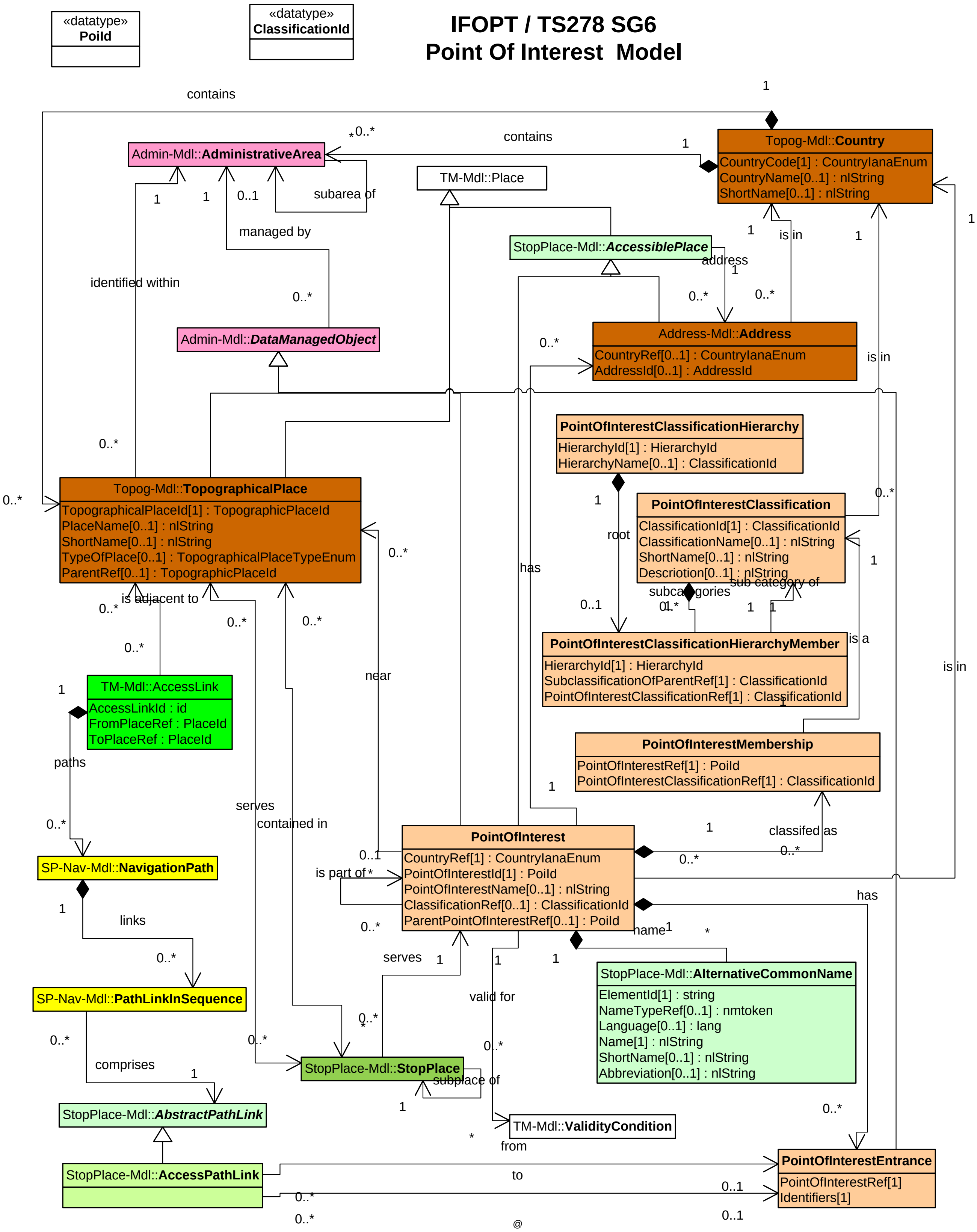


Figure 62 — UML Diagram for a Point of Interest Model

8 Topographical Model

The Topographical Model provides the context necessary to associate a stop with real-world places relevant for journey planning and stop finding. It provides in effect a Gazetteer of place names in a jurisdiction, providing a canonical list of place names, with sufficient context to discriminate between settlements with the same or name that lie in different parts of the region – the TOPOGRAPHICAL DATA SYSTEM. It also provides a simple model of the hierarchy and adjacency of such places.

8.1 Physical Models

Topographic places reflect the hierarchies of towns, cities and other settlements.

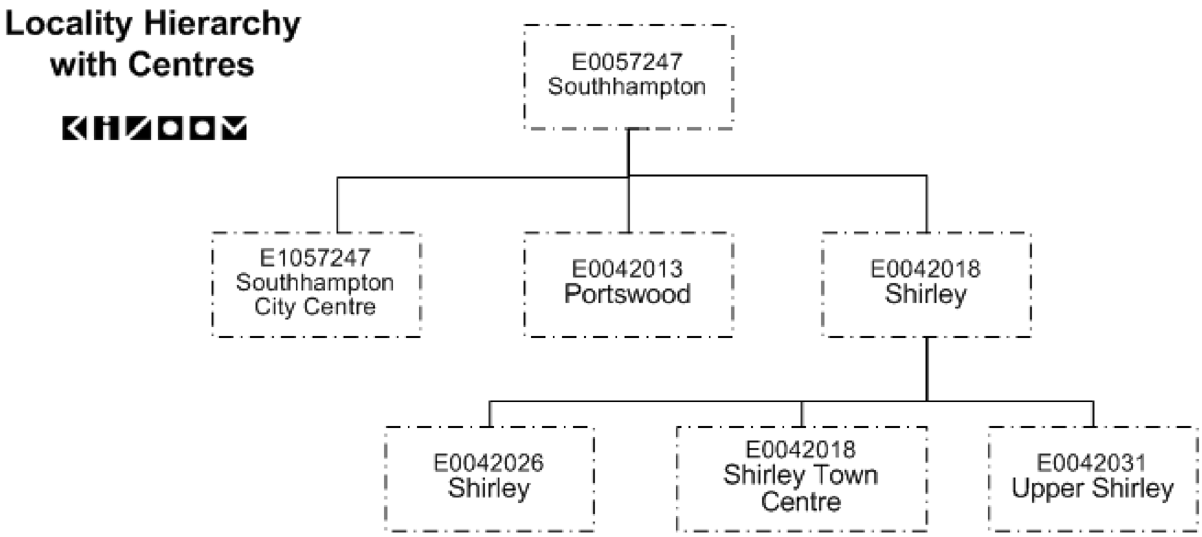


Figure 63 — Example: of a Place Hierarchy

8.2 UML Model of Topographical Model

Figure 64 shows a UML diagram that introduces the Topographical Place Model.

TOPOGRAPHICAL PLACEs correspond to named geographic localities and so for any country can be organised hierarchically (For example London, Westminster, Whitehall) using an '*is part of'* Relationship.

Each TOPOGRAPHICAL PLACE constitutes a Gazetteer entry for a specific TYPE OF TOPOGRAPHIC PLACE (town, city, suburb etc). The data of the TOPOGRAPHICAL PLACE model is similar to that of a simple Gazetteer of names of places but includes additional relationships relating to the use of public transport and also for the management of data.

TOPOGRAPHICAL PLACEs may overlap (e.g. London West End and Westminster), so it is legitimate for a TOPOGRAPHICAL PLACE to belong to more than one hierarchy.

— The '*is part of*' relationship indicates spatial containment.

— Physical *adjacency* may be indicated by a separate relationship.

A STOP PLACE may be associated with a TOPOGRAPHICAL PLACE in three separate relationships.

— The *contained in* relationship indicates that the STOP PLACE lies within the bounds of the TOPOGRAPHICAL PLACE. A STOP PLACE may be contained in more than one TOPOGRAPHICAL

PLACE. By implication if a STOP PLACE is contained in a TOPOGRAPHICAL PLACE, then it is also contained in all the parent TOPOGRAPHICAL PLACEs that the TOPOGRAPHICAL PLACE *is part of.*

— The *serves* relationship indicates that the STOP PLACE may be considered to serve the TOPOGRAPHICAL PLACE but is not necessarily located within it, as for example an Airport outside a city. A STOP PLACE may serve more than one TOPOGRAPHICAL PLACE.

