

DIN EN 12896-6

ICS 35.240.60

**Öffentlicher Verkehr –
Datenreferenzmodell –
Teil 6: Information an Reisende;
Englische Fassung EN 12896-6:2019, nur auf CD-ROM**

Public transport –
Reference data model –
Part 6: Passenger information;
English version EN 12896-6:2019, only on CD-ROM

Transports publics –
Modèle de données de référence –
Partie 6: Information des usagers;
Version anglaise EN 12896-6:2019, seulement en CD-ROM

Gesamtumfang 181 Seiten

DIN-Normenausschuss Automobiltechnik (NAAutomobil)
DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Dieses Dokument (EN 12896-6:2019) wurde vom Technischen Komitee CEN/TC 278 „Intelligente Verkehrssysteme“ ausgearbeitet, dessen Sekretariat von NEN (Niederlande) gehalten wird.

Das zuständige deutsche Normungsgremium ist der Gemeinschaftsarbeitsausschuss NA 052-00-71 GA „Gemeinschaftsarbeitsausschuss NAAutomobil/DKE: Intelligente Verkehrssysteme“ des DIN-Normenausschusses Automobiltechnik (NAAutomobil).

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die Englische Fassung von EN 12896-6:2019

Das Präsidium des DIN hat mit seinem Beschluss 1/2004 festgelegt, dass von dem in den Regeln der europäischen Normungsarbeit von CEN/CENELEC verankerten Grundsatz, wonach Europäische Normen in den drei offiziellen Sprachen Deutsch, Englisch und Französisch veröffentlicht werden, in begründeten Ausnahmefällen abgewichen und auf die deutsche Sprachfassung verzichtet werden kann.

Dienste im öffentlichen Verkehr verlassen sich zunehmend auf Informationssysteme, um Zuverlässigkeit, einen effizienten Betrieb und einen weitgehenden Zugriff auf zuverlässige Passagierinformationen sicherzustellen. Diese Systeme werden für die folgenden Anwendungen genutzt:

- Bereitstellung von Fahrplänen;
- Steuerung der Fahrzeugflotte;
- Ausstellung von Tickets und Quittungen;
- Bereitstellung von Echtzeitinformationen (Ankunft, Abfahrt usw.).

Diese Normenreihe verbessert eine Reihe von Informationseigenschaften im öffentlichen Verkehr, wie Interoperabilität zwischen Informationsprozesssystemen der Transportbetreiber und Behörden, indem ähnliche Definitionen, Strukturen und Bedeutungen ihrer Systemdaten benutzt werden. Das bezieht sich sowohl auf die Verbindung verschiedener Anwendungen innerhalb einer Organisation als auch auf die Verbindung von Anwendungen zwischen verschiedenen Organisationen.

Diese Normenreihe erlaubt Betreibern, Behörden und Softwarelieferanten eine einfachere Zusammenarbeit in der Herstellung integrierter Systeme.

Dieser Teil der Normenreihe legt Informationen an Reisende (geplant und Echtzeit) fest.

Nationaler Anhang NA (informativ)

Begriffe

Die Benummerung der folgenden Begriffe und Abkürzungen ist identisch mit der Benummerung in der englischen Fassung.

3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>

3.1 Allgemeine Begriffe

ANMERKUNG Es werden die folgenden generischen Begriffe verwendet.

3.1.1

Attribut

Eigenschaft einer Entität

3.1.2

konzeptuelles Datenmodell

Beschreibung eines realen Bereiches im Sinne von Einheiten, Beziehungen und Attributen in einem implementierungsunabhängigen Verhalten, um eine Struktur bereitzustellen, auf der die Restentwicklung eines Anwendungssystems basieren kann

3.1.3

konzeptuelles Niveau

bezogen auf Datenmodellierung das konzeptuelle Datenmodell

3.1.4

Datenbasis

Datensammlung

Anmerkung 1 zum Begriff: Wird oftmals im Sinne einer physischen Implementierung eines Datenmodells verwendet.

3.1.5

Datenbereich

Datenstruktur (in dieser Europäischen Norm ein Teil des Referenzdatenmodells für den öffentlichen Verkehr), zusammengesetzt aus Daten, die gegenseitig auf sich bezogen sind durch die Tatsache, dass es ein funktionales Gebiet oder eine Gruppe von Funktionen gibt, die diesen Datensatz als Ganzes verwenden

3.1.6

Datenmodell

Beschreibung eines realen Bereiches im Sinne von Daten und Beziehungen

3.1.7

Entität

Objekt (Daten), welches seine eigene Existenz hat (im Gegensatz zu einem Attribut)

3.1.8

Fahrgeldmanagement

alle Aktivitäten, die auf die Sammlung von Geld von den Passagieren bezogen sind

3.1.9

Funktion

Aktivität

Anmerkung 1 zum Begriff: In dieser Europäischen Norm eine Unteraktivität eines funktionalen Gebietes.

3.1.10

funktionales Gebiet

zufällig festgelegte Menge von Aktivitäten, die in dieser Europäischen Norm dafür verwendet werden, die Ziele und Grenzen von Datenmodellen festzulegen

3.1.11

Interoperabilität

Fähigkeit von (Sub-)Systemen, sich mit anderen (Sub-)Systemen nach vordefinierten Regeln (Schnittstelle) gegenseitig zu beeinflussen

3.1.12

logisches Datenmodell

Datengestaltung, welche den zu verwendeten Datenbasistyp berücksichtigt, aber keine anderen Mittel zur Nutzung von Bereichen oder Zugängen berücksichtigt

3.1.13

logisches, nicht vereinheitlichtes Modell

relationales Datenmodell, welches nicht vollständig vereinheitlicht ist, d. h. nicht vollständig den Vereinheitlichungsregeln folgt und deswegen möglicherweise redundant ist

3.1.14

logisches Niveau

bezogen auf Datenmodellierung das logische Datenmodell

3.1.15

betriebliche Informationen

alle Aktivitäten, die es dem Firmenmanagement erlauben, Informationen zu sammeln, die notwendig sind, um Problemlösungen nachzukommen

3.1.16

objektorientiertes Datenmodell

Datenstruktur, die nach den Prinzipien ausgedrückt ist, eine direkte Implementierung als objektorientierte Datenbasis zu ermöglichen, in der Informationen in Form von Objekten dargestellt werden, d. h. das Prinzip der Einbindung derart berücksichtigt werden, dass auf jedes Datenelement über zugehörige Funktionen (Methoden) zugegriffen oder dieses modifiziert werden kann

3.1.17

betriebliche Überwachung und Steuerung

Aktivitäten bezogen auf den Transportprozess, d. h. Echtzeitfunktionen bezogen auf die Fahrt und den Transport von Passagieren nach vorgegebenen Anweisungen, inklusive des Fahrprozesses und dessen Steuerung im Falle von Abweichungen sowie aller Aktivitäten, die den Fahrprozess unterstützen, wie Ampelphasen Priorisierung, Weichenschaltung, Bahnsteigauswahl, Vorlauf/Verzögerungsratschlag usw.

3.1.18**Passagierinformation**

Aktivitäten bezogen auf den Nutzer entweder den geplanten oder den gegenwärtigen Transportdienst zu informieren

3.1.19**Personaldisposition**

Aktivitäten bezogen auf die mittelfristige und kurzfristige Steuerung von Fahrern

3.1.20**Echtzeitsteuerung**

siehe betriebliche Überwachung und Steuerung

3.1.21**relationales Datenmodell**

Form eines logischen Datenmodells, das Informationen als Serie von Tabellen (Beziehungen) und Attributen liefert und die folgenden Eigenschaften verarbeitet:

- a) alle Attributwerte sind elementar,
- b) alle „Tupel“ (Reihen/Vorkommen) sind eindeutig,
- c) kein Teil des Grundschlüssels kann Null sein und
- d) fremde Schlüsselwerte entsprechen einem bestehenden Grundschlüssel, in anderer Beziehung als Null

3.1.22**Disposition**

siehe taktische Planung

3.1.23**taktische Planung**

Aktivitäten bezogen auf die taktische Transportplanung, Aufteilung der Fahrzeugdisposition, Fahrerdisposition, Dienstplanung

3.2 Bereichsbezogene Begriffe

ANMERKUNG Die folgenden Begriffe beziehen sich auf den Bereich für Informationen des Reisenden. Begriffe, die außerdem Dateneinheitsnamen sind, werden im Wörterbuch im Anhang A festgelegt und die meisten werden hier nicht wiederholt.

3.2.1**verteilter Reiseplaner**

Fahrtplaner, der seine Ergebnisse durch die Delegation der Planung an andere Systeme für diese Teile der Fahrt berechnet, die spezifische Gebiete oder Module abdecken

3.2.2**Austauschpunkt**

vereinbarter Übergabepunkt zur Zusammenführung verteilter Reiseplanungssysteme

3.2.3**Beobachter**

jemand, der auf Passagierinformationen schaut

3.2.4

wiederholte Fahrt

dieselbe Fahrt, die über dieselbe Strecke mehrmals gemacht wird, z. B. zur Arbeit oder Schule pendeln

3.2.5

Einzelfahrt

Fahrt, die ohne Reiseunterbrechungen direkt vom Startpunkt zum Ziel führt

3.2.6

Text-To-Speech

automatische Generierung von Sprache basierend auf einer Textdarstellung

3.2.7

Fahrtwiederherstellung

Aktivität zur Suche für Reisehinweise bezogen auf eine spezifische Fahrt, um eine Unterbrechung von Diensten wieder aufzunehmen

English Version

Public transport - Reference data model - Part 6: Passenger information

Transports publics - Modèle de données de référence -
Partie 6: Information des usagers

Öffentlicher Verkehr - Datenreferenzmodell - Teil 6:
Information an Reisende

This European Standard was approved by CEN on 19 April 2019.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword.....	11
Introduction	12
1 Scope.....	13
1.1 General Scope of the Standard.....	13
1.2 Functional Domain Description	14
1.3 Particular Scope of this document.....	14
2 Normative references.....	14
3 Terms and definitions	15
4 Symbols and abbreviations	18
5 Passenger Information Domain.....	19
5.1 Scope and overview.....	19
5.2 Passenger Information.....	20
5.2.1 Provision of Information	20
5.2.2 Types of Passenger Information.....	23
5.2.3 Timetable Information.....	25
5.2.4 Passenger Trip Planning	29
5.2.5 Estimation of Trip Duration	33
5.2.6 Information on Fares	35
5.2.7 Other Information.....	36
5.3 Use Cases for the Passenger Information Model.....	37
5.3.1 Purpose.....	37
5.3.2 Business context.....	37
5.3.3 Actors and use case types.....	38
5.3.4 Use cases.....	39
5.4 Public Transport Passenger Information – Conceptual MODEL	41
5.4.1 General.....	41
5.4.2 Trip Description	41
5.4.3 Passenger Information Queries.....	53
Annex A (normative) Data Dictionary	55
A.1 Introduction	55
A.2 Data Dictionary — Passenger Information.....	55
A.2.1 ACCESS LEG.....	55
A.2.2 LEG.....	55
A.2.3 LEG TRACK.....	55
A.2.4 MEAN INTERCHANGE TIME.....	56
A.2.5 MEAN PASSENGER WAIT TIME	56
A.2.6 MEAN RUN TIME	56
A.2.7 MIXED TRIP	57
A.2.8 MONITORED LEG	57

