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

Transports publics - Modèle de données de référence - Partie 2: Réseau de transport en commun

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European foreword

This document (EN 12896-2:2026) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2027 and conflicting national standards shall be withdrawn at the latest by January 2027.

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

This document supersedes EN 12896-2:2016.

Annex C provides details of the significant technical changes between this document and EN 12896-2:2016.

This document is part of the European Standard series EN 12896, known as “Transmodel”. This is a series of documents that comprises the following parts:

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

— EN 12896-2, Public transport - Reference data model - Part 2: Public transport network

— EN 12896-3, Public transport - Reference data model - Part 3: Timing information and vehicle scheduling

— EN 12896-4, Public transport - Reference data model - Part 4: Operations monitoring and control

— EN 12896-5, Public transport - Reference data model - Part 5: Fare management

— EN 12896-6, Public transport - Reference Data model - Part 6: Passenger information

— EN 12896-7, Public transport - Reference data model - Part 7: Driver management

— EN 12896-8, Public transport - Reference data model - Part 8: Management information and statistics

— EN 12896-10, Public transport – Reference data model – Part 10: Alternative modes

Together these documents create Transmodel version 6.2 and thus replace Transmodel V6.0.

In addition to the nine normative Parts of this European Standard, a Technical Report (Public Transport – Reference Data Model – Informative Documentation) was published in 2016 under the reference CEN/TR 12896-9. It provides additional information to help those implementing projects involving the use of Transmodel. It is intended that this Technical Report will be extended and republished as soon as all the normative parts are revised.

The split into several documents is intended to ease the task of users interested in particular functional domains. It corresponds to the modularisation of Transmodel into functionally related parts, each made up of distinct UML packages and subpackages that describe a particular aspect of public transport. The NeTEx UML model follows the same modularisation, allowing a direct mapping from the conceptual model to the implementation.

For information on the conventions, methodology, and notations for conceptual modelling, for a clear overview to help understand the core principles, structure and purpose of Transmodel, and for information on the Functional domains and Modes of operation, refer to EN 12896-1.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

1 Scope

This document incorporates the following main data packages:

— Network Description;

— Fixed Object;

— Tactical Planning Components;

— Explicit Frame.

It is composed of the following parts:

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

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

— Annex B presenting the model evolution (informative);

— Annex C, providing details of the significant technical changes between this document and EN 12896-2:2016 (informative).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12896-1, *Public transport — Reference data model — Part 1: Common concepts*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
accessibility
characteristic of a public transport asset (equipment or location) describing the ability to be physically accessed with respect to passengers with various types of mobility impairment

3.1.2
graph
set of vertices and a set of edges (also called arcs)

Note 1 to entry: Transmodel defines the public transport network as a graph where the vertices are points and edges are links between the points.

3.1.3
navigation path
route that can be used by pedestrians, wheelchairs, cyclists, etc. (i.e. passengers who are not in a transport vehicle) to access or transfer between two places / or transport access points

Note 1 to entry: In Transmodel, a NAVIGATION PATH made up of discrete PATH LINKs.

3.1.4
run time
time taken for a vehicle to go between two points

Note 1 to entry: In Transmodel a run time may be specified for the individual SERVICE LINK between two stops and for the whole journey pattern.

3.1.5
stop
dedicated place where a vehicle may stop in order to allow passengers to get on and off

3.2 Abbreviations

API	Application Programming Interface
AVM	Automatic Vehicle Monitoring
GIS	Geographical Information System
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
IFOPT	Identification of Fixed Objects in Public Transport
ISO	International Organization for Standardization
IT	Information Technology
NeTEx	Network and Timetable Exchange
PT	Public Transport
PTO	Public Transport Operator
OJP	Open API for Distributed Journey Planning
OpRa	Operating Raw Data and statistics exchange
SIRI	Service Interface for Real-time Information
TM	Transmodel
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Universal Resource Locator
VDV	Verband Deutscher Verkehrsunternehmen (Germany)
WGS	World Geodetic Standard

4 General information

The following standards are based on the Transmodel conceptual data model for public transport domain to provide a harmonized, interoperable, and consistent approach for public transport data, service interfaces, and journey planning across Europe:

— EN 15531 series [10] to [16] – Service interfaces for real-time public transport operations.

— CEN/TS 16614 series (NeTEx) [17] to [22] – Network and timetable data exchange, including passenger information and accessibility.

— CEN/TS 17118 [23] – Open API for distributed journey planning.

5 Network topology domain

5.1 Introduction

The reference data model includes entity definitions for different types of points and links as the building elements of the topological network. Stop points, timing points and route points, for instance, reflect the different roles one point may have in the network definition: whether it is used for the definition of (topological or geographical) routes, as a point served by vehicles when operating on a line, or as a location against which timing information like departure, passing, or wait times are stored in order to construct the timetables.