— The *main terminus* relationship indicates that the STOP PLACE may be considered to serve the TOPOGRAPHICAL PLACE as one of its main points of access, for example main rail termini or airports. Typically there will be only a few main termini instances. A STOP PLACE may be the main terminus for more than one TOPOGRAPHICAL PLACE.

TOPOGRAPHICAL PLACE is a Type of PLACE and so may be given a spatial projection.

A POINT of INTEREST may also be associated with a STOP PLACE.

All the components of a STOP PLACE are considered to have the same topographical relationships as their parent STOP PLACE.

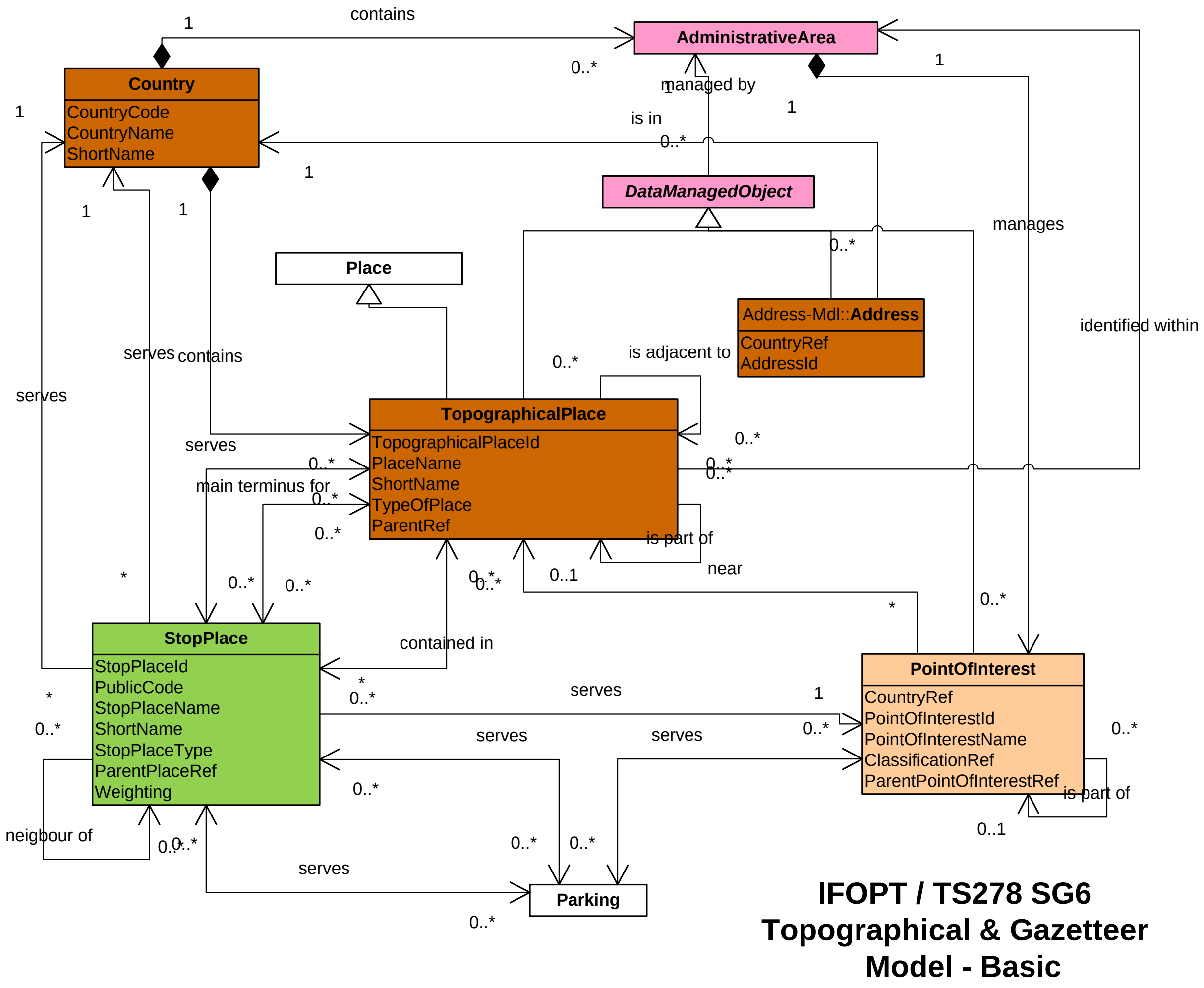


Figure 64 — Basic UML Diagram for Topographic Place

Figure 65 elaborates the UML diagram of the Topographical Place Model with some further detail.

It is also possible to associate SCHEDULED STOP POINTs and STOP AREAs directly with a TOPOGRAPHICAL PLACE without recourse to a STOP PLACE.