A.2.9	MONITORED LEG ARRIVAL.....	57
A.2.10	MONITORED LEG CALL.....	58
A.2.11	MONITORED LEG CALL PART.....	58
A.2.12	MONITORED LEG DEPARTURE.....	58
A.2.13	MONITORED LEG PROGRESS.....	59
A.2.14	MONITORED TRIP	59
A.2.15	MONITORED TRIP PATTERN	59
A.2.16	NON-PT TRIP	60
A.2.17	OTHER LEG.....	60
A.2.18	PARTICIPANT SYSTEM	60
A.2.19	PATH GUIDANCE.....	61
A.2.20	PI DELIVERY.....	61
A.2.21	PI REQUEST	61
A.2.22	PI REQUEST FILTER.....	62
A.2.23	PI REQUEST POLICY	62
A.2.24	PT CONNECTION LEG	62
A.2.25	PT FARE OFFER.....	63
A.2.26	PT RIDE LEG.....	63
A.2.27	PT TRIP	63
A.2.28	TRAVEL.....	64
A.2.29	TRAVEL FLOW	64
A.2.30	TRAVELLING ENTITY	64
A.2.31	TRIP	64
A.2.32	TRIP PATTERN.....	65
A.2.33	TRIP PATTERN MONITORING.....	65
A.2.34	TRIP REASON.....	65
A.2.35	TYPE OF GUARANTEE	66
A.2.36	TYPE OF PASSENGER	66
A.2.37	TYPE OF TRAVELLING ENTITY	66
A.2.38	TYPE OF REQUEST	67
Annex B (normative)	Additional Common Concepts — Extension to EN 12896-1:2016, <i>Public transport – Reference data model – Part 1: Common concepts</i>	68
B.1	Methodology and Conventions	68
B.1.1	Methodology for conceptual modelling.....	68
B.1.1.1	General	68
B.1.1.2	Packages.....	68
B.1.1.3	Package Prefixes and Package order.....	69

B.1.1.4 Part Prefixes and diagram names	70
B.1.1.5 Class diagrams.....	70
B.1.1.6 Class Diagram Presentations	71
B.1.1.7 Use of Colour	71
B.1.2 MODEL Class Diagrams	72
B.1.2.1 General.....	72
B.1.2.2 Classes and attributes.....	73
B.1.2.2.1 General	73
B.1.2.2.2 Attribute visibility.....	74
B.1.2.2.3 Attribute names.....	74
B.1.2.2.4 Attribute types.....	74
B.1.2.2.5 Multiplicity of Attributes.....	74
B.1.2.2.6 Common attributes	74
B.1.2.2.7 Simple Diagram Example	74
B.1.2.3 Relationships	76
B.1.2.3.1 General	76
B.1.2.3.2 Association relationships	76
B.1.2.3.3 Reflexive associations.....	76
B.1.2.3.4 Aggregation relationship	77
B.1.2.3.5 Generalization relationship	78
B.1.2.3.6 Multiplicity (Cardinality) of Relationships.....	79
B.1.2.3.7 Presence of Relationships on a given diagram.....	79
B.1.2.3.8 Relationships and navigability	80
B.1.2.3.9 Positional semantics for laying out classes and relationships.....	81
B.1.2.3.10 Explicit Frames	81
B.1.3 Summary of Rules for Transmodel Presentation	82
B.1.3.1 Presentation of Class Structure diagrams.....	82
B.1.3.2 Rules for naming and presenting classes	82
B.1.3.3 Rules for use of role names.....	83
B.1.3.4 Rules for use of multiplicity	84
B.1.3.5 Rules for relationship qualifiers.....	84
B.1.3.6 Rules for presenting relationships	85
B.1.3.7 Rules for Placing Role names.....	86
B.2 Extensions to the Common Concept MODEL.....	86
B.2.1 General.....	86
B.2.2 Additional Common Concepts — Additional Generalizations	86

B.2.2.1 Generic Type of Value – Conceptual MODEL	86
B.2.2.2 Generic Assignment – Conceptual MODEL.....	88
B.2.2.3 Generic Section – Conceptual MODEL.....	88
B.2.3 Extensions to the Generic Framework.....	89
B.2.3.1 General	89
B.2.3.2 Alternative Text – Conceptual MODEL	89
B.2.3.3 Generic View – Conceptual MODEL	90
B.2.3.4 Generic Loggable Object – Conceptual MODEL.....	91
B.2.3.5 Event Model – Conceptual MODEL	91
B.2.4 Extensions to the Reusable Components	92
B.2.4.1 Employee Model – Conceptual MODEL.....	92
B.2.4.2 Message Model – Conceptual MODEL.....	93
B.2.4.2.1 Messages.....	93
B.2.4.2.2 Publication Scope	94
B.2.4.3 Role Model – Conceptual MODEL	95
B.2.4.3.1 Generic Roles	95
B.2.4.3.2 Service Organization Roles	96
B.2.4.3.3 Employee Roles	97
B.2.4.3.4 Administrative Organization Roles	97
B.2.4.3.5 Technology Organization Roles	98
B.2.4.3.6 Messaging Roles.....	99
B.2.4.3.7 Transport Customer Roles	100
B.2.4.4 Security List – Conceptual MODEL	100
B.2.4.5 Transfer Time – Conceptual MODEL	101
B.2.5 Data Dictionary.....	101
B.2.5.1 General	101
B.2.5.2 ADMINISTRATIVE ORGANIZATION ROLE.....	102
B.2.5.3 ALTERNATIVE TEXT	102
B.2.5.4 ASSIGNMENT	102
B.2.5.5 BLACKLIST	102
B.2.5.6 CLASS ATTRIBUTE	103
B.2.5.7 CONDUCTOR ROLE.....	103
B.2.5.8 CUSTOMER SERVICE PROVIDER ROLE	103
B.2.5.9 CUSTOMER SERVICE ROLE.....	104
B.2.5.10 DATA COLLECTOR ROLE	104
B.2.5.11 DRIVER ROLE	104

B.2.5.12	EMPLOYEE	104
B.2.5.13	EMPLOYEE ROLE	105
B.2.5.14	EVENT.....	105
B.2.5.15	GENERAL EVENT.....	105
B.2.5.16	GENERAL OBSERVER ROLE.....	106
B.2.5.17	GENERAL SECTION.....	106
B.2.5.18	LOG	106
B.2.5.19	LOG ENTRY	106
B.2.5.20	LOGGABLE OBJECT	107
B.2.5.21	MESSAGE	107
B.2.5.22	MESSAGE PART	107
B.2.5.23	MESSAGE PRIORITY	107
B.2.5.24	ORGANIZATION ROLE.....	108
B.2.5.25	PT SCOPE.....	108
B.2.5.26	PUBLICATION APPROVER ROLE	108
B.2.5.27	PUBLICATION DECISION	109
B.2.5.28	PUBLICATION SCOPE	109
B.2.5.29	PUBLICATION WINDOW	109
B.2.5.30	PUBLISHING ACTION.....	109
B.2.5.31	PUBLISHING CHANNEL.....	110
B.2.5.32	QUALIFICATION.....	110
B.2.5.33	REGISTRAR ROLE	110
B.2.5.34	SECTION.....	110
B.2.5.35	SECTION IN LINK SEQUENCE	111
B.2.5.36	SECURITY LIST	111
B.2.5.37	SECURITY LISTABLE.....	111
B.2.5.38	SECURITY LISTING.....	111
B.2.5.39	SECURITY MANAGER ROLE.....	111
B.2.5.40	SERVICE OPERATOR ROLE.....	112
B.2.5.41	SITUATION AUTHOR ROLE	112
B.2.5.42	SPECIFIC OBSERVER ROLE.....	112
B.2.5.43	STATION EMPLOYEE ROLE	113
B.2.5.44	TECHNOLOGY ORGANIZATION ROLE.....	113
B.2.5.45	TRAFFIC INFORMATION OFFICER ROLE	113
B.2.5.46	TRANSFER TIME	114
B.2.5.47	TRANSPORT USER ROLE.....	114

B.2.5.48	TRAVEL DOCUMENT CONTROLLER ROLE.....	114
B.2.5.49	TRAVEL DOCUMENT CONTROLLING ORGANIZATION ROLE	114
B.2.5.50	TRAVEL ORGANIZATION ROLE	115
B.2.5.51	TYPE OF AUDIENCE.....	115
B.2.5.52	TYPE OF EVENT	115
B.2.5.53	TYPE OF MESSAGE.....	116
B.2.5.54	TYPE OF MESSAGE PART CONTENT	116
B.2.5.55	TYPE OF QUALIFICATION	116
B.2.5.56	TYPE OF SECURITY LIST	116
B.2.5.57	TYPE OF VALUE	117
B.2.5.58	View.....	117
B.2.5.59	WHITELIST.....	117
Annex C (informative)	Data Model Evolution	118
C.1	Change Requests	118
C.2	Source of Text.....	128
C.3	Diagram Status.....	130
Annex D (informative)	Mapping to OADJP and to SIRI	131
D.1	Table of equivalent SIRI Services.....	131
D.2	Table of equivalent OADJP Services.....	131
Annex E (informative)	Passenger Information Functional Requests	133
E.1	Introduction.....	133
E.2	Overview of Passenger Information Functional Requests.....	133
E.2.1	General	133
E.2.2	Further types of PI Query	135
E.3	System Provisioning Queries — Exchange Point Query	135
E.3.1	Exchange Point Request.....	135
E.3.2	Exchange Point Delivery	135
E.3.2.1	General	135
E.3.2.2	Exchange Point example	136
E.4	Travel Related Queries.....	137
E.4.1	Location Query.....	137
E.4.1.1	Location Request.....	137
E.4.1.2	Location Delivery	138
E.4.2	Stop Event Query.....	139
E.4.2.1	Stop Event Request.....	139
E.4.2.2	Stop Event Delivery.....	140

E.4.3	Schedule Query	141
E.4.3.1	Schedule Request	141
E.4.3.2	Schedule Delivery	142
E.4.4	Situation Query	143
E.4.4.1	Situation Request	143
E.4.4.2	Situation Delivery	144
E.4.5	Trip Query.....	145
E.4.5.1	Trip Request.....	145
E.4.5.2	Trip Delivery.....	146
E.4.6	Service Journey Query	147
E.4.6.1	Service Journey Request.....	147
E.4.6.2	Service Journey Delivery	148
E.5	Fare Related Queries.....	149
E.5.1	Stop Fare Query	149
E.5.1.1	Stop Fare Request	149
E.5.1.2	Stop Fare Delivery.....	150
E.5.2	Trip Fare Queries	151
E.5.2.1	General.....	151
E.5.2.2	Common Trip Fare Query Model	151
E.5.2.3	Single Trip Fare Query	152
E.5.2.3.1	Single Trip Fare Request.....	152
E.5.2.3.2	Single Trip Fare Delivery	153
E.5.2.4	Repeated Trip Fare Query.....	154
E.5.2.4.1	Repeated Trip Fare Request.....	154
E.5.2.4.2	Repeated Trip Fare Delivery	155
E.5.3	Fare Product Query	156
E.5.3.1	Fare Product Request	156
E.5.3.2	Fare Product Delivery.....	157
E.6	Data Dictionary — Passenger Information Requests.....	158
E.6.1	EXCHANGE POINTS DELIVERY	158
E.6.2	EXCHANGE POINTS REQUEST	158
E.6.3	EXCHANGE POINTS REQUEST FILTER.....	159
E.6.4	EXCHANGE POINTS REQUEST POLICY.....	159
E.6.5	FARE PRODUCT DELIVERY.....	159
E.6.6	FARE PRODUCT REQUEST	160
E.6.7	FARE PRODUCT REQUEST POLICY	160