The line network is the fundamental infrastructure for the service offer, to be provided in the form of vehicle journeys which passengers may use for their trips. The main entities describing the line network in the reference data model are the line, the route and the journey pattern, which refer to the concepts of an identified service offer to the public, the possible variants of itineraries vehicles would follow when serving the line, and the (possibly different) successions of stop points served by the vehicles when operating on the route.

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

— the stops and stations at which transport is accessed together with accessibility characteristics;

— the points of interest from/to which passengers are travelling;

— the detailed navigation paths between the various locations and associated constraints;

— the equipment and services relevant for public transport actors;

— the parking locations relative to both stops and points of interest.

5.2 Model and document structure

The Network Topology models split into the following main sub-models:

a) Network description model (ND);

b) Fixed object model (FO);

c) Tactical planning components model (TP);

d) Explicit frame model (NT).

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

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

Tactical planning components model: description of basic concepts related to the description of the work patterns of public transport vehicles, such as journey patterns and service patterns, which are useful for planning transport and some related aspects. This part describes the space-related aspects of the vehicle services, whereas the time-related aspects (vehicle journeys, run times, etc.) are described in EN 12896-3, Public transport - Reference data model - Part 3: Timing Information and Vehicle Scheduling.

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

The present document is structured according to the model structure.

5.3 Network description model

5.3.1 Model overview

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

— Network infrastructure model;

— Infrastructure network;

— Network restriction;

— Route model;

— Route instruction model;

— Line model;

— Line network model;

— Flexible network model;

— Activation model;

— Vehicle and crew point model.

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

The sub-models depend on several general framework models (e.g. generic point and link model, notice model, etc.) described in EN 12896-1, Public transport - Reference data model - Part 1: Common concepts.

5.3.2 Infrastructure network

5.3.2.1 General

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

5.3.2.2 Infrastructure network – Conceptual model

5.3.2.2.1 General

Figure 1 presents the INFRASTRUCTURE NETWORK conceptual model, i.e. describes the main components of the physical path network (rail, roads, etc.).

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

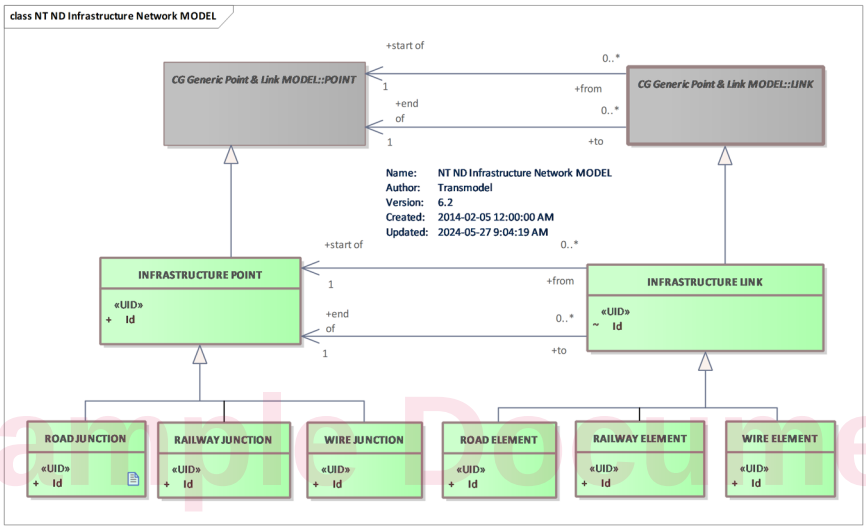

Figure 1 — Infrastructure network – Conceptual model

5.3.2.2.2 Infrastructure points and links

The PT network is described in Transmodel by POINTs and LINKs. This means that separate descriptions of a network either as a set of points or a set of links, or both, are possible and may be kept separately (cf. Generic POINT and LINK – conceptual model in EN 12896-1, Public transport - Reference data model - Part 1: Common concepts).

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

5.3.2.2.3 Infrastructure network and functional aspects of the network

In Transmodel terms, the infrastructure network builds a LAYER (cf. Layer – Conceptual Model in EN 12896-1, Public transport - Reference data model - Part 1: Common concepts). A LAYER is a user-defined GROUP OF ENTITies, specified for a particular functional purpose, associating data referring to a particular LOCATING SYSTEM.

Examples of LAYERS (described through concepts introduced later in this document) are: timing pattern layer (defined through TIMING POINTs and TIMING LINKs), and service pattern layer (defined through SCHEDULED STOP POINTs and SERVICE LINKs). Transmodel defines a correspondence mechanism between LAYERS, called PROJECTION (cf. section Generic Projection in EN 12896-1, Public transport - Reference data model - Part 1: Common concepts). It should be noted that the uniqueness of a LOCATING SYSTEM within a LAYER is an important parameter, in particular for the coherence of distances.