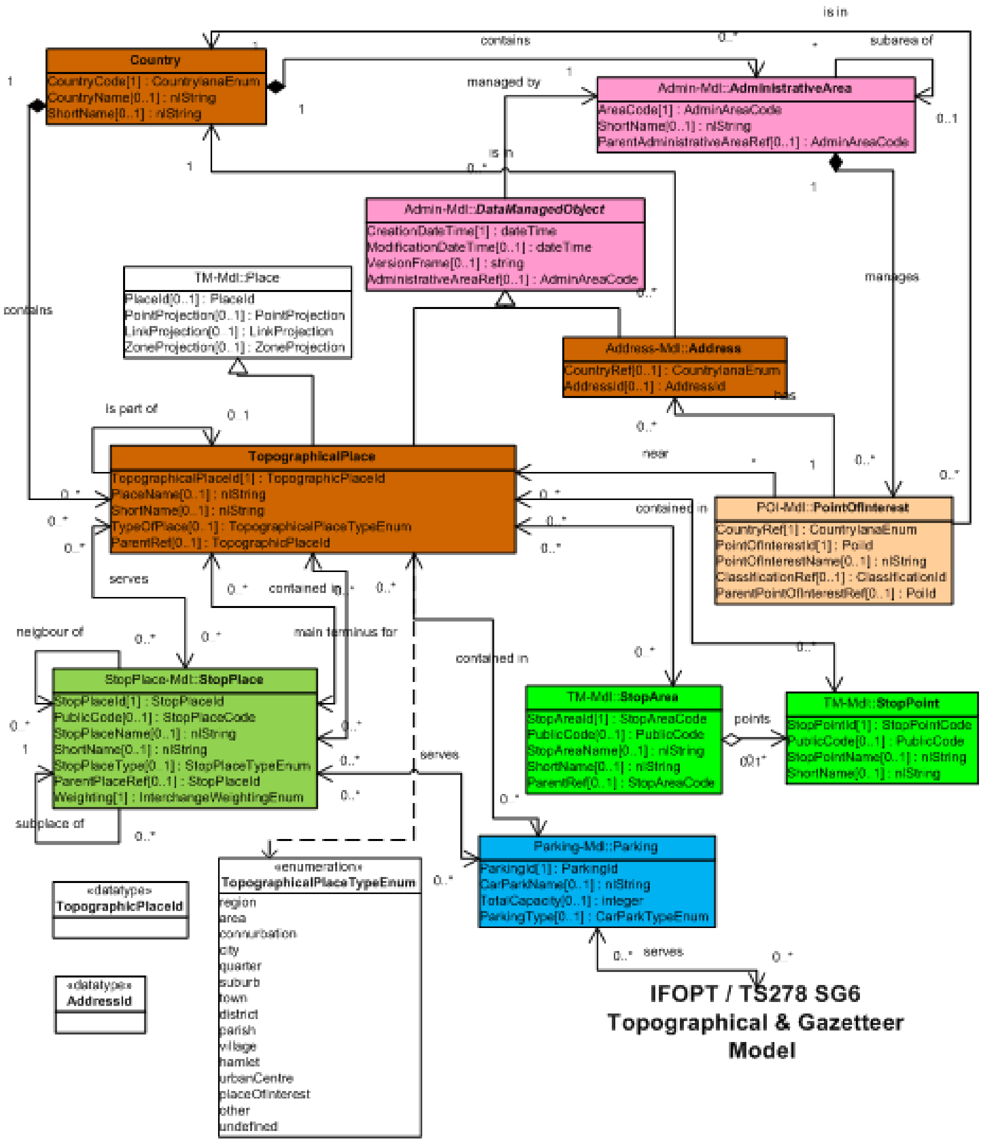


Figure 65 — UML Diagram for Topographic Place

8.2.1 Populating Topographic Models

In the real world the question arises as to how fine a granularity may be used for a TOPOGRAPHICAL PLACE, i.e. how small an area may be appropriate. In a minimal use, TOPOGRAPHICAL PLACE is used to represent named settlements, with the smallest being suburb, town quarter, or hamlet size. A TOPOGRAPHICAL PLACE should not be used alone to represent an individual POINT OF INTEREST or STOP PLACE, even though in some cases these may be of a corresponding size to a hamlet, as the latter, as well as having an ADDRESS and other properties, should have ENTRANCEs, ACCESS LINKs and other data that the TOPOGRAPHICAL MODEL does not support. There may of course be a similarly named pair of a POINT OF INTEREST and a TOPOGRAPHICAL PLACE.

8.2.2 Partitioning of Topographic Models

A Particular use of TOPOGRAPHICAL PLACE is to provide qualifiers to distinguish between other places with similar names. The Short Name of a TOPOGRAPHICAL PLACE should be suitable for appending as a qualifier to other elements, for example to distinguish between. two or more places with similar or identical names.

9 Administrative Model

The Administrative Model describes the parties and roles of the organisations responsible for managing data elements.

9.1 Physical models

The administration of STOP PLACE and other data may be organised in different ways depending on both the jurisdictional area, AUTHORITY and TRANSPORT MODE. Typically STOP PLACE and STOP PLACE COMPONENT data for a given STOP PLACE will be gathered and managed by the AUTHORITY responsible for the STOP PLACE. However sometimes this may be done by a different organisation – for example a body responsible for Railways may provide the data about STOP PLACEs in the National Railway to other authorities, or data may be gathered by a separate company altogether.

It may be that different components within a given STOP PLACE are managed by different administrators. For large data sets, data for different places will be managed by different parties.

9.2 UML Model for Data Administration

A simple conceptual model, as shown in Figure 66, can be used to describe the ownership of data and the various roles needed to manage it. This model can be used to support different allocations of responsibility for different circumstances.

Each COUNTRY is uniquely identified, for example by IANA code.

ADMINISTRATIVE AREAs are allocated and identified within a COUNTRY.

Data management is carried out by organisations acting as DATA ADMINISTRATORs, each of whom is responsible for performing an ADMINISTRATIVE ROLE for the data of a particular TRANSPORT MODE or TRANSPORT MODEs in one or more ADMINISTRATIVE AREAs. Distinct roles are possible, for example to create, gather, aggregate, verify, and redistribute data. There may be different ADMINISTRATIVE AREAs for different PLACEs and or Transport MODEs.

ADMINISTRATIVE AREAs may be organized hierarchically using a parent ADMINISTRATIVE AREA.

Each ADMINISTRATIVE AREA may have one or more AREA IDENTIFIER NAMESPACEs associated with it, used to allocate identifier values from a predefined range to different types of data object. Several ADMINISTRATIVE AREAs may share the same namespace. Global IDENTIFIER NAMESPACEs can be used for national scope.

Each type of DATA MANAGED OBJECT is assigned to a specific ADMINISTRATIVE AREA for data management. Examples of DATA MANAGED OBJECT include STOP PLACE COMPONENT (and hence STOP PLACE, QUAY, etc), POINT OF INTEREST, ADDRESS, PARKING and TOPOGRAPHICAL PLACE. (Note that not all types of DATA MANAGED OBJECT are shown in Figure 66). Similar principles apply to the management of other classes of data.

DATA MANAGED OBJECTS are versioned by assignment to a VERSION FRAME and also have individual change management attributes.

Ownership of stop place infrastructure by an AUTHORITY or OPERATOR is a separate relationship from that of data administration, as is the provision of transport services.

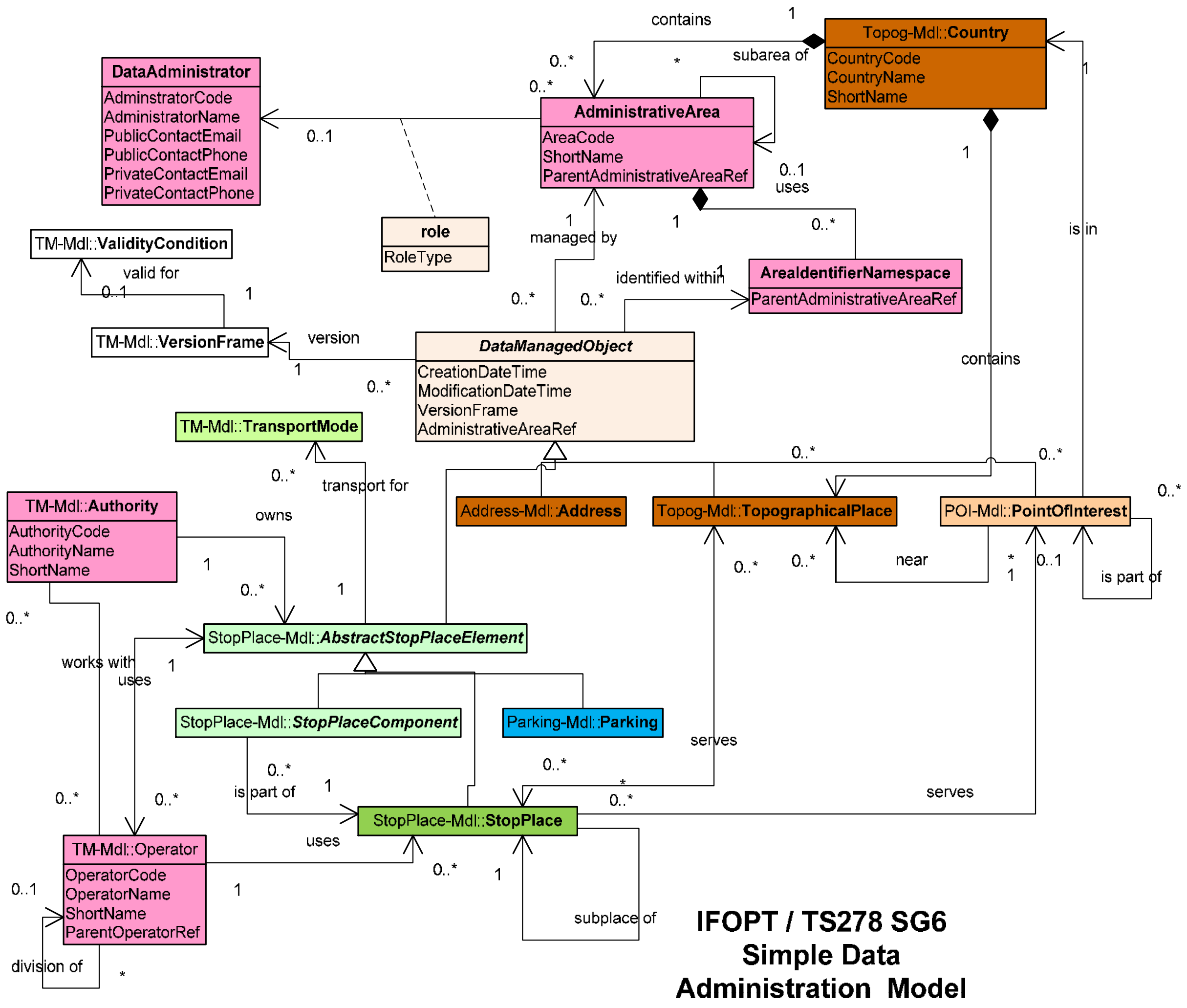


Figure 66 — UML Diagram for basic Data Administration

Figure 67 adds additional information about the attributes of the Administrative model.

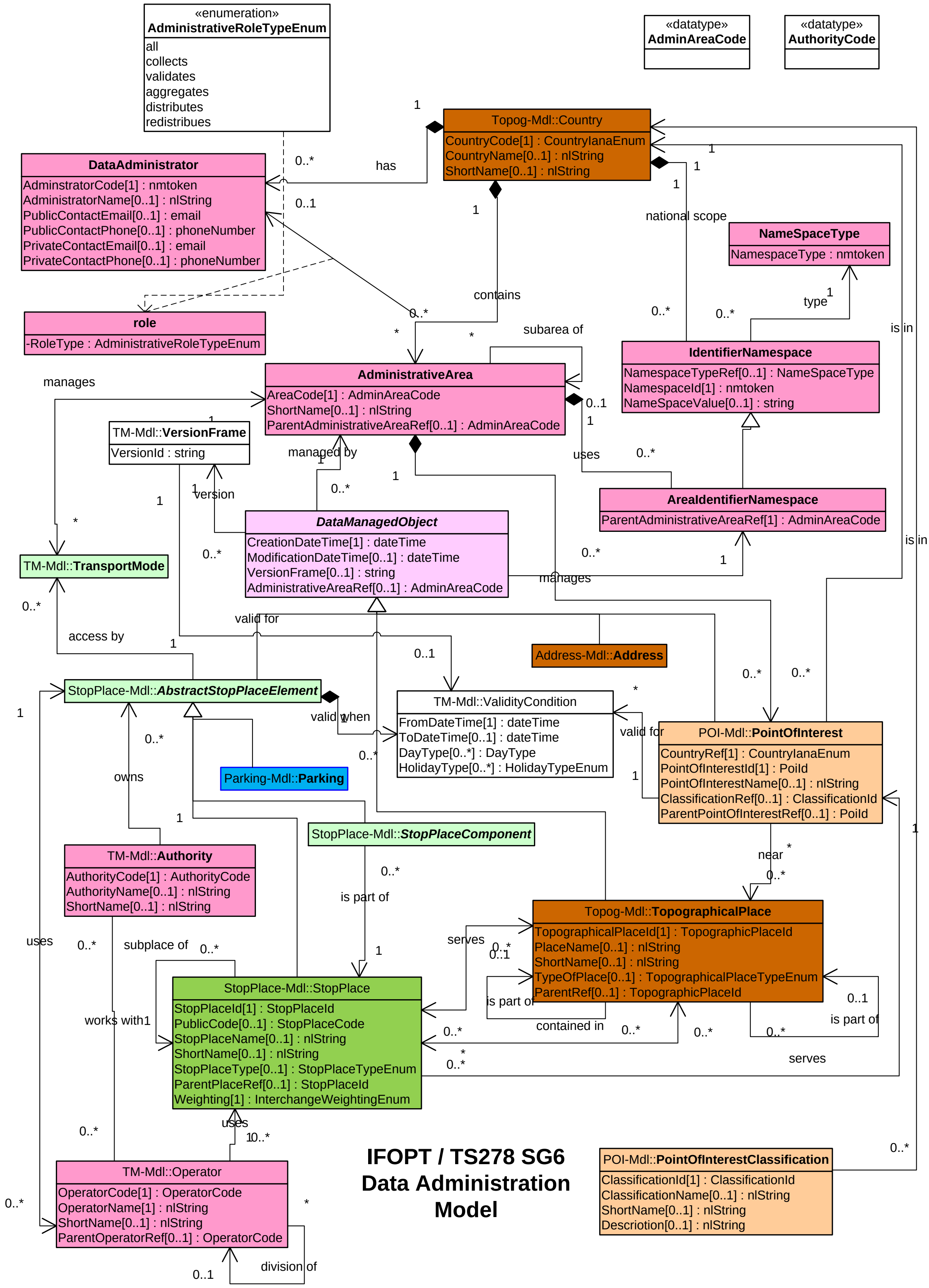


Figure 67 — UML Diagram of Administrative Model

10 Common Modelling Points

10.1 Relationship to GIS data

As noted earlier, IFOPT indicates the required geospatial projections of specific PLACE entities such as LINKs or POINTs by the inclusion of POINT PROJECTION, LINK PROJECTION and ZONE PROJECTION objects. Figure 68 shows the three types of projection. It also shows the ADDRESS entity, which may be further refined as a POSTAL and/or ROAD ADDRESS.

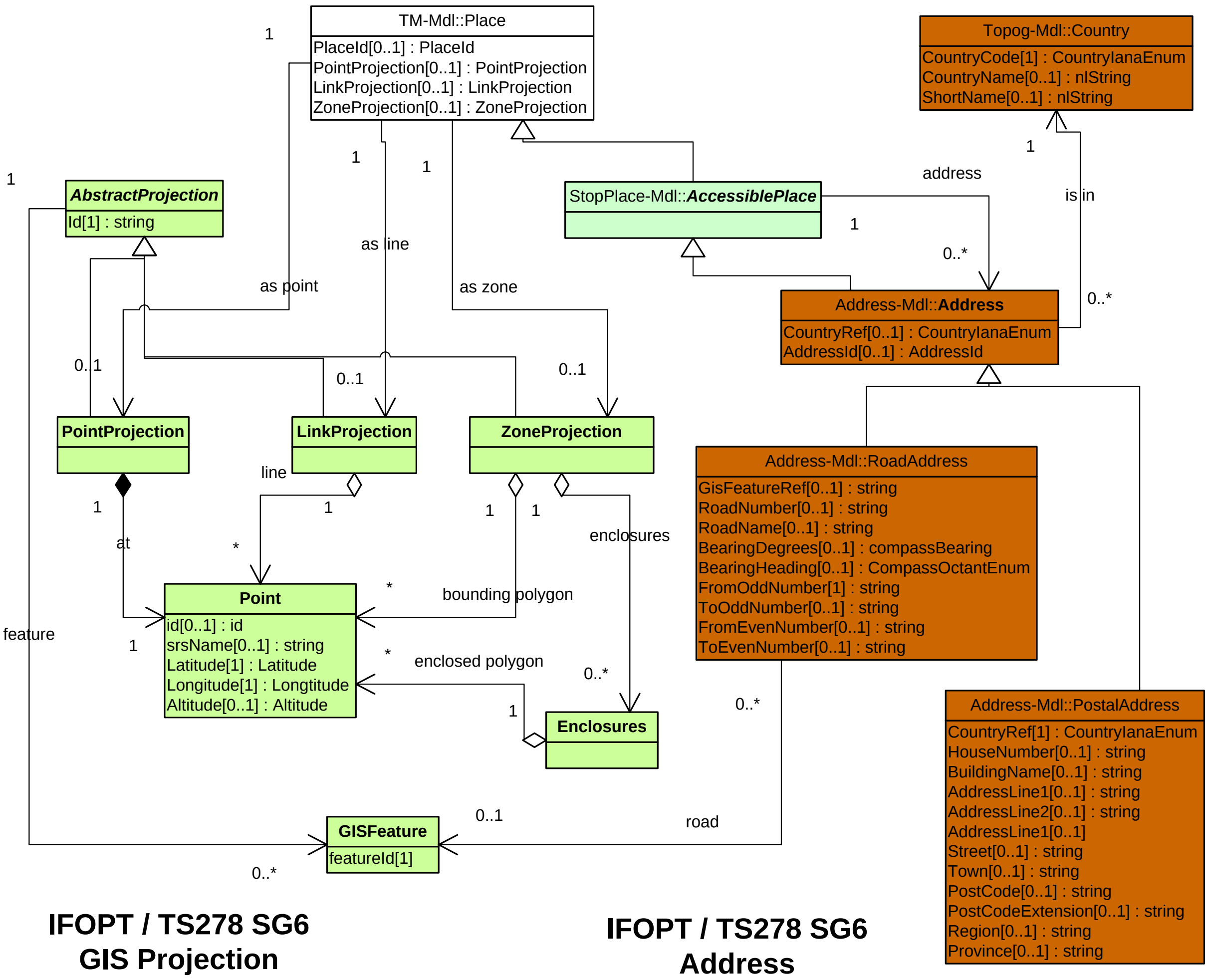


Figure 68 — UML Diagram of Projection & Address Elements

10.2 Common Enumerations

IFOPT uses a number of standard data types, together with enumerations for specific values. Enumeration values are chosen to be interoperable with those of other standards such as TPEG.

10.2.1 Common XML Data types

Common XML data types are used, in particular those shown in Figure 69.

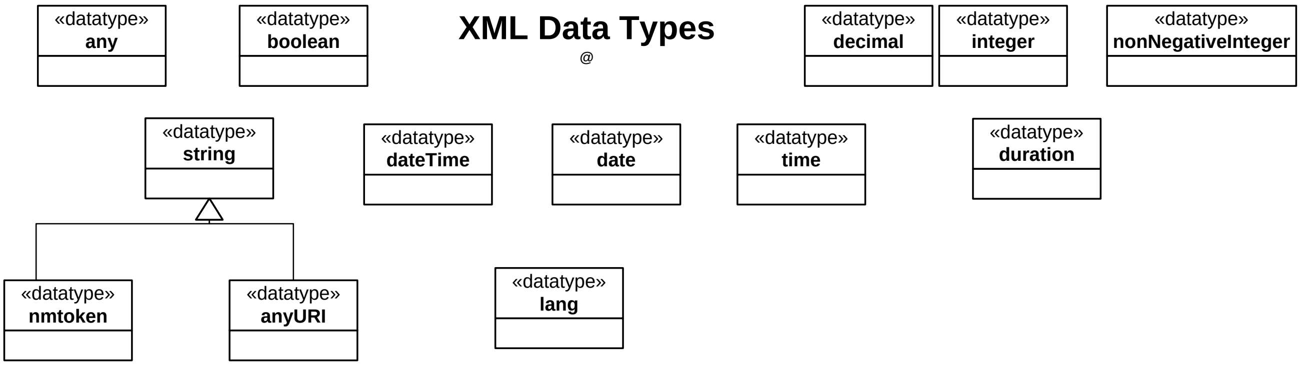


Figure 69 — UML Diagram of Common XML Data types

10.2.2 Additional Generic Data Types & Enumerations

Some generic data types are additionally defined as in Figure 70.

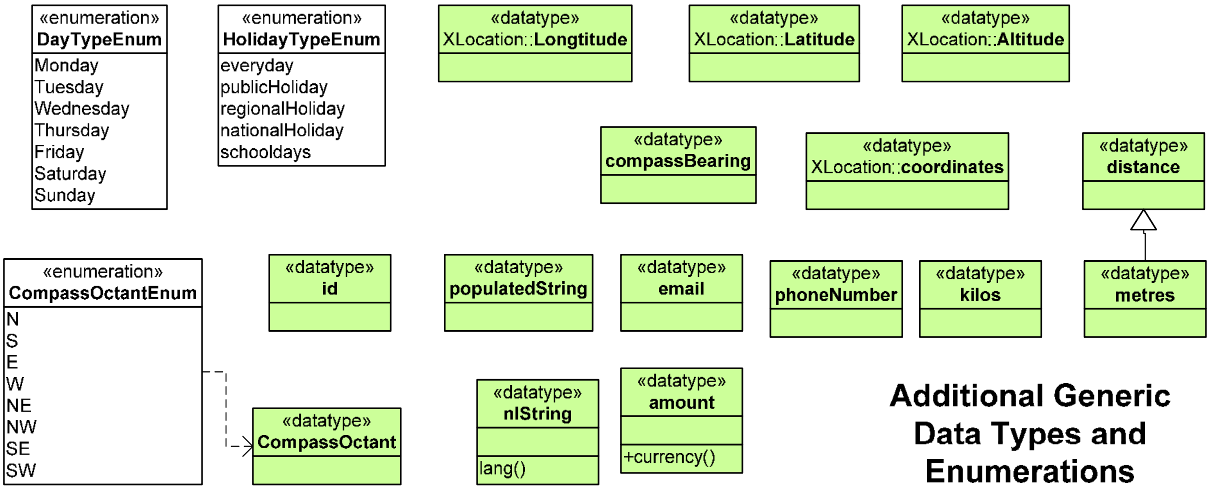


Figure 70 — UML Diagram of Generic Data types

10.2.3 Transmodel related Data Types

Data types are used for the identifiers of entities that are Transmodel entities as shown in Figure 71.

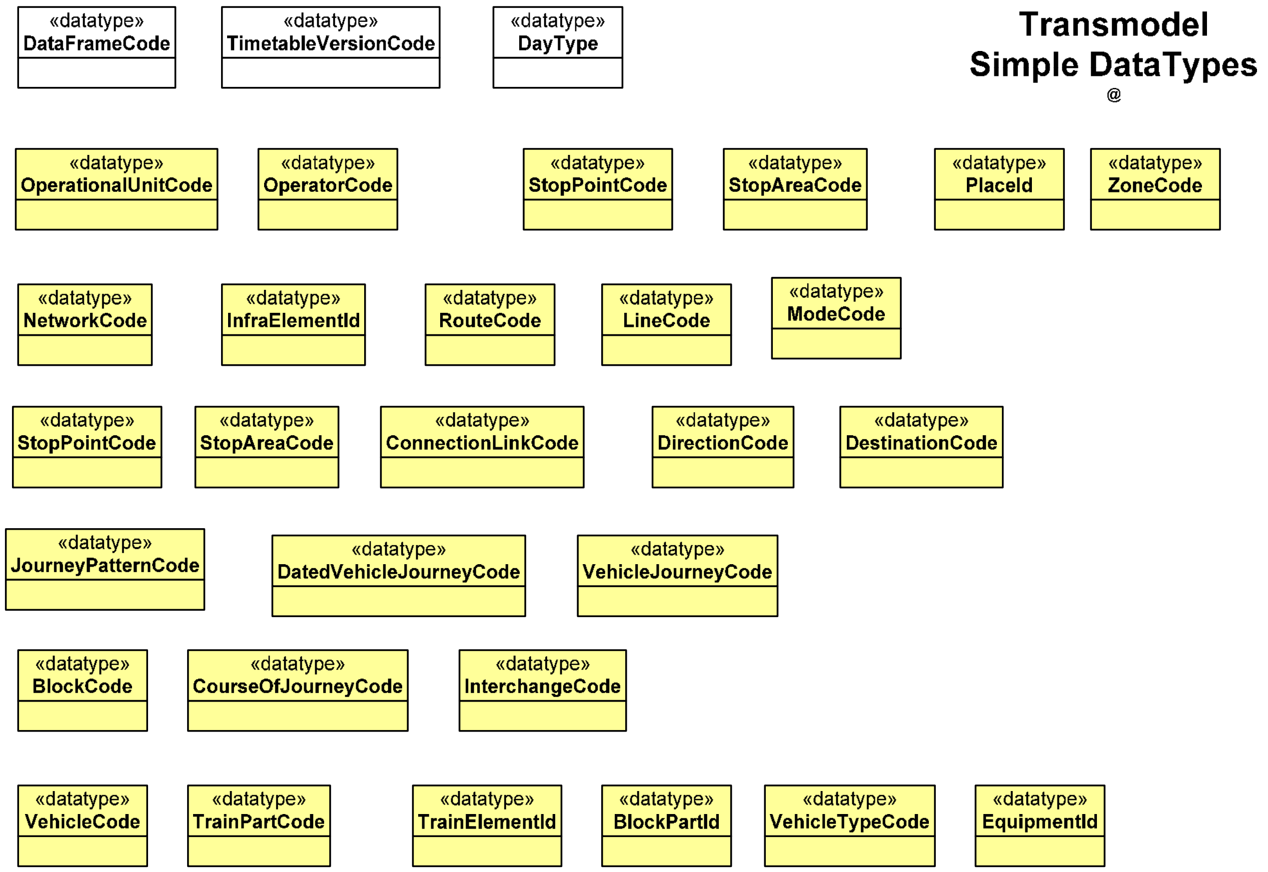


Figure 71 — UML Diagram of Transmodel related identifier Data Types used in IFOPT

10.2.4 Stop Place Model Identifier Data types

Data types are defined for the identifiers of Stop Place Model entities as shown in Figure 72.

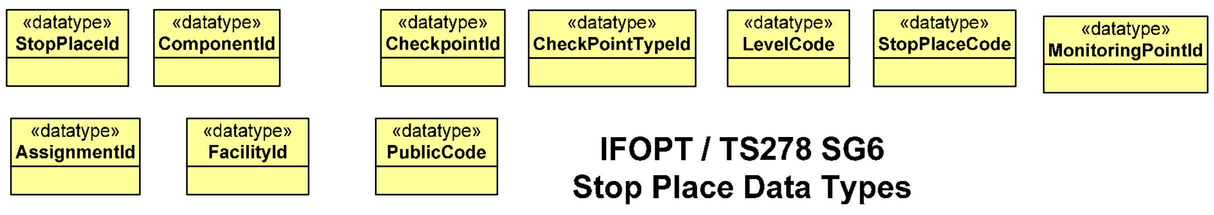


Figure 72 — UML Diagram of identifier Data Types used in IFOPT Stop Place Model

10.2.5 Stop Place Model Enumerations

Figure 73 summarises the enumerated values used in the IFOPT Stop Place Model.

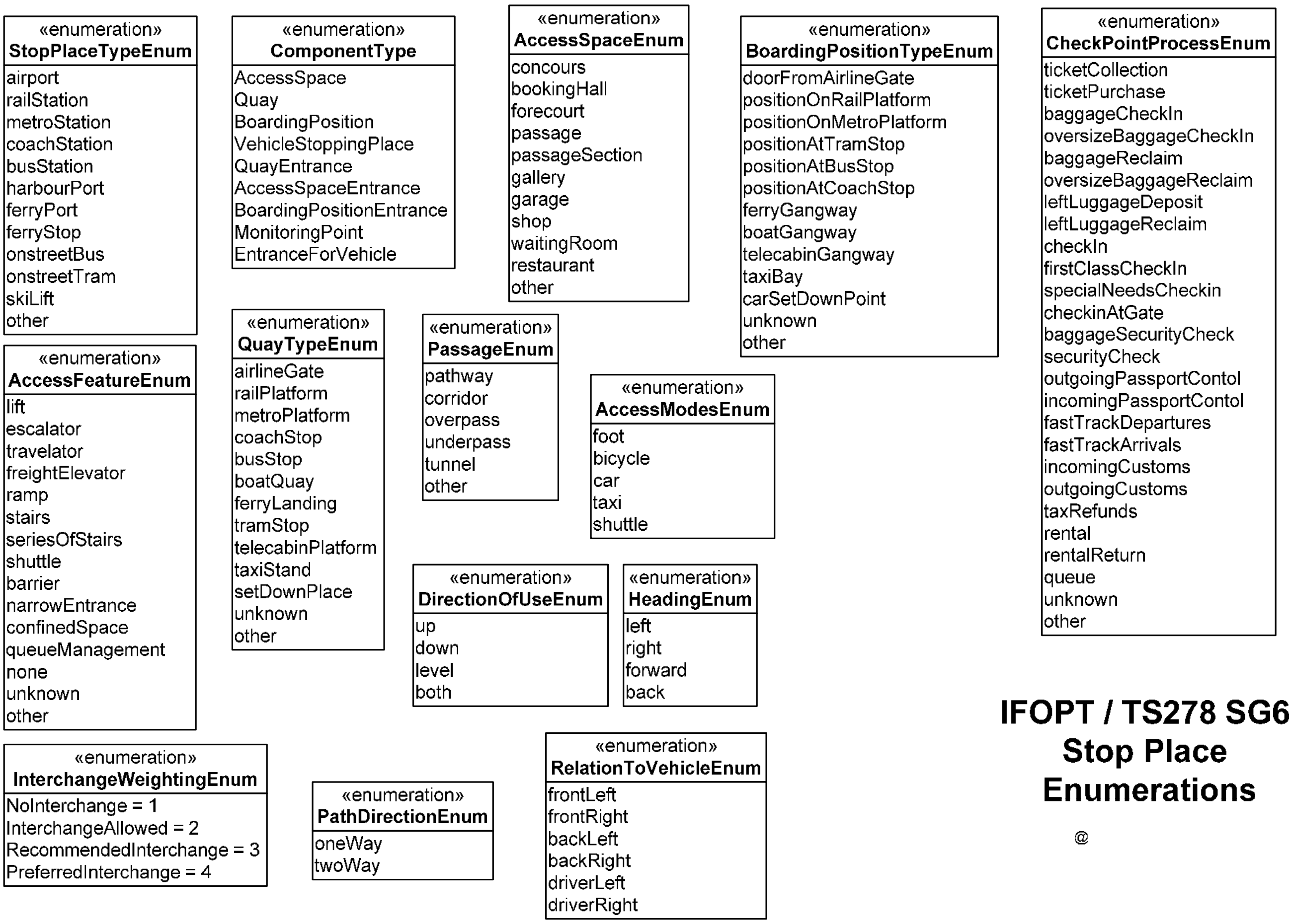


Figure 73 — Enumerated Values used in IFOPT Stop Place Model

Figure 74 summarises the enumerated values used in the IFOPT Stop Place Model.

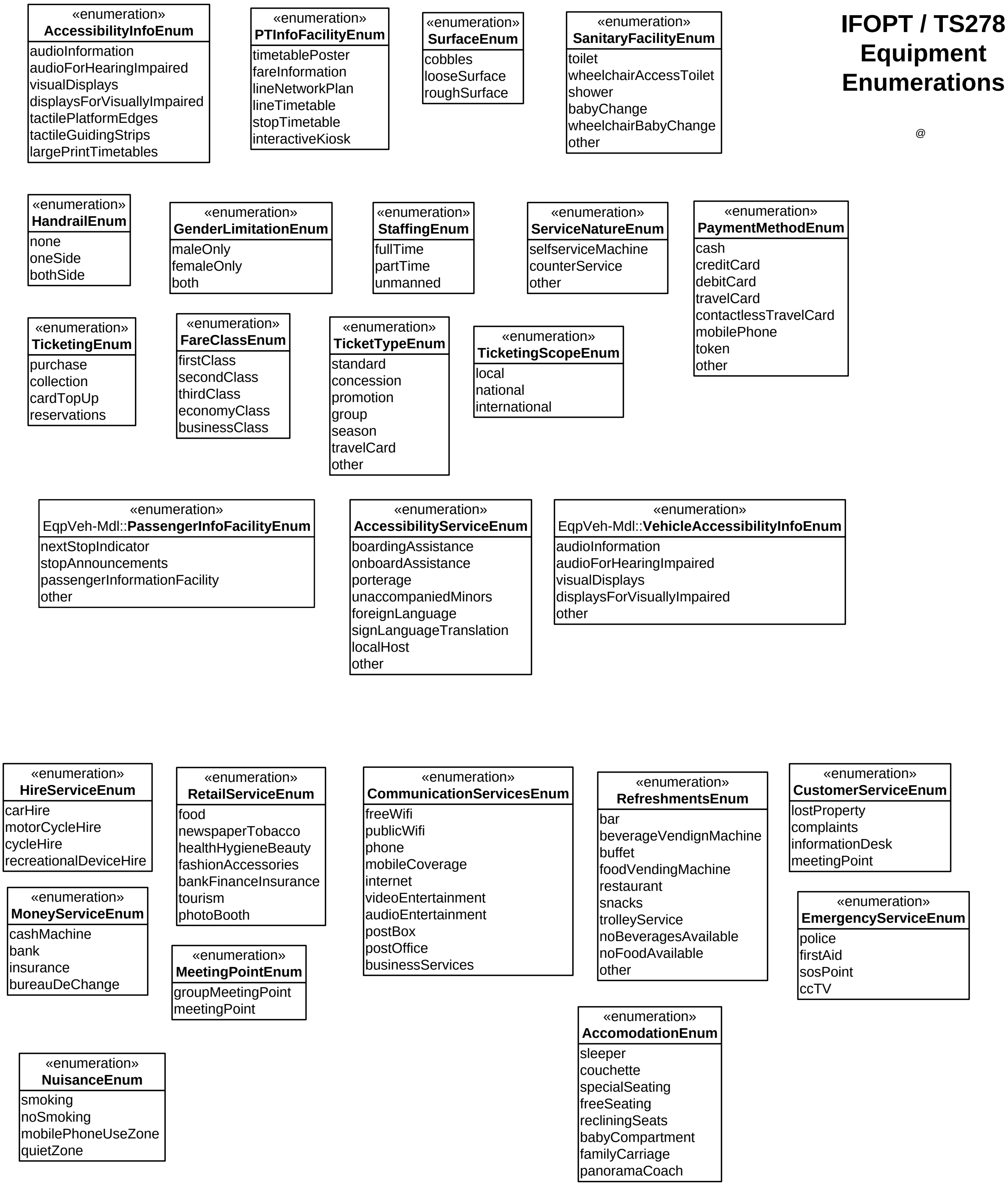


Figure 74 — Enumerated Values used in IFOPT Stop Place Equipment Model

Figure 75 summarises the enumerated values used in the IFOPT Parking Model.

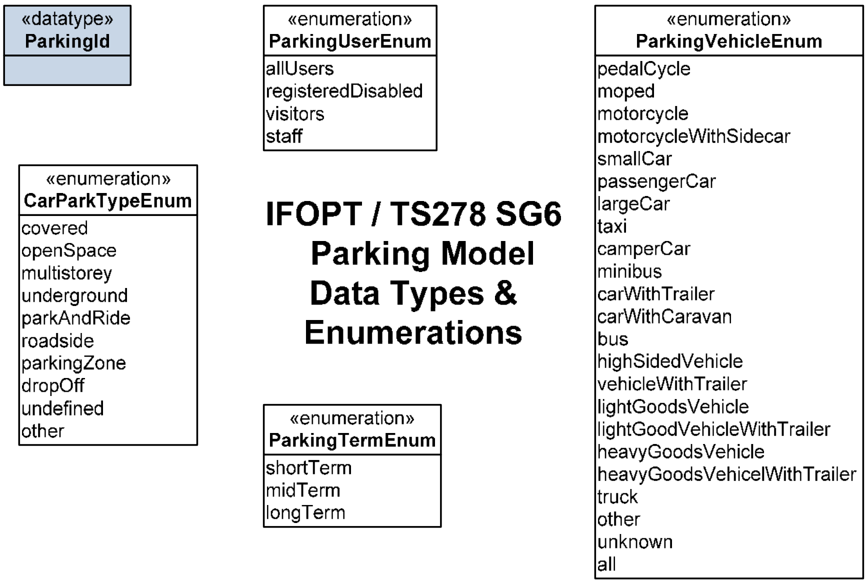


Figure 75 — Enumerated Values used in IFOPT Parking Model

10.2.6 TPEG Mode Enumerations

It is desirable that an IFOPT implementation use a set of modes that is compatible with TPEG. Figure 76 shows the a set of enumerated values for modes and submodes that correspond to the values used in the TPEG Public Transport Information (PTI) Model.

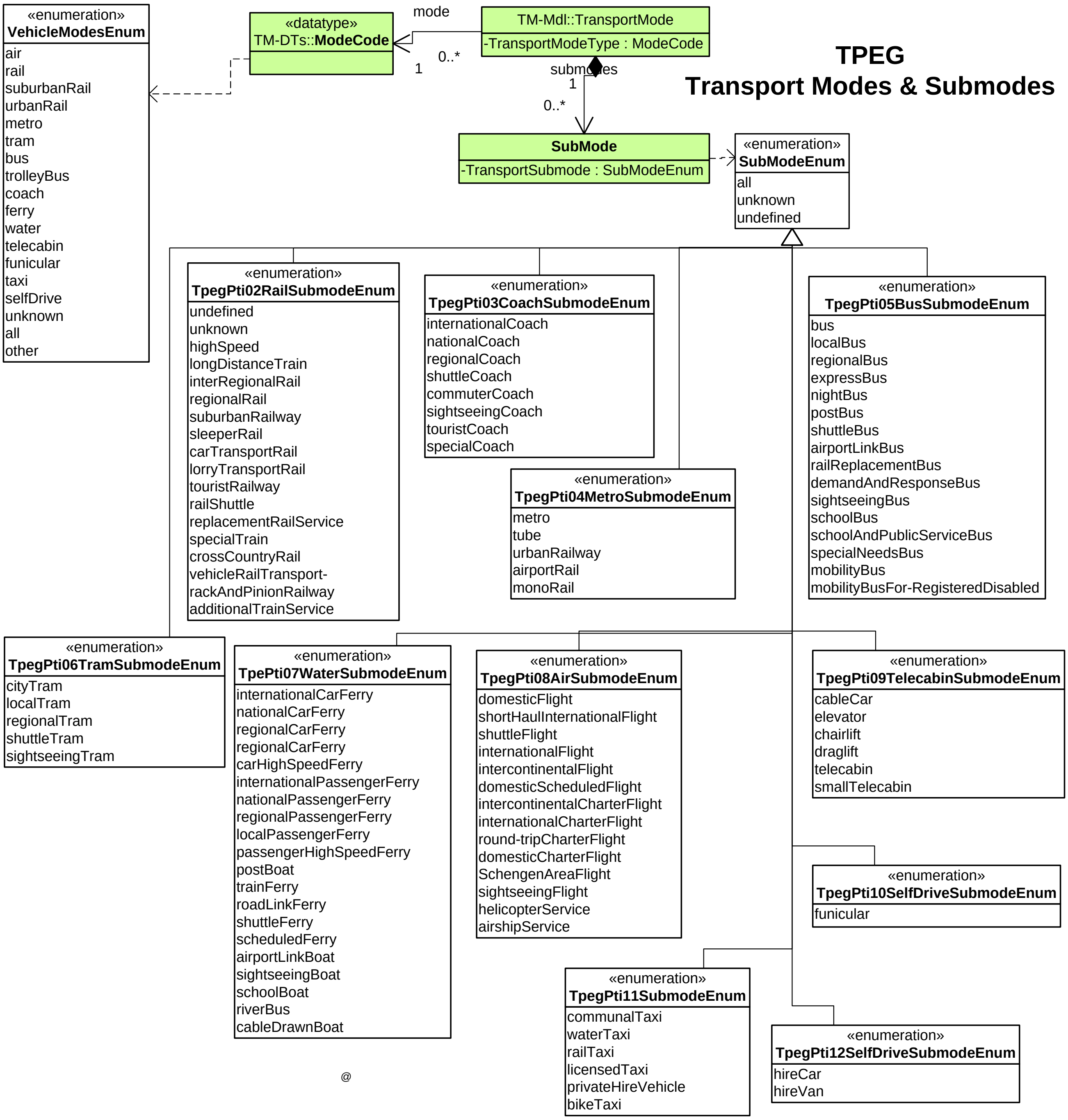


Figure 76 — TPEG modes as IFOPT enumerations

Annex A
(informative)

Example of dimensional functions to classify disability included in the FINAL (Complete Integration of Demand Responsive Transport and PT) project in Sweden, as an example of Accessibility Classification of medical conditions

a) **Wheelchair users having function in arms and hands and in parts of torso and/or legs.** Persons that use a manual wheelchair and that can manage for the most part to compensate quick movements caused by sudden retardation, vibrations etc; that can manage some small step-by-step changes of level, but have problems managing heavy doors.

b) **Wheelchair users with partially reduced function in arms and hands and in parts of torso and/or legs and have often problem with balance.** Persons that are primarily using a manual wheelchair, have problems bending to the side or forward without falling, have problems stretching and reaching things, cannot compensate with their body for fast movements caused by sudden retardation, vibrations etc; have problems managing inclinations sideways; have major problems managing heavy doors; do not usually have pinch grip; do usually not manage even small step by step changes of level; may have problems with pain.

c) **Wheelchair users with reduced function in arms, torso and legs and have severe problems with balance.** Persons that primarily use an electric wheelchair; have major problems bending to the side or forward without falling; have limited ability to stretch to reach things; that cannot compensate with their body for fast movements caused by sudden retardation, vibrations etc; have problems managing inclinations sideways; have problems managing even small step by step changes of level; cannot handle heavy doors; do not usually have pinch grip; may have problems with pain.

d) **Reduced mobility, reduced function in legs and/or hips and/or spine, often have problems with balance, short (in stature).** Persons that usually use a rollator (wheeled walker), stick or crutches; have severe problems lifting their feet; have problems going backwards; have problems walking on rough surfaces; can only walk short distances before requiring rest; have problems managing inclinations sideways, as well as long low changes of level; may have problems stretching to reach things; have problems managing heavy doors; cannot usually manage even small changes of level.

e) **Reduced mobility, reduced function in arms and/or hands, limited reach; short in stature** Persons with problems stretching to reach things, or to put their weight against objects, for instance handling heavy doors; may often be in great pain; often cannot carry bags.

f) **Reduced mobility, reduced strength and problem with balance.** Persons that due to medical dysfunction, for example heart and lung dysfunction, have major problems walking longer distances; may have problems with fast movement of the head.

g) **Vision impairment, can orientate with parts of sight, problem with balance.** Persons that have great problems viewing the surrounding area; have problems noticing changes in level or changes vertically; have limited sight to the side or forwards; have reduced visual acuity; have major problems walking on rough surfaces; that require strong contrasts of light; have problems managing inclinations sideways; that sometimes use a long white cane and will then be helped by tactile contrasts; have problems differentiating important voice information in a noisy environment.

h) **Vision impairment, can orientate with the long white cane/guide dog, problems with balance.** Persons that are blind or with defective vision; have no ability to view the surrounding area; have problems detecting changes in level both horizontally and vertically; have major problems walking on rough surfaces; have great problems managing inclinations sideways, need sharp tactile contrasts and/or sharp targets (also for their guide dog); that have problems differentiating important voice information in a noisy environment.

i) **Hearing impairment, severe loss of hearing, or deafness.** Persons that require a hearing aid or are deaf: that have problems viewing the surrounding area, have problems apprehending speech and sound; are very distracted by background noise; have problems differentiating or hearing important voice information; that require sharp visual information and, whenever applicable, an inductive loop.

j) **Cognitive impairment, retardation.** Persons with congenital retardation of cognitive functions leading to problems with orientation; problems with understanding layouts that are not logical; problem with handling sudden changes or with making fast evaluations or calculations; problems with reading written text; that can usually understand pictogram images; that have problems moving around in a complex traffic environment.

k) **Cognitive impairment, acquired brain damage.** Persons that have a limited reduction of some function that can lead to problems with orientation and/or problems with understanding layouts that are not logical; problems handling sudden changes; problems reading written text; can usually understand pictogram images; that may have problems moving around in a complex traffic environment; that can, in some cases, use previously acquired knowledge

l) **Allergy and hypersensitiveness, allergic reactions and difficulty in breathing.** Persons that suffer from allergic reactions when exposed to scents, smoke, emissions, exhausts, pollen, electricity; have problems being outdoors due to odours or particles from scents, wind pollinated plants or dense traffic environments; often have problems walking long distances and/or have problems being in densely populated areas due to exposure to breathing allergens.

Source:

SV: Dimensionerande funktionell förmåga enl. Almén och Ståhl 2002 (Arkitekt MSA Mai Almén, professor Agneta Ståhl)

ENG: Dimensional functional ability according to Almén and Ståhl 2002 (Architect MSA Mai Almén, Professor Agneta Ståhl)

Translated to English by Almén, Ståhl and Ask - 2007

Bibliography

[1] CEN ISO/TS 18234-1 Traffic and Travel Information (TTI) – TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 1: Introduction, Numbering and Versions (ISO/TS 18234-1:2006)

[2] CEN ISO/TS 18234-2 Traffic and Travel Information (TTI) – TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 2: Syntax, Semantics and Framing Structure (SSF) (ISO/TS 18234-2:2006)

[3] CEN ISO/TS 18234-3 Traffic and Travel Information (TTI) – TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 3: Service and Network Information (SNI) application (ISO/TS 18234-3:2006)

[4] CEN ISO/TS 18234-4 Traffic and Travel Information (TTI) - TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 4: Road Traffic Message (RTM) application (ISO/TS 18234-4:2006)

[5] CEN ISO/TS 18234-5 Traffic and Travel Information (TTI) – TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 5: Public Transport Information (PTI) application (ISO/TS 18234-5:2006)

[6] CEN ISO/TS 18234-6 Traffic and Travel Information (TTI) – TTI via Transport Protocol Expert Group (TPEG) data-streams – Part 6: Location referencing applications (ISO/TS 18234-6:2006)

[7] XML, Extensible Mark-up Language (XML) 1.0 W3C Recommendation 04 February 2004, available at http://www.w3.org/TR/2004/REC-xml-20040204.

[8] prEN ISO 8601, Data elements and interchange formats – Information interchange – Representation of dates and times

[9] IETF RFC 2119, RFC 2119: Key words for use in RFCs to Indicate Requirement Levels

[10] ISO/IEC 8859-15, Information technology – 8-bit single-byte coded graphic character sets – Part 15: Latin alphabet No. 9

[11] ISO-639-1:2001, Codes for the representation of names of languages – Part 1: Alpha-2 code

[12] ISO-639 /IETF 1766, Tags for the Identification of Languages

[13] ISO/IEC 19501:2005, Information technology – Open Distributed Processing - Unified Modelling Language (UML) Version 1.4.2

[14] SAE J1939/71. Bearing in degrees

[15] WGS 1984, World Geodetic Standard 1984, available at http://www.wgs84.com

[16] Datex2 Schema 48_3

[17] CERTU Etude des systèmes de localisation pour les transports – Clarification des concepts liés aux ârrets de transports en commun' 2006.

[18] NaPTAN National Public Transport Access Nodes. Department for Transport. NPTG and NaPTAN Schema Guide, release 2.1, at www.naptan.org.uk October 2003.

[19] NPTG National Public Transport Gazetteer. As per NaPTAN Schema Guide 2.1.

[20] TRIDENT TRansport Intermodality Data sharing and Exchange NeTworks Version 2.0 D 3.7. 25 11 2002. Ertico IST-1999-1076.

[21] JourneyWeb UK Department for Transport Schema Guide 3.0b. January 2004.

[22] Delfi Report on the current status of the DELFI-system implementation. 19th April 2006.

[23] TDS Transport Database System – Geographic model version 5.0.

[24] ment for Transport Schema Guide 3.0b. January 2004.

[25] Delfi Report on the current status of the DELFI-system implementation. 19th April 2006.

[26] TDS Transport Database System – Geographic model version 5.0.