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Vägtrafikinformatik – Kollektivtransporter – Identifiering av fasta hållpunkter i kollektivtransporter (IFOPT)

Intelligent transport systems – Public transport – Identification of Fixed Objects in Public Transport (IFOPT)

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EUROPEAN STANDARD

EN 28701

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2012

ICS 35.240.60

Supersedes CEN/TS 28701:2010

English Version

Intelligent transport systems - Public transport - Identification of Fixed Objects in Public Transport (IFOPT)

Systèmes de transport intelligents - Transports publics -
Identification des objets fixes dans les transports publics
(IFOPT)

Intelligente Transportsysteme - Öffentlicher Verkehr -
Identifizierung fester Objekte im Öffentlichen Verkehr
(IFOPT)

This European Standard was approved by CEN on 9 September 2012.

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Foreword

This document (EN 28701:2012) has been prepared by Technical Committee CEN/TC 278 "Road transport and traffic telematics", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2013, and conflicting national standards shall be withdrawn at the latest by June 2013.

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

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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, etc.;
- Mobile objects: vehicles, on board validators, etc.;
- Events: accidents, works, and situations affecting parts of the network, etc.

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, etc.);
- optimisation of passenger trips (trip proposals made according to specific criteria, etc.);
- management of Public Transport resources (sales points, validators, passenger information devices, etc.).

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 it appears that 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 should 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 localisation 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 arrêts 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 should 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

1.1 General

This European Standard 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.

1.2 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 as 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 museums, stadiums, etc., but does not set out a recommended informative value set of Point of Interest categories.

1.3 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.

1.4 Approach – Modularisation

1.4.1 General

This European Standard builds on the Transmodel Standard to define four related sub models; See Figure 1.

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

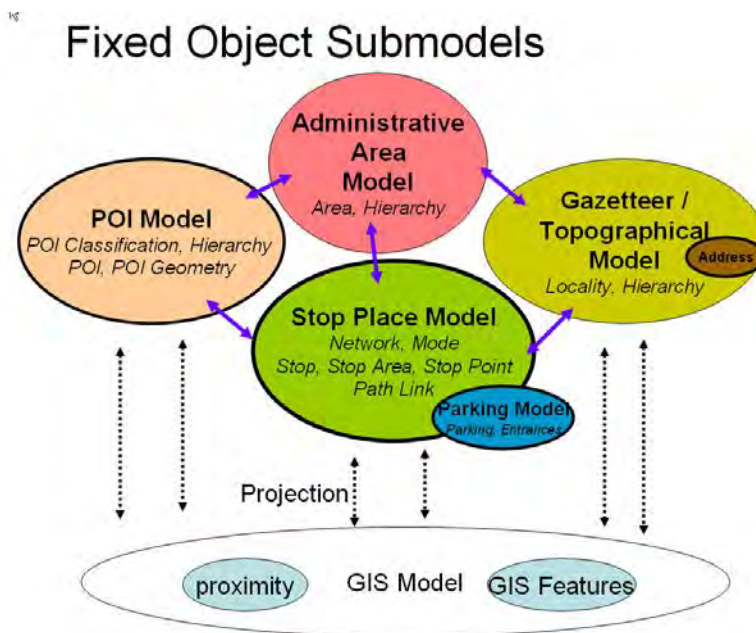


Figure 1 — Fixed Object Submodels

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 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

1.4.2 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.

1.5 Approach – Modelling

1.5.1 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.

1.5.2 Level of Detail and 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.

1.5.3 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 should 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 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 should 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 types 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.

Table 1 — Indicative numbers of Access points

| | 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 |

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

1.5.4 Stop Identification and 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.

1.5.5 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.

1.5.6 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.

1.5.7 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.

1.5.8 Scope of Phase 1

This first part of the IFOPT European Standard 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. An informative XML schema is separately available at <http://www.ifo.org.uk>.