E.6.8	LOCATION DELIVERY	161
E.6.9	LOCATION GEOMETRY RESTRICTION.....	161
E.6.10	LOCATION PLACE FILTER.....	161
E.6.11	LOCATION REQUEST	161
E.6.12	LOCATION REQUEST POLICY	162
E.6.13	PLACE RESULT	162
E.6.14	PROFILE REQUIREMENTS.....	162
E.6.15	REPEATED TRIP FARE REQUEST	163
E.6.16	REPEATED TRIP FARE REQUIREMENTS	163
E.6.17	SCHEDULE DELIVERY	164
E.6.18	SCHEDULE REQUEST.....	164
E.6.19	SCHEDULE REQUEST CONTENT FILTER.....	164
E.6.20	SCHEDULE REQUEST POLICY	165
E.6.21	SERVICE JOURNEY DELIVERY	165
E.6.22	SERVICE JOURNEY REQUEST.....	165
E.6.23	SERVICE JOURNEY REQUEST POLICY	166
E.6.24	SINGLE TRIP FARE REQUEST	166
E.6.25	STOP EVENT DELIVERY.....	167
E.6.26	STOP EVENT REQUEST	167
E.6.27	STOP EVENT REQUEST CONTENT FILTER.....	167
E.6.28	STOP EVENT REQUEST POLICY	168
E.6.29	STOP FARE DELIVERY	168
E.6.30	STOP FARE REQUEST.....	169
E.6.31	TARIFF ZONE IN AREA.....	169
E.6.32	TRIP ACCESS CONSTRAINT	169
E.6.33	TRIP DELIVERY	169
E.6.34	TRIP DESTINATION PLACE	170
E.6.35	TRIP FARE DELIVERY	170
E.6.36	TRIP FARE REQUEST.....	170
E.6.37	TRIP FARE REQUEST FILTER	170
E.6.38	TRIP FARE REQUEST POLICY	171
E.6.39	TRIP MOBILITY FILTER	171
E.6.40	TRIP ORIGIN PLACE.....	171
E.6.41	TRIP REQUEST	172
E.6.42	TRIP REQUEST FILTER.....	172
E.6.43	TRIP REQUEST PLACE	172

E.6.44 TRIP REQUEST POLICY 173

E.6.45 TRIP VIA PLACE..... 174

Bibliography..... 175

European foreword

This document (EN 12896-6:2019) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2020, and conflicting national standards shall be withdrawn at the latest by March 2020.

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.

The series composed of the following documents:

- *Public transport – Reference data model – Part 1: Common concepts;*
- *Public transport – Reference data model – Part 2: Public transport network;*
- *Public transport – Reference data model – Part 3: Timing information and vehicle scheduling;*
- *Public transport – Reference data model – Part 4: Operations monitoring and control;*
- *Public transport – Reference data model – Part 5: Fare management;*
- *Public transport – Reference data model – Part 6: Passenger information;*
- *Public transport – Reference data model – Part 7: Driver management*
- *Public transport – Reference data model – Part 8: Management information & statistics; and*
- *Public transport – Reference data model – Part 9: Informative documentation [CEN/TR].*

Together these create version 6 of the European Standard EN 12896, known as “Transmodel”, and thus replace EN 12896:2006, known as “Transmodel v5.1”.

In comparison with EN 12896:2006, the technical modifications made are presented in the Technical CEN/TR 12896-9, *Public transport – Reference data model – Part 9: Informative documentation*.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Turkey and the United Kingdom.

Introduction

Part 1 of this European Standard presents the following items:

- Rationale for the Transmodel Standard;
- Use of the Transmodel Standard;
- Applicability of the Transmodel Standard;
- Conformance Statement;
- Transmodel Origins;
- Reference to the Previous Version and Other Documents.

The data structures represented in Part 1 are generic patterns that are referenced by different other parts.

Part 2 of this European Standard presents space-related data structures.

Part 3 presents time-related data structures and replaces the sections of EN 12896:2006 referring to the time-related Tactical Planning Components and to Vehicle Scheduling.

Part 4 presents data referring to daily operations (i.e. to operational days), different from those planned for day types (space-related data structures and tactical planning components) and including operational raw data referring to operations follow-up.

Part 5 presents fares structures including sales, validation and control.

Part 6 (this part) presents Passenger Information (planned and real-time).

Part 7 presents Driver Management including Driver Scheduling (day-type related driver schedules), Rostering (ordering of driver duties into sequences according to some chosen methods) and Driving Personnel Disposition (assignment of logical drivers to physical drivers and recording of driver performance).

Part 8 presents Management Information and Statistics.

1 Scope

1.1 General Scope of the Standard

The main objective of the present standard is to present the Reference Data Model for Public Transport, based on:

- the Reference Data Model, EN 12896, known as Transmodel V5.1;
- EN 28701:2012, *Intelligent transport systems – Public transport – Identification of Fixed Objects in Public Transport (IFOPT)*, although note that this particular standard has been withdrawn as it is now included within Parts 1 and 2 of this standard (EN 12896-1:2016 and EN 12896-2:2016) following their successful publication,

incorporating the requirements of:

- EN 15531-1 to -3 and CEN/TS 15531-4 and -5: *Public transport – Service interface for real-time information relating to public transport operations (SIRI)*;
- CEN/TS 16614-1 and -2: *Public transport – Network and Timetable Exchange (NeTEx)*, in particular the specific needs for long distance train operation.

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

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

The following functional domains are considered:

- Network Description: routes, lines, journey patterns, timing patterns, service patterns, scheduled stop points and stop places;
- Timing Information and Vehicle Scheduling (runtimes, vehicle journeys, day type-related vehicle schedules);
- Passenger Information (planned and real-time);
- Fare Management (fare structure, sales, validation, control);
- Operations Monitoring and Control: operating day-related data, vehicle follow-up, control actions;
- Driver Management:
 - Driver Scheduling (day-type related driver schedules),
 - Rostering (ordering of driver duties into sequences according to some chosen methods),
 - Driving Personnel Disposition (assignment of logical drivers to physical drivers and recording of driver performance);
- Management Information and Statistics (including data dedicated to service performance indicators).

The data modules dedicated to cover most functions of the above domains will be specified.

Several concepts are shared by the different functional domains. This data domain is called “Common Concepts”.

1.2 Functional Domain Description

The different functional domains (enumerated above) taken into account in the present standard, and of which the data have been represented as the reference model, are described in EN 12896-1:2016, *Public transport – Reference data model – Part 1: Common concepts*.

1.3 Particular Scope of this Document

The present document entitled *Public transport – Reference data model – Part 6: Passenger information*, incorporates the following main data packages:

- Trip Description;
- Passenger Queries.

This document itself is composed of the following parts:

- Main document (normative) representing the data model for the concepts shared by the different fare domains covered by Transmodel;
- Annex A (normative), containing the data dictionary, i.e. the list of all the concepts and attribute tables present in the main document together with the definitions;
- Annex B (normative), providing a complement to EN 12896-1:2016, particularly useful for parts 4 to 8 of the Public Transport Reference Data Model;
- Annex C (informative), indicating the data model evolutions;
- Annex D (informative), indicating the high-level equivalences of the example passenger information functional requests to the capabilities of other standards;
- Annex E (informative), providing an example set of commonly found passenger information functional requests and data dictionary for the elements used in the examples.

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

EN 12896-2:2016, *Public transport – Reference data model – Part 2: Public transport network*

EN 12896-3:2016, *Public transport – Reference data model – Part 3: Timing information and vehicle scheduling*

EN 12896-5:2019, *Public transport – Reference data model – Part 5: Fare management* (“Transmodel v6”)

EN 12896-8:2019, *Public transport – Reference data model – Part 8: Management information & statistics* (“Transmodel v6”)

EN 15531-1, *Public transport – Service interface for real-time information relating to public transport operations – Part 1: Context and framework*

EN 15531-2, *Public transport – Service interface for real-time information relating to public transport operations – Part 2: Communications*

EN 15531-3, *Public transport – Service interface for real-time information relating to public transport operations – Part 3: Functional service interfaces*

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

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

CEN/TS 17118, *Intelligent transport systems – Public transport – Open API for distributed journey planning*

3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 General terms and definitions:

NOTE The following generic terms and definitions are used.

3.1.1

attribute

property of an entity

3.1.2

conceptual data model

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

3.1.3

conceptual level

conceptual data model in the context of data modelling

3.1.4

database

collection of data

Note 1 to entry: Often used in the sense of the physical implementation of a data model.

3.1.5

data domain

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

3.1.6

data model

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

3.1.7

entity

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

3.1.8

fare management

all activities related to the collection of money from passengers

3.1.9

function

activity

Note 1 to entry: In this European Standard, a sub-activity of a functional area.

3.1.10

functional area

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

3.1.11

interoperability

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

3.1.12

logical data model

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

3.1.13

logical denormalized model

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

3.1.14

logical level

logical data model in the context of data modelling

3.1.15

management information

activities allowing the company management to collect the information necessary to meet problem-solving needs

3.1.16

object-oriented data model

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

3.1.17

operations monitoring and control

activities related to the transportation process, i.e. real-time functions related to the driving and transportation of passengers according to given instructions, including the monitoring of the driving process and its control in case of deviations, as well as all activities that support the driving process such as traffic light priority, track switching, bay selection, advance/delay advice, etc.

3.1.18

passenger information

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

3.1.19

personnel disposition

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

3.1.20

real-time control

see operations monitoring and control

3.1.21

relational data model

type of logical data model giving the information as series of tables (relations) and attributes, and possessing the following characteristics:

- a) all attribute values are atomic;
- b) all "tuples" (rows/occurrences) are distinct;
- c) no part of the primary key may be null; and
- d) foreign key values must correspond to an existing primary key in another relation or be null

3.1.22

scheduling

see tactical planning

3.1.23

tactical planning

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

3.2 Domain specific terms and definitions:

NOTE The following terms specific to the passenger information domain are used. Terms which are also data entity names are defined in the data dictionary in Annex A and are not repeated here.