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

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

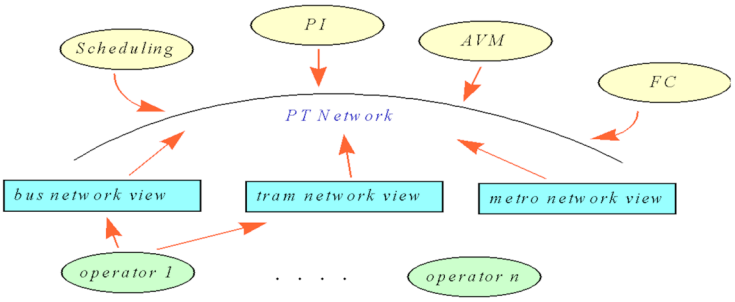

Figure 2 — Examples of layers – Different layers according to the transport mode

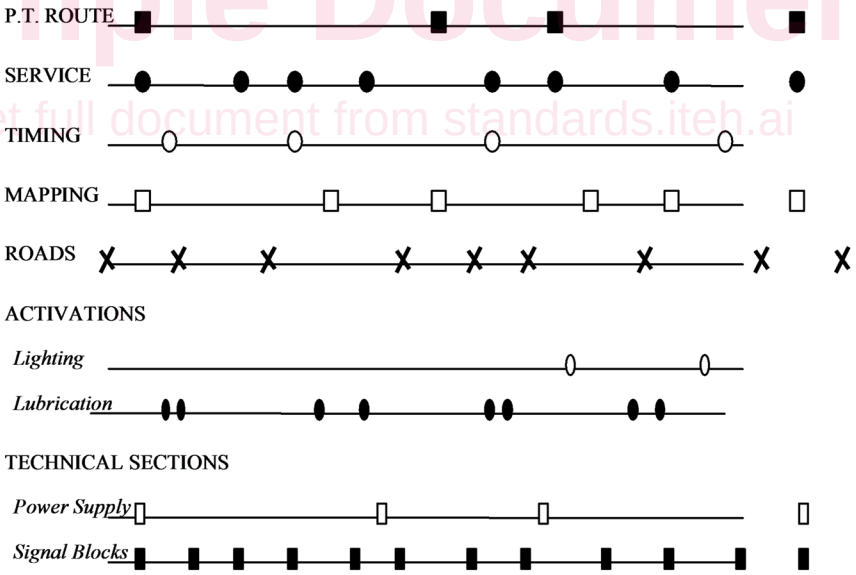

Figure 3 — Example of layers – Different layers according to an operational need

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

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

5.3.2.2.4 Road network: road junction and road element

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

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

5.3.2.2.5 Rail network: rail junction and rail element

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

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

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

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

5.3.2.2.6 Wire network: wire junction and wire element

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

5.3.2.3 Network infrastructure – Example

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

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

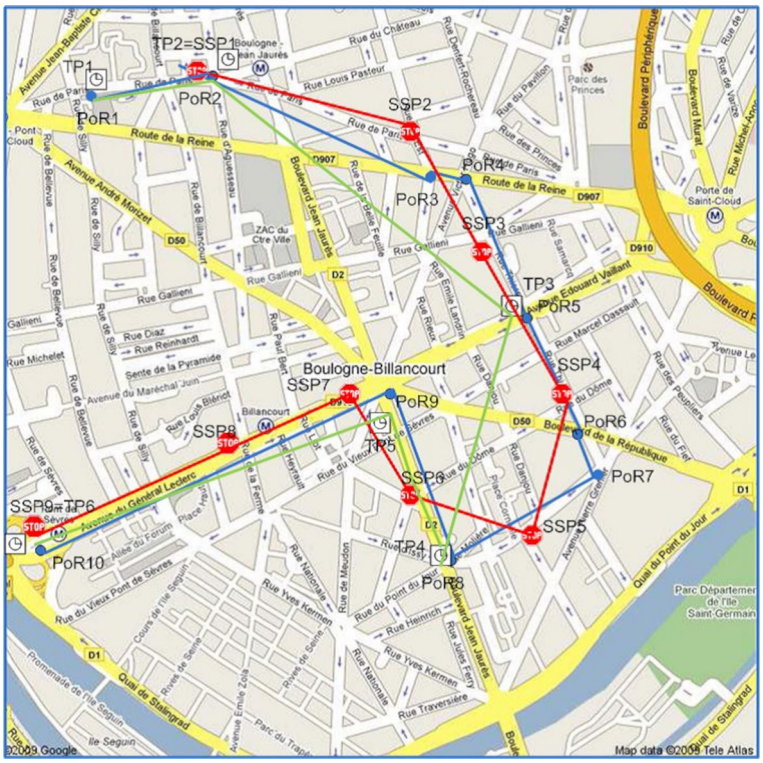

Figure 4 — Network infrastructure example (source: NeTEx – Part 1)

5.3.3 Network restriction

5.3.3.1 General

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

5.3.3.2 Network restriction – Conceptual model

5.3.3.2.1 General

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

The model comprises a set of different types of network restriction elements (VEHICLE TYPE AT POINT, OVERTAKING POSSIBILITY, IMPOSSIBLE MANOEUVRE and MEETING RESTRICTION) that apply to specific VEHICLE TYPEs (cf. EN 12896-1, Public transport - Reference data model - Part 1: Common concepts).

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