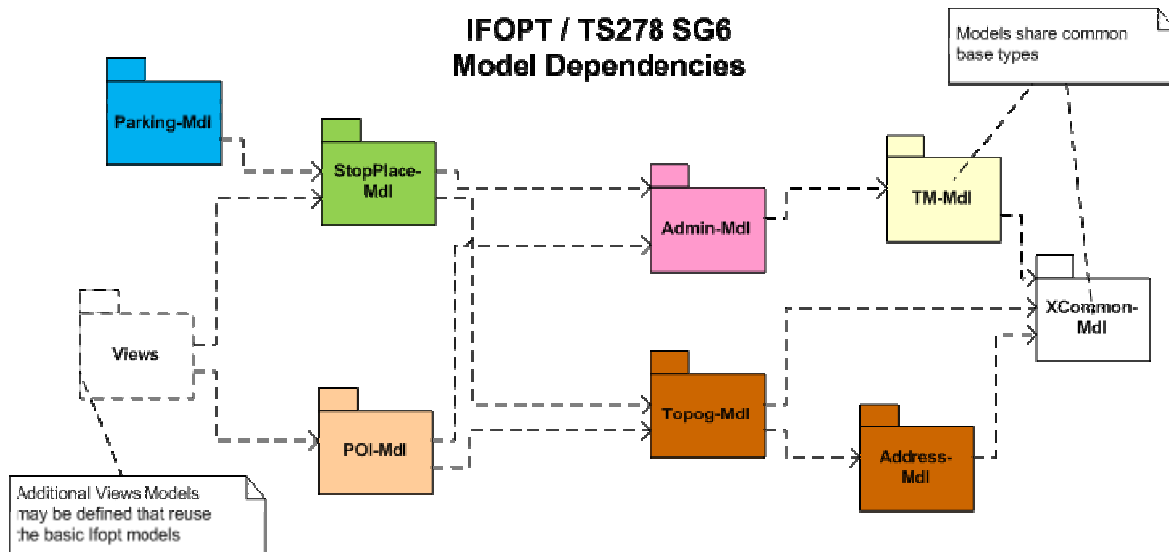


Figure 2 — Dependencies of Fixed Object Models

2 Normative references

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

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

CEN/TS 15531-1:2007, *Public transport — Service interface for real-time information relating to public transport operations — Part 1: Context and framework*

CEN/TS 15531-2:2007, *Public transport — Service interface for real-time information relating to public transport operations — Part 2: Communications infrastructure*

CEN/TS 15531-3:2007, *Public transport — Service interface for real-time information relating to public transport operations — Part 3: Functional service interfaces*

CEN/TS 15531-4:2011, *Public transport — Service interface for real-time information relating to public transport operations — Part 4: Functional service interfaces: Facility Monitoring*

CEN/TS 15531-5:2011, *Public transport — Service interface for real-time information relating to public transport operations — Part 5: Functional service interfaces — Situation Exchange*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12896:2006, CEN/TS 15531-1:2007, CEN/TS 15531-2:2007, CEN/TS 15531-3:2007, CEN/TS 15531-4:2011, CEN/TS 15531-5:2011 and the following apply.

3.1 Transport Related Terms

Note 1 to entry: 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).

Note 2 to entry: 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

physical (spatial) possibility for a passenger to access or leave the public transport system

Note 1 to entry: 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).

Note 2 to entry: 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

type of external PATH LINK connecting a PLACE with another PLACE

Note 1 to entry: A sequence of ACCESS PATH LINKs may project onto an ACCESS LINK.

Note 2 to entry: 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 an 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.

Note 3 to entry: Inside a physical STOP PLACE, STOP PATH LINKs should be used instead of ACCESS PATH LINKs.

3.1.3

ACCESS SPACE – IFOPT

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

Note 1 to entry: 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

entrance or exit for passengers to or from an ACCESS SPACE

Note 1 to entry: 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

ZONE for which the duration to cover any ACCESS LINK to a particular STOP POINT is the same

Note 1 to entry: 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

type of PLACE, such as a STOP PLACE, POINT OF INTEREST or ADDRESS, to which passengers may wish to travel

Note 1 to entry: 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

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

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

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

Note 1 to entry: 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

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 portage or language services

Note 1 to entry: In IFOPT these are specified as types of LOCAL SERVICE.

3.1.11

ACTUAL STOP POINT EQUIPMENT – Transmodel

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

Note 1 to entry: 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

item of equipment of a particular type actually available in an individual VEHICLE

3.1.13

ADDRESS – IFOPT

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

Note 1 to entry: It may be refined as either a ROAD ADDRESS, a POSTAL ADDRESS or both.