3.2.1

distributed journey planner

trip planner that computes its results by delegating planning to other systems for those parts of the trip covering specific areas or modes

3.2.2

exchange point

agreed handover point for linking distributed journey planning systems

3.2.3

observer

someone who looks at Passenger Information

3.2.4

repeated trip

same trip made over the same route multiple times, for example to commute to work or school

3.2.5

single trip

trip that goes direct from an origin to a destination without breaks in the journey

3.2.6

text to speech

automatic generation of speech from a textual representation

3.2.7

trip repair

activity of looking for travel advice regarding a specific trip in order to recover from a disruption to services

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

ABT	Account Based Ticketing
API	Application Program Interface
DJP	Distributed Journey Planner
FQ	Fare Query
GIS	Geographic Information System
GTFS	General (sometimes “Google”) Transit Feed Specification
IFM	Interoperable Fare Management
FM	Fare Management
IFOPT	Identification of Fixed Objects in Public Transport
ISO	International Organization for Standardization
IT	Information Technology
NeTEx	Network and Timetable Exchange
NFC	Near Field Communication
OADJP	Open API for Distributed Journey Planner
PI	Passenger Information
PT	Public Transport
QR	Query Request
TD	Trip Description
TTS	Text to Speech
SIRI	Service Interface for Real-time Information
UML	Unified Modelling Language
URL	Universal Resource Locator
VDV	Verband Deutscher Verkehrsunternehmen (D)
WGS	World Geodetic Standard

5 Passenger Information Domain

5.1 Scope and overview

The passenger information part of Transmodel describes the data which are presented to passengers by applications that can interact directly with passengers. This covers both data on the planned and actual services, but also data resulting from the planning and control processes which may result in service modifications.

Classically, passenger information was published as printed timetables or shown on electro mechanical boards in stations. Earlier generations of electronic display were typically available only in stations using localized systems.

Modern passenger information systems are generally provided through service interfaces that access online data and may be used from web and mobile internet devices anywhere.

Applications providing data to customers typically use an optimized API to fetch the data from a back-end system. The standard does not aim to define an actual API for such services, but rather to provide a mapping that shows how the data elements of the reference model relate to the different possible types of passenger Information service.

Two other European Standards provide concrete API's;

- SIRI (*Server Interface for Real Time Information* - EN 15531-1, EN 15531-2, EN 15531-3, CEN/TS 15531-4 and CEN/TS 15531-5), which provides real-time status information; and
- OADJP (*Open API for Distributed Journey Planning* - CEN/TS 17118) describes stop finding, trip planning, schedule, and related APIs.

All of the following are relevant for delivering passenger information;

- Passenger information facilities and their utilization for passenger queries;
- Detailed descriptions of all the conceptual components of a passenger *trip*, as possibly needed by an interactive passenger information system when answering a PI REQUEST;
- Basic definitions of run times and wait times needed to calculate trip duration;
- Planned, predicted, and actual passing times of journeys at individual stops;
- Service modifications decided by the schedulers or the control staff, resulting in changes of the vehicle journeys and blocks, compared to the original plan;
- Fare structures, fareProducts and prices along with distribution and fulfilment options.

Most types of passenger information make use of many underlying elements from the topological network definition, such as the lines and journeys which form the service offer, the definition of run and wait times, and other fundamental definitions. Geographical information may possibly be provided in some cases if corresponding application systems are available, for example to show the route of a bus. Specific types of passenger queries may be related to fares, where the relevant information elements are included in the fare collection sub-model of the reference data model.

Thus, the information basis for passenger information systems is widely spread over the whole reference data model, and the genuine passenger information data model covers only those elements which cannot be derived from, and are not explicitly included in, other parts of the model. It is also useful to indicate how such data may be assembled into specific services corresponding to commonly-made passenger queries.

5.2 Passenger Information

5.2.1 Provision of Information

5.2.1.1 General

In early generations of information systems used for public transport, the passenger information functions were often designed as sub-functions of other systems. For instance, printed timetables were simply an end product of the scheduling process, dynamic displays at stop points were incorporated in monitoring and control systems, etc. More and more, the trend is to gather all data likely to be used for passenger information functions into specific databases, independent of the operation and control systems. The required data are then put at the disposal of information applications interfaced with such databases, which make appropriate requests to collect the data. This approach gives the necessary scalability and security need to support mass consumer applications without compromising the operation of the transport network.

It is therefore necessary to distinguish the data handled by passenger information functions from the management of the operation and control systems and the distribution of information to in-station and onboard devices. Besides all the data forming the basis for passenger information (e.g. network description, planned schedules, monitored passing times, etc.), some data structures are necessary to organize the distribution of this information. The present part describes some important concepts referring to the ways of delivering such information to the customers.

5.2.1.2 Passenger Information Types

Information for passengers can be communicated to the passengers using a large variety of equipment, such as:

- printed material such as leaflets at stops, information booklets, etc.;
- passive terminals, such as displays at stop points or onboard vehicles, delivering information on planned or actual service, e.g. information on the arrival times;
- interactive terminals, delivering information on request regarding planned or actual service, such as home internet terminals, personal mobile devices, an information desk terminal operated by the staff, etc.

Data for the last two will be obtained from servers that aggregate and distribute data.

In spite of this variety of media and techniques, some common data features exist to describe the characteristics of the provided information. For instance, the location of a display (e.g. at a stop point) or the list of routes about which information is provided does not depend on the type of equipment that is used to present the information.

5.2.1.3 Passenger Information Equipment

This subclause summarizes the delivery elements for in-station displays, found in EN 12896-2:2016.

Delivery of passenger information through any form of device is described by the entity PASSENGER INFORMATION EQUIPMENT, a generic class of information device, which can be classified by the entity TYPE OF PASSENGER INFORMATION EQUIPMENT according to the common functional capabilities. It may be passive (for example a printed timetable), active (for example a display), or interactive (for example a kiosk terminal supporting trip planning).

PASSENGER INFORMATION EQUIPMENT may be located at a POINT in the network. Such a POINT will often be at a STOP POINT. The STOP PLACE model can be used to specify the exact locations of displays within a stop or interchange.

PASSENGER INFORMATION EQUIPMENT may also be located at a place that is not on the PT network (e.g. at a central place in the city, in a shopping centre, or an office lobby); here, the SITE model can be used to locate displays outside of stations.

Onboard terminals (e.g. dynamic displays) may also be described as PASSENGER INFORMATION EQUIPMENT, located using an ACTUAL VEHICLE EQUIPMENT.

At-stop and onboard systems will show a subset of data relevant to the transport available at their location. A DISPLAY ASSIGNMENT to a LOGICAL DISPLAY associated with the PASSENGER INFORMATION EQUIPMENT is used to indicate which specific services (e.g. LINES, or services following a specific JOURNEY PATTERN) should be included.

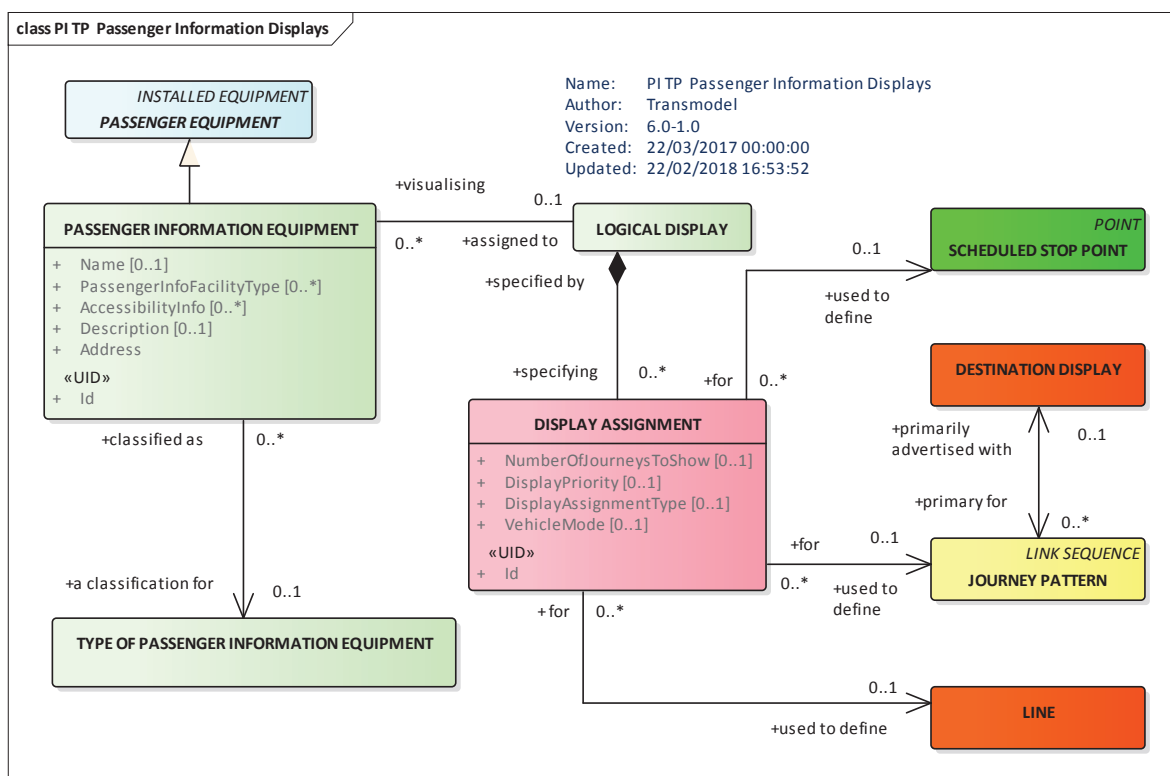


Figure 1 — EN 12896-2:2016 Passenger Information Displays (UML)

5.2.1.4 Internet based information services

Data may also be distributed to customers on their own devices using web and mobile applications, either directly or via an intermediary. These may be specifically orientated to PT transport or may include PT data among other data. The selection of relevant types of data can be represented by a PASSENGER INFORMATION QUERY.

Specific TRIPs and MONITORED TRIPs may be persistently associated with a CUSTOMER ACCOUNT.

5.2.1.5 Transactions and Queries

Operators that provide information for interactive services will often log the parameters of transactions made against their services. For instance, the time and the duration of a request and response may be stored along with the locations sought, allowing statistical analysis, and in some cases also for invoicing. An entity PI DELIVERY is defined to describe these parameters.

In interactive systems the results of one query may be used to obtain input for another; for example, having found a possible trip a customer may then enquire as to the available fares. The entity PI REQUEST describes any elementary request, being part of a PI DELIVERY.

Each PI REQUEST refers to a precise topic and is therefore classified by the entity TYPE OF QUERY. The main types, modelled as sub-types of PI REQUEST, are:

- SCHEDULE REQUEST, for which a potential passenger asks for schedules, departure or passing times on certain lines and stop points;
- LOCATION REQUEST, for which a passenger asks for details of a location;
- TRIP REQUEST, for which a passenger asks for a journey plan between an origin and a destination to follow on the public transport network;
- SERVICE JOURNEY REQUEST for which a passenger asks for details about a specific journey;
- STOP EVENT REQUEST, for which a passenger asks about arrivals and departures at a specific stop;
- FARE REQUEST, for information on the fare structure, or on the amount of fare for a particular trip; this may be either for a single trip (SINGLE TRIP FARE REQUEST) or repeated travel (REPEATED TRIP FARE REQUEST) on a route.

The methods of selecting a trip proposal in response to a TRIP REQUEST can use a variety of selection and optimization criteria, which can be expressed using a TRIP CONTENT FILTER and a TRIP REQUEST POLICY on the query. For instance:

- preference for a particular OPERATOR;
- preference for one transport mode (bus, metro...);
- whether to select a journey by arrival or departure time;
- maximum duration or distance of the whole trip;
- maximum walking distance;
- maximum number of interchanges;
- maximum amount of fare;
- etc.

5.2.1.6 Push services

Some delivery systems use a publish/subscribe or 'push' interaction to deliver data. The client subscribes to receive particular data, and this is then sent to them at regular intervals. For example, the SIRI framework allows for the same delivery types to be fetched both by direct request/response and by subscription. The content of a publish/subscribe service can also be described by a PI REQUEST and PI DELIVERY. Push, or notification, services are suitable for particular types of data where there is a suitable entity to which to subscribe, for instance arrivals at a given stop or disruptions to a given line or service.

5.2.2 Types of Passenger Information

5.2.2.1 Spatial Information

5.2.2.1.1 General

The reference model includes spatial data suitable for providing different sorts of Map visualizations of routes and fare zones. These may include both visualization of specific PASSENGER TRIPs and general-purpose visualization of a line or the whole network.

5.2.2.1.2 Network Maps

The network is often represented on a background map, which describes the area served by public transport (e.g. city map). It is also common to show a projection of various parts of a PASSENGER TRIP on a map. The map with its layers or spatial features is typically provided separately by a map server that integrates and renders geographical information system (GIS) data.

In order to display the PT layer data onto the map layer a projection as a sequence of spatial coordinates must be provided to the application. This can be done, for instance, by LINK PROJECTION (see EN 12896-2:2016) of the ROUTE LINKs on INFRASTRUCTURE LINKs. ROUTE LINKs will in turn bear by projection the other required information (e.g. STOP POINTs). Another solution is to project only the ROUTE POINTs (and possibly some other POINTs) on the infrastructure network, the shape of the ROUTE LINKs between such POINTs being given by LINE SHAPEs, specific to this map representation layer.

As such a mapping of information may be represented on various scales, the required level of detail may be different, depending on the chosen scale. An important station may be represented, on a small scale map, by a point (or an icon), whereas the different STOP POINTs will be represented on medium scale maps, or the details of platforms will be shown on a large scale map. This will require other types of projection, in particular the COMPLEX FEATURE PROJECTION targeting a POINT.

A very simple representation of a PT network consists in drawing a schematic description of each SERVICE PATTERN on a straight line, with all STOP POINTs marked on that line at the same distance from each other ("thermometer"). This is a purely topological representation of the basic definition of a JOURNEY PATTERN (or a SERVICE PATTERN) as an ordered sequence of points.

Some additional information may be added to this simple representation of a SERVICE PATTERN. The LINEs (or ROUTEs or SERVICE PATTERNS) with which an interchange is proposed at particular STOP POINTs may be indicated. This will require a request on either:

- other SERVICE PATTERNS serving the represented STOP POINTs, or those related to them by a CONNECTION link; or
- other SERVICE PATTERNS related to the represented one by any SERVICE JOURNEY PATTERN INTERCHANGE.

The FARE SECTIONS (see EN 12896-2:2016) may also be represented on this schema. This will require a LINK PROJECTION of each FARE SECTION on either the JOURNEY PATTERN or the ROUTE it covers.

The actual distances between STOP POINTs (e.g. stored as attributes of SERVICE LINKs) may be proportionally represented on the schema, instead of equal distances.

Such representations are useful for showing a single service in a given direction, as say for a passenger trip. Where multiple service patterns or services need to be shown, say, as a line, then a simple projection, while useful for some trip planning and management purposes, is not generally sufficiently detailed. Typically, the two ROUTEs of opposite DIRECTIONS will be drawn, including every minor variant.

If the LINE includes more than two ROUTEs, in particular when there are diverging branches, other linear forms are necessary. A SCHEMATIC MAP (see EN 12896-1:2016) can be used to provide a coloured line-based representation, including branches. Every feature on the map (SCHEDULE STOP POINTS, TARIFF ZONES, LINE SECTIONS, etc.) is linked to an underlying entity so as to enable direct interaction by the user to drill down to get further details.

5.2.2.2 Line and Destination Information

Most of the lines will have an advertised destination, generally known by the passengers and displayed on the vehicle (i.e. on the headsign). This destination will also be used in most of the information material.

This information is not necessarily the name of the final destination (e.g. the name of the last POINT IN JOURNEY PATTERN). Any exception may be described by the entity DESTINATION DISPLAY.

A DESTINATION DISPLAY is advertised for one or several JOURNEY PATTERNS (if several, they are often operated on the same ROUTE or LINE). The DESTINATION DISPLAY may change along the route and so be shown differently at different stops.

This entity may also be used for online modification of the destination information. With some modifications due to control actions, it may be more useful to display other indications on the bus (e.g. “shortened route”, “depot”, “out of service”, etc.) than the normal text. This is possible thanks to the unique identifier (‘#ID’) of the entity, which could be completed by a VALIDITY CONDITION (e.g. a simple time limit).

The information on the final destination will usually be coupled with a public “line number”. According to local usage, such a number may be attached to a LINE (or a GROUP OF LINES) or, more precisely, to each ROUTE or JOURNEY PATTERN. In the case of diverging branches, for instance, the number may be different for each branch (i.e. to each ROUTE), even if they belong to the same LINE. However, two ROUTEs following the same path in opposite DIRECTIONS usually bear the same number. To cope with this variety of practices, an attribute ‘name’ is attached to each of those entities.

5.2.2.3 Footnotes and other Notices

For passenger information (or sometimes driver information) purposes, it is often useful to attach remarks to various parts of the supply (a point, a line, a section etc.). For instance, the fact that a shortened journey pattern is used exceptionally may be emphasized. Such remarks are usually printed as footnotes on public timetables at stops, timetable booklets or, for driver information, on driver cards.

The entity NOTICE describes such remarks (this entity was previously called a FOOTNOTE in Transmodel v5.1 EN 12896:2006). It may concern a whole LINE, or a GROUP OF POINTS (e.g. one or several STOP AREAS).

More frequently, a NOTICE will be assigned to a JOURNEY PATTERN, a COMMON SECTION, or even a specific VEHICLE JOURNEY. In such cases, the same NOTICE will be often assigned to several objects (e.g. to several consecutive VEHICLE JOURNEYS).

Moreover, the validity of a NOTICE, for instance on a JOURNEY PATTERN or a COMMON SECTION, may be restricted from a POINT IN JOURNEY PATTERN, or to another POINT IN JOURNEY PATTERN.

The entity NOTICE ASSIGNMENT describes these spatial or operational assignments. Only the most frequent assignments are represented in the model; others may be added using the same construction.

A NOTICE ASSIGNMENT may be subject to various other conditions of validity (such as DAY TYPE, TIME BAND), represented by VALIDITY CONDITIONS.

A NOTICE is different from a DESTINATION DISPLAY. The first is designed to specify some characteristics of a journey or a journey pattern, likely to evolve. They are, in most cases, printed in leaflets but may also be queried by dynamic trip planning tools. A DESTINATION DISPLAY corresponds

to stable information attached to a JOURNEY PATTERN, for instance the destination announcement displayed on bus headsigns.

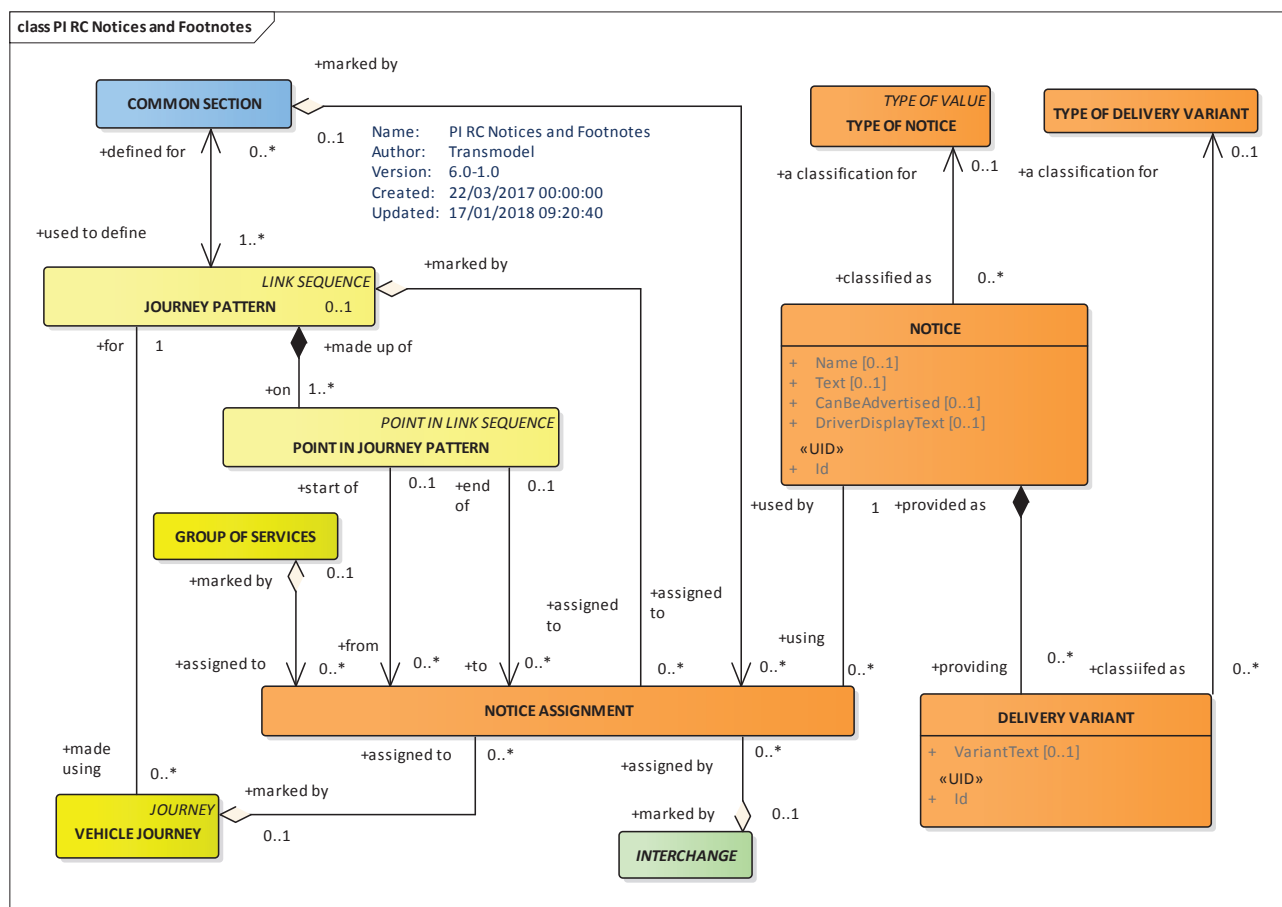


Figure 2 — Notices and Footnotes (UML)

5.2.3 Timetable Information

5.2.3.1 Introduction

The basis for almost all passenger information functions is the ‘timetable’. A timetable is an end product of the scheduling process. It gives the scheduled passing times (in general, departure times) for all VEHICLE JOURNEYS, on all STOP POINTS, for one or possibly several DAY TYPES.

The timetable information may be published in many different forms. A classical way of providing timetable information is the booklet with the complete timetable for a certain operator or area. At stops, a selection from the complete timetable is often displayed, for instance the departure times of all lines that pass by the stop. An electronic display may provide variable timetable information. The answer to a SCHEDULE REQUEST will be composed of a subset of timetable data, etc.

The displayed times may refer to all departures times from a certain stop point, or all departure times at any stop point served by a line, etc. A timetable may provide information on one or, more frequently, several day types, for a certain calendar period.

Although the ‘timetable’ is a very well-known and important concept, it is not described in the data model as an inherent entity, because it contains only derived data; a TIMETABLE FRAME represents such an assembly and can be used to organize journeys into named sets with a particular validity that can be rendered in tabular form. The GROUP OF SERVICE element can be used to indicate subgroupings

for the purposes of presentation; for example, there might be separate groups for outbound and inbound journeys of a route, or for weekdays and weekends. The process of computing timetable information (in particular the passing times) is described in detail in EN 12896-3:2016.

5.2.3.2 Passing Times

Although any theoretical passing time at a point may be derived from the underlying scheduling information, this data will, in real implementations, often be pre-calculated and stored. For instance, it would be a waste of time to re-compute passing times for each occurring SCHEDULE REQUEST, or for each time an AVM system needs to position a PT vehicle against its schedule.

Moreover, information exchanges between a PT company database and the outside world are increasingly prevalent. Systems such as route guidance systems for private cars or park and ride systems request data about the planned and actual arrival and departure times. In places where several PT companies operate, passenger information may be provided by an authority, without any access to the detailed scheduling data of each operator. In such exchanges, the concept of timetable is often used (although almost never accurately specified) and arrival and departure times at points are the core information.

These theoretical passing times are likely to evolve during the course of an operating day, producing target passing times. In addition, forecasts may be made on estimated passing times and actual observed passing times may be recorded by a monitoring system.

Finally, the concept of passing time may be extended to support specific properties attached to the period spent at the stop (e.g. the right to alight for a while).

The entity PASSING TIME represents the common properties of any passing time at a point in the network. This entity has several subtypes.

5.2.3.3 Timetabled Passing Times

The PASSING TIMES that are the results of the scheduling process for publishing in a timetable are called TIMETABLED PASSING TIMES.

The TIMETABLED PASSING TIMES are normally generated a long time before the day of operation and are valid for a long period of time (e.g. summer, winter timetable). They are calculated for the planned NORMAL DATED VEHICLE JOURNEYS that were defined during the scheduling process. They may be computed as well for any extra DATED VEHICLE JOURNEY created by a CONTROL ACTION.

The TIMETABLED PASSING TIMES can be calculated for the TIMING POINTs that were used for scheduling, but they are often also generated through interpolation, for POINTs that were not defined as TIMING POINTs (for instance for all STOP POINTs of a JOURNEY PATTERN). Therefore, a TIMETABLED PASSING TIME is defined for a POINT IN the JOURNEY PATTERN that the journey in question is serving.

5.2.3.4 Actual Passing Times

The PASSING TIMES that are computed on a specific OPERATING DAY are called DATED PASSING TIME. This entity has several subtypes, described in EN 12896-3:2016:

- TARGET PASSING TIME, the latest official plan for a DATED VEHICLE JOURNEY, on a POINT IN JOURNEY PATTERN;
- ESTIMATED PASSING TIME, a forecast for a MONITORED VEHICLE JOURNEY, on a POINT IN JOURNEY PATTERN;
- OBSERVED PASSING TIME, recorded for a MONITORED VEHICLE JOURNEY, on a particular POINT.

These concepts are crucial for online traveller information. Dynamic information systems will provide, permanently or on request, TARGET PASSING TIMES or, whenever possible, ESTIMATED PASSING TIME. In some situations, information on past OBSERVED PASSING TIME may be of interest.

When a monitoring and control system allows the relation of a MONITORED VEHICLE JOURNEY to a planned DATED VEHICLE JOURNEY, the computation of ESTIMATED PASSING TIMES will use this information. An observed delay, for instance, will produce an estimation based on a TARGET PASSING TIME with addition of the delay value.

In some situations, the exact planning data of all VEHICLE JOURNEYS is not available to the information supplier. In such a case, transport authorities may want to supply passenger information without detailed knowledge of the planning of the various operators. In those situations, information is given through the detection of buses. Whenever a bus is detected, the arrival (or departure) time at the next bus stop is calculated by adding the (estimated) driving time to the moment of detection. This estimation may be based on planned run times, on mean run times (see EN 12896-3:2016) or on observed run times. The served JOURNEY PATTERN, related to the MONITORED VEHICLE JOURNEY, shall be known for prediction to be possible. This is often carried out using a journey pattern code keyed by the driver. In such a case, the MONITORED VEHICLE JOURNEY is only related to that JOURNEY PATTERN and will not have any TARGET PASSING TIME, because the planning is not known.

Actual passing times are used for dynamic displays at stops. The expected waiting time or arrival time of the next vehicle(s) is displayed, in general for each JOURNEY PATTERN. The estimated arrival time at the final destination of a journey is sometimes displayed onboard vehicles. Such times are also used to answer specific queries on actual schedules (e.g. passing time at a stop of a specified journey) or to build “push” messages (e.g. alert on delay).

5.2.3.5 Specific Properties of Passing Times

Typically, an ESTIMATED PASSING TIME will be calculated several times before the vehicle passes the considered point.

The concept of PASSING TIME may be understood with an extended meaning. While many companies will generate simple passing times, without noticing whether they are, for instance, arrival or departure times, others may require a more differentiated description. Therefore, the sub-types of PASSING TIME have several optional attributes, expressing the time value of a possible:

- arrival time;
- departure time;
- waiting time (in general associated to one of the previous two);
- (non-stop) passing time when the vehicle is not obliged to stop or when a rough indication is sufficient.

In operations of transport modes such as railway, ferry, etc., the functions carried out when a vehicle passes a stop point are much more complex than, for instance, in bus operations. Passengers may be allowed, when the stopping time is sufficient, to alight for a while (e.g. for refreshment) before resuming their trip on the same vehicle. Some facilities or some specific passenger information may be provided on this occasion.

The concept of PASSING TIME may be viewed as a simple passage (e.g. of a bus at a stop point) or as a longer stay (e.g. in maritime ports of call). The attributes describing the waiting time in the subtypes of PASSING TIME, in particular, will be used to describe such a call. The attribute ‘alight and reboard’ will express the possibility for the passenger to alight for a while, during the PASSING TIME of a VEHICLE JOURNEY at a particular STOP POINT.

5.2.3.6 Merged Timetables

As already mentioned, the TIMETABLED PASSING TIMES, from the point of view of a single operator, is informationally redundant; in principle it can be derived from basic scheduling information (journey pattern description, timing reference of vehicle journeys, run and wait times, etc.). This is in general not the case in an integrated traveller information system which does not necessarily have access to the planning data. Although such systems sometimes require the theoretical run times (e.g. to refine online estimated passing times), the core information will consist of the computed passing times, transmitted by the operators without any notice of the scheduling data.

Such computed passing times, to be published in a timetable, are described by the entity TIMETABLED PASSING TIME. Such times will be transmitted to an authority's information system, possibly with a few pieces of complementary information. The DUTIES and BLOCKS will be omitted in most cases, as well as the run times, and even the corresponding VEHICLE JOURNEYS may sometimes not be associated to the TIMETABLE PASSING TIMES.

For the authority, merging the TIMETABLED PASSING TIMES from different operators will require a significant integration effort in order to keep the data accurate and consistent. Each passing time has to be related to its origin DATA SYSTEM (from the concerned operator) and probably to a specific VERSION, depending on some VALIDITY CONDITIONS.

5.2.3.7 Calls and Passing Times

When organizing data for efficient exchange and presentation to the passenger, it is sometimes useful to rearrange it in views that may be denormalized, or that may include additional derived data. In particular a CALL assembles information held variously on a POINT IN PATTERN and related entities, grouping planned estimated and observed arrival times and departure times in convenient CALL PARTs, and referencing ancillary information such as the DESTINATION DISPLAY and NOTICEs for the POINT IN PATTERN. A SERVICE JOURNEY may thus be considered as an ordered collection of class, each describing the visit by the VEHICLE to a single stop.

5.2.3.8 Frequency based services

Where services are very frequent (typically less than every 10 min) it is often the practice not to publish specific passing times for the stops on a timetable, but rather simply to indicate a frequency of service (for example, "every 5-8 minutes"). This may be represented by a TEMPLATE SERVICE JOURNEY which gives the service pattern that is followed, and a FREQUENCY GROUP that gives the expected intervals – see EN 12896-3:2016.

5.2.3.9 Information on Interchanges

Guaranteeing interchanges between different service journeys will decrease both waiting time and uncertainty in travel time, therefore increasing the attractiveness of the public transport product. Such a guarantee is often limited to a maximum waiting time, although some PT companies offer unconditionally guaranteed interchanges. Therefore, the actual number of realized or missed interchanges is an important quality indicator.

The SERVICE JOURNEY INTERCHANGE entity (described in EN 12896-3:2016) specifies a planned interchange between two particular SERVICE JOURNEYS and a corresponding pair of STOP POINTs. It may be used to store some information on the planned interchange (level of priority, advertised or not, guaranteed or not). It also allows the storing of a quality parameter for ensuring connections, providing the maximum time a vehicle may wait for connecting vehicles beyond the planned departure time.

The follow-up of actual interchanges usually concerns only those interchanges that are planned in advance. This means that it refers to SERVICE JOURNEY INTERCHANGES, each relating two SERVICE JOURNEYS that are implemented on a particular OPERATING DAY as NORMAL DATED VEHICLE

JOURNEYS. The detailed behaviour of services at an interchange may be described using INTERCHANGE RULEs and INTERCHANGE RULE PARAMETERS (see EN 12896-3:2016).

Data on the status of actual SERVICE JOURNEY INTERCHANGES will be recorded using the entity INTERCHANGE STATUS. An INTERCHANGE STATUS is related to a certain SERVICE JOURNEY INTERCHANGE and to a particular OPERATING DAY. The actual 'status' of the concerned SERVICE JOURNEY INTERCHANGE may be "met" or "missed". Whenever a monitoring system permits forecasting that an interchange will be met or missed, this attribute may be used to record such an information, in order to inform the passengers or the operational staff.

The 'number of passengers' involved in an actual SERVICE JOURNEY INTERCHANGE may be recorded as an attribute of the INTERCHANGE STATUS entity. If a SERVICE JOURNEY INTERCHANGE is missed, the reason for missing this interchange may be recorded in another attribute.

5.2.3.10 Other Passing Time Data

Some concepts, mainly referring to functions other than passenger information (e.g. statistics on operations) are related or analogous to passing times:

- RECORDED STOP, which records that a stop has been observed, with exchange of passengers (doors open);
- BOARDING AND ALIGHTING, which records the number of passengers;
- IMPEDED TIME, describing a period during which the vehicle is not moving, due for instance to a traffic jam.

These entities are described with more details in EN 12896-3:2016.

5.2.4 Passenger Trip Planning

5.2.4.1 Principles

Modern computer-aided travel tools assist potential travellers in preparing their trips, particularly in answering specific TRIP REQUESTs. Such a trip planning function identifies the origin and destination places of an intended trip and proposes one or several trip solutions. The proposition takes into account the user's constraints or preferences, such as minimal trip duration, minimal number of interchanges, cheapest fare, etc., and involves an optimization process using such parameters.

After specification of the trip origin and destination, the system proposes a "trip pattern", composed of access or connection walks/transfers and "rides" on PT vehicles. Given a trip pattern proposal, it is possible to compute a precise duration of the trip (taking into account, for instance, the latest arrival time requested by the traveller) or a mean duration. It is also possible to calculate the corresponding fare, the suitability for a person of reduced mobility, etc.

If the request is made for a trip taking place on the same day, it is possible to take into account the monitored situation to refine the proposal. The trip pattern proposal will be influenced by service modifications due to control actions (e.g. service cancelled or shortened because of a protest) and the timing proposal will be based on actual (monitored) passing times.

5.2.4.2 Access Walks

A powerful trip planning tool should be able to cope with origin and destination places that are not necessarily STOP POINTs, but other places in the area served by public transport. In such cases, the optimization algorithm will estimate the time necessary to access from the origin to a close STOP POINT, as well as the time to proceed to the final destination from the STOP POINT where the passenger alights from the public transport network.

There is a rather wide variety of possibilities for expressing the (urban) origin and destination of a trip to be undertaken by a passenger. For example:

- public site, known by the user by name;
- stop point or stop area;
- urban environment: neighbourhood, housing estates, administrative entity;
- street;
- address; or
- specified point in space, e.g. plotted on a digital map or selected by an operator.

These elements can be grouped into three categories:

- 0 dimension: sites, stop points, etc.;
- 1 dimension: road sections (streets), etc.;
- 2 dimensions: sections of town (zones), etc.

Operators willing to take into account such urban walks for passenger information will store or calculate the walk duration for a limited number of cases or solutions. The entity PLACE (introduced in EN 12896-2:2016) is a generic description of all geographical elements that will be used to define the origin and the destination of a passenger trip.

A TRIP REQUEST represents the trip planning request, as specified by the traveller. It is expressed from one PLACE to another.

The walking paths to access the public transport network from a PLACE origin, or to leave the network for a PLACE destination, are described by the entity ACCESS link. The main attribute of the ACCESS link is a 'default duration'. The duration to cover this link, depending on the type of passenger (e.g. frequent or occasional traveller), is described by various other attributes. A flag indicates whether the ACCESS link is suitable for persons of reduced mobility. The 'distance' (length) of the ACCESS link may also be stored.

The ACCESS links will usually be covered by walking movements. Applications may also consider such journeys as undertaken by other modes of transport; this may occur, for instance, in systems managing park and ride facilities.

5.2.4.3 Types of Place

An ACCESS link starts from one PLACE and ends at another. There is no formal constraint to indicate that one end of an ACCESS link is a PLACE which is necessarily a STOP POINT: this is to allow the integration of any arbitrary point.

A PLACE may be identical to an instance of the following entities:

- a POINT, which can be a STOP POINT or another point of any type;
- a STOP AREA;
- a ZONE, such as administrative zones, tariff zones, etc.;

- a SITE, which is used to describe any site in the neighbourhood of the network, the name of which is well known to passengers, such as a POINT OF INTEREST. A SITE may have well defined SITE ENTRANCES with defined accessibility characteristics to allow for disabled access, etc.

Depending on the particular application used, the operators will choose to store or dynamically calculate the ACCESS links duration between one or several categories of PLACE. Some operators will, for instance, create ZONES for each of which the duration to cover ACCESS links to some other PLACES is considered as homogeneous (e.g. concentric zones around a central point). A sub-type of ZONE will describe this kind of zone: ACCESS ZONE.

As regards the SITES, they may be classified by an entity TYPE OF SITE. Two main sub-types of SITE are modelled explicitly:

- SERVICE SITE, which is a SITE of specific interest for the operator, e.g. where a joint-service or a joint-fee, common to other public or private services, is provided;
- PUBLIC SITE, which describes any other kind of SITE, used only because passengers often refer to them to express their origin or destination.

A SITE may be in the vicinity of a STOP AREA.

5.2.4.4 Connections and Transfer Times

One of the parameters to be taken into account for trip optimization is the duration of interchanges between two PT vehicles. During interchanges, passengers may have to walk (or sometimes use a traveller) from the position where the arriving vehicle stops to the position from which the connecting vehicle will depart.

The stop positions of the arriving and the connecting vehicle may be located on the same or on different STOP POINTS. The entity CONNECTION expresses a possibility of proceeding from a specific STOP POINT to another, during the course of an interchange. Users will implement such a connection possibility only between pairs of STOP POINTS that are considered as suitable for an interchange.

Like an ACCESS link, a CONNECTION link is characterized by attributes providing a default duration, a duration for various types of travellers, the suitability for persons of reduced mobility, or a distance.

Both ACCESS link and CONNECTION link entities express the possibility for two PLACES to be linked by one or several infrastructure paths that may be followed by travellers (e.g. suitable ways for pedestrians). This information is used for planning and for rough timing traveller information. However, neither entity represents the corresponding paths, which shall be described by other concepts. One reason is that, for instance, for the same CONNECTION link relating a pair of STOP POINTS, several different paths may exist. Systems willing to describe such paths will use a NAVIGATION PATH to describe each path and its accessibility properties, made up of JUNCTION POINTS and PATH LINKS. The projection mechanism will be used to project each STOP POINTS on the appropriate POINT (if the ends meet) or LINK (if not), then to project the CONNECTION link (or ACCESS link) on a sequence of such LINKS. This would allow, for instance, a portable terminal to deliver information guiding the passenger to the required STOP POINT.

If no transfer times are specified for a CONNECTION then a general default for transfer at the SITE may be used, represented by a SITE CONNECTION. If no SITE CONNECTION is specified, a general DEFAULT CONNECTION for the mode may be used to set expected times.

It may be that transfer times vary significantly according to the time of day or day type – for example weekday rush hour versus off-peak. CHECK CONSTRAINTS can be used to specify precise delays under different conditions.

5.2.4.5 Trip Pattern Components

The complete spatial movement of a passenger from a PLACE origin to a PLACE destination is described by the entity TRIP PATTERN. This entity describes the path between these two places, using public transport vehicles and possibly walking. This entity may be used for trip planning (as a proposal), as well as for some other functions (e.g. driver trips, recording observed passenger trip patterns, etc.). For two different paths on the network, two different TRIP PATTERNS shall be defined.

An important component of a TRIP PATTERN is the PT RIDE LEG (pattern), which is that part of a passenger trip taken on a single PT vehicle, from one STOP POINT to another. A RIDE is carried out on only one JOURNEY PATTERN. As long as the TRIP PATTERN is not complemented by a precise timing, any VEHICLE JOURNEY covering this JOURNEY PATTERN may support the proposed RIDE.

A TRIP PATTERN may be the result of a TRIP REQUEST. It may be composed of:

- one or more PT RIDE LEGs;
- Walks (or travel by other non-PT modes such as cycle or taxi) as ACCESS LEGs made at the beginning and at the end of the TRIP PATTERN (possibly of length/duration null) to follow a given ACCESS link;
- in the case where there are two or more sequential RIDE LEGs, there may be intermediate PT CONNECTION LEGs describing interchange over a CONNECTION link (possibly of length/duration null) and additional a NAVIGATION PATH giving a detailed guidance to suit specific accessibility requirements.

A PT RIDE LEG is operated from one STOP POINT to another, and on a JOURNEY PATTERN. This entity describes a theoretical movement and may be related to a particular VEHICLE JOURNEY on a particular OPERATING DAY.

A PT RIDE LEG will generally be carried out on a JOURNEY PATTERN, that is a SERVICE JOURNEY PATTERN. In some rare cases it will be carried out on a DEAD RUN PATTERN, e.g. if a TRIP PATTERN is used as a DRIVER TRIP for driver scheduling (see EN 12896-7:2019).

A TRIP PATTERN may consist of one TRIP and walks (as ACCESS LEGs) on the corresponding ACCESS links, or (in rare cases) of one walk using an ACCESS link only. A PT TRIP serves one TRIP PATTERN, or several differing by the ACCESS links.

A precise definition of the PT TRIP necessitates the identification of the order of the successive LEGs, because it is not always possible to derive the order from the corresponding CONNECTIONS.

5.2.4.6 Trip Pattern Computation

Given a TRIP REQUEST, expressed by two PLACES, the algorithm will compare various solutions to propose a TRIP PATTERN and the corresponding PT TRIP, by combination of various processes:

- identification of the closest STOP POINTs suitable to be the origin(s) of possible PT TRIPs, by comparing the duration to cover the ACCESS links from the origin PLACE to the considered STOP POINTs;
- identification of the closest STOP POINT suitable as destination of possible PT TRIPs, with the same method;
- selection of a PT TRIP between each pair of selected STOP POINTs, i.e. identifying a JOURNEY PATTERNS that serve both STOP POINTs, or searching for CONNECTION links if no direct connection is available.

The algorithm will find the most convenient proposal, the above functions being combined in an optimization process, according to a given OPTIMIZATION MODE. It will use the data describing the topology of the network, especially STOP POINT, SERVICE JOURNEY PATTERN, POINT IN JOURNEY PATTERN, COMMON SECTION and possibly OPERATOR.

5.2.5 Estimation of Trip Duration

5.2.5.1 Processes

To answer a query on the duration of a passenger trip necessitates:

- the identification of a possible TRIP PATTERN, as described in the previous section;
- the identification of the data on which the calculation will be operated; and
- the calculation of the duration of the proposed TRIP PATTERN.

The latter two items are discussed in the subclauses below.

The calculation may be based, depending on the time of the request and the system capabilities, on:

- planned data (e.g. standard run times or TIMETABLED PASSING TIMES);
- actual monitored data (e.g. TARGET PASSING TIMES or ESTIMATED PASSING TIMES); or
- mean times specifically defined for passenger information.

5.2.5.2 Selection of Valid Data

The timing specification of a trip planning query by a passenger may be precise (e.g. “today, not later than 4 p.m.”) or imprecise (e.g. “on week days, in the morning”). The algorithm, which manages data referring to days of operations and time periods for each day, will have to deal with this uncertainty.

The first concern is to select the appropriate versions of the data describing the network (e.g. NETWORK VERSION), in particular the valid JOURNEY PATTERNS. If the traveller specifies a precise OPERATING DAY for the intended trip, the version management system will allow the selection of the appropriate data. If it is not the case, the algorithm should use a rule to select versions that seem suitable for the request (e.g. the current versions).

If the traveller specifies a precise time constraint, in addition to a precise OPERATING DAY, the algorithm will be able to deliver a very precise answer. The optimized research of a TRIP PATTERN will be completed by a parallel checking of the DATED VEHICLE JOURNEYS operated on that OPERATING DAY. In most cases, this process will not use the run, wait and departure times assigned to each journey, but pre-calculated TIMETABLED PASSING TIMES. If the information systems are coupled to a monitoring system, an online calculation is possible, taking into account TARGET PASSING TIMES or even ESTIMATED PASSING TIMES. The proposal will hence comprise a detailed timing of all components of each proposed trip.

If the OPERATING DAY is specified but the timing remains imprecise, the algorithm (with a possible action of an operator) will probably select a TIME BAND (or even a TIME DEMAND TYPE) that suits as much as possible the time parameters expressed in the query. The timing computation will in most cases use the standard run and wait times defined for that TIME BAND (or TIME DEMAND TYPE) on the DAY TYPE assigned to that OPERATING DAY.

A similar method will be used when the user does not specify a precise OPERATING DAY. The algorithm will choose the most relevant DAY TYPE, especially by using the PROPERTIES OF DAY that may have been expressed in the query.

In addition, the algorithm may use data specifically defined for passenger information purposes, such as mean intervals or mean run times (see EN 12896-3:2016).

5.2.5.3 Trip Duration Elements

The total duration of a TRIP PATTERN is composed of several elements:

- the duration needed to cover any ACCESS link;
- the duration needed to cover any CONNECTION link;
- the wait duration at STOP POINTs during interchanges: this is the time spent by a passenger at a STOP POINT waiting for a vehicle, i.e. after a walk on an ACCESS link or a CONNECTION link and before a RIDE; and
- the duration of each RIDE.

It is often assumed that the various components of a TRIP PATTERN are operated without interruption between each other. It is generally considered that the proposals given are based on a minimum waiting time at stops. However, the proposals may take into account the possibility of taking more time than needed, for instance for an interchange. Such a calculation should in principle use the fare structure specifications (see EN 12896-5:2019) that specify commercial conditions of carriage that further prescribe what is allowed, such as a maximum trip duration or a maximum interchange duration.

To compute the duration of an ACCESS LEG over an ACCESS link or a PT CONNECTION LEG over a CONNECTION link, the most specific level of detail will be used.

- For an interchange this may be any of the following in increasing specificity:
 - 1) general default values for the MODE (DEFAULT CONNECTION);
 - 2) default values for any connection at the SITE (SITE CONNECTION);
 - 3) values for use of the specific CONNECTION link;
 - 4) values for use of a specific NAVIGATION PATH including any CHECK CONSTRAINTs.
- For an ACCESS LEG this may be either
 - 1) ACCESS LINK; or
 - 2) more specifically, NAVIGATION PATH values for a specific path including any CHECK CONSTRAINTs.

The duration of each PT RIDE LEG will be computed according to one of the methods described in the previous section, depending on the precision of the query and on the system capabilities. The wait times at stops may be estimated from the planned or monitored PASSING TIMES (e.g. by computation of the mean interval in the corresponding TIME BAND, if no precise timing is specified by the query). The RIDE duration calculation may also use mean values, as described in the next section.

5.2.5.4 Mean Frequency and Run Times

Some operators will provide information on trip duration using only a limited set of schedule parameters. This may be relevant, for instance, in the case of stand-alone terminals or small passenger information systems, for which it is not realistic to store and to update continuously the whole set of data necessary for scheduling and daily operational planning. This method is useful for answering passenger queries but can be equally useful for other functions. Many operators, for instance, use such a

simplified set of data for timetable publication, because an exhaustive presentation of the whole variety of schedules would be too complex for most passengers. This alternative method will use:

- a mean frequency between vehicles for the itinerary concerned, in order to estimate a mean passenger waiting time at stops (approximately half of mean interval);
- mean run times for the concerned rides.

This method, aimed at simplifying the set of data stored, uses specific entities defined for this function, the values of which will be decided and stored by the operator.

The entity MEAN RUN TIME is used to store the estimated mean run time on a specific TIMING LINK. For such a function, this TIMING LINK will often consist of the whole length of the concerned JOURNEY PATTERN, the run times for the intermediate STOP POINTs being interpolated (using the length of the LINKs). A MEAN RUN TIME is applied to a DAY TYPE and to a TIME BAND.

The entity MEAN PASSENGER WAIT TIME describes the estimated mean wait time at a stop, based on a mean frequency of journeys. It can be defined either on a JOURNEY PATTERN or on a COMMON SECTION (if any), serving the intended RIDE. The MEAN PASSENGER WAIT TIME will be applied to a DAY TYPE and to a TIME BAND.

The TIME BANDs used to define MEAN RUN TIMES and MEAN PASSENGER WAIT TIMES will often be created specifically for passenger information, with simple requirements such as peak or off-peak periods. These mean values will often be stored only for a limited number of DAY TYPEs (simplified set of DAY TYPEs for passenger information).

Some information systems store mean times or intervals as calculated from the most recent passages of vehicles at the considered point. This is the case when there is no information available on theoretical plans (e.g. on standard run times). Some classical systems also use this kind of information to improve the accuracy of estimated times. Those entities may be used to register such mean times. The 'duration' here represents the last measured value. If older measures are to be stored, a version system is to be added to those entities.

5.2.6 Information on Fares

5.2.6.1 General

The main passenger information functions related to fare collection (and described in the clauses related to Passenger Information in EN 12896-8:2019), are the following:

- to provide information on the general structure of fares and on the products sold (FARE PRODUCT QUERY);
- to provide the available products and prices for a specific trip (SINGLE TRIP FARE REQUEST);
- to provide the available products and prices for repeated travel on a given route (REPEATED TRIP FARE REQUEST);
- to optimize a trip by searching for the lowest amount of fare (TRIP REQUEST).

In yield managed systems the prices of products may be fetched dynamically.

5.2.6.2 Fares for a Single Trip

The SINGLE TRIP FARE REQUEST allows the available products to be found, with their prices, for a specific trip at a specific time, indicated by specifying a TRIP PATTERN with its components (e.g. RIDE); it may also be relevant to provide information about the number and characteristics of the passengers (Adult, Child, persons of reduced mobility, etc.). The characteristics of the proposed TRIP PATTERN,

together with any specified parameter, will be compared to the available theoretical access rights, in order to find a VALIDABLE ELEMENT able to address the FARE REQUEST requirements. By comparison with the set of compatible FARE PRODUCTS and SALES PACKAGES a solution will be presented, and the corresponding price calculated using the relevant PRICE entities.

5.2.6.3 Fares for a Repeated Trip

The REPEATED FARE REQUEST allows the available products to be found, with their prices, for a specific trip that is made repeatedly, perhaps at a specific time, indicated by specifying a TRIP PATTERN with its components (e.g. RIDE); it may also be relevant to provide information about the number and characteristics of the passengers (Adult, Child, persons of reduce mobility, etc.). The characteristics of the proposed TRIP PATTERN, together with any specified parameter, will be compared to the available theoretical access rights, in order to find a VALIDABLE ELEMENT able to address the FARE REQUEST requirements. Products that offer discount for repeated travel will be considered, in particular, such as season passes. By comparison with the set of compatible FARE PRODUCTS and SALES PACKAGES a solution will be presented, and the corresponding price calculated using the relevant PRICE entities.

5.2.6.4 Fare Products

The FARE PRODUCT REQUEST function provides a description of the detailed properties of a SALES PACKAGE and its FARE PRODUCTS. In particular, the description of theoretical access rights (e.g. VALIDABLE ELEMENT) of the fare structure (e.g. TIME STRUCTURE FACTOR) or of the marketable combinations (e.g. FARE PRODUCT, SALES PACKAGE etc.) with attached conditions may be useful. In addition, price data will be presented by using the relevant PRICE entities (e.g. FARE PRODUCT PRICE). The product to be described will need to be supplied either with an identifier (obtained for example from a TRIP REQUEST) or with a name.

5.2.6.5 Optimizing Trips by price

A TRIP REQUEST using the amount of fare as the OPTIMIZATION MODE will use an algorithm to evaluate potential TRIP PATTERNS that prioritize the cheapest solutions, rather than say the fastest or most convenient.

5.2.7 Other Information

5.2.7.1 Next Stop Announcement

The vehicle monitoring process may be used to deliver onboard information on the current vehicle location. This information may be represented in various forms:

- announcement or display of the next stop point;
- display of the vehicle location on a schematic map (e.g. on the “thermometer”);
- warning concerning the final destination, in case of diverging branches;
- etc.

Such processes work in a similar way. The system should be able to identify the MONITORED VEHICLE JOURNEY under way and the covered JOURNEY PATTERN. The current location can then be used to trigger announcements, for example when the vehicle approaches the next alighting point, passes a point of interest, etc.

The DESTINATION DISPLAY associated with the upcoming POINT IN JOURNEY PATTERN can have voice media representations associated with it so that either text-to-speech engines or pre-recorded stop names can be used.

5.2.7.2 Messages and Situations

Modern passenger information tools will manage messages to passengers; these will be sent, for instance, to displays onboard vehicles or at stops, or be pushed towards individual devices. Messages may concern information about disturbances of the PT services, or about the road traffic, accidents, etc. There may be commercial messages inviting travellers to use public transport or to buy some fare products. They may also concern city events, weather, advertising, etc. Such messages need to be worded appropriately and can be automatically computed only in rare cases.

It may also be useful to include relevant messages in the responses to PI REQUESTs, for example the response to a TRIP REQUEST might include the information that engineering works are planned for the particular time of travel and so delays may be expected.

In order to be able to associate messages with the appropriate information requests, events affecting the network can be represented as structured SITUATIONS, as described in EN 12896-4:2019. A SITUATION provides both a human-readable text explanation of the event, and also a machine-readable representation that both classifies the SITUATION and its likely impact and also associates it with the model elements it may affect.

The content of such a SITUATION uses data elements present in the model: descriptions of the network (e.g. SCHEDULED STOP POINTs, LINE, SERVICE PATTERN, etc.); plans (e.g. SERVICE JOURNEY); monitored progress of operational elements (e.g. VEHICLE, OBSERVED PASSING TIME); etc.

The distribution of messages among the various PI FACILITIES will be carried out based on the descriptions of the network and some restrictions specific to passenger information functions (e.g. DISPLAY ASSIGNMENT or NOTICE ASSIGNMENT).

For personal terminals (mobile phone or home computer), this distribution may use the CUSTOMER or CUSTOMER ACCOUNT entities (see EN 12896-5:2019), to determine an appropriate delivery channel.

5.2.7.3 Domains Not Covered

Some other functions dealing with passenger information are not addressed by the reference model: distribution of actual time, general information such as the time spread of the services, exchanges with customers (complaints, lost and found, etc.) or various other information (e.g. local news).

Information services to handle reservation, booking and after-sales service are out of scope, falling under the aegis of reservation and retailing systems. However, information on the conditions attached to products, such as the purchase window or whether it is refundable, is available as part of the FARE PRODUCT REQUEST.

Schedule adherence and other performance data may also be of interest to passengers but is not covered by the current model, although it might be computed from the low level OBSERVED TIME data collected.

Data from trip planners may be used to compute advanced visualizations such as travel isochrones and to support company travel plans – such additional uses are not covered here.

5.3 Use Cases for the Passenger Information Model

5.3.1 Purpose

This subclause outlines some possible use cases for the application of the Transmodel Passenger Information model.

5.3.2 Business context

The provision of information to travellers is a crucial function for public transport operators and authorities. Public transport services face competition with private transport modes, in particular private cars. It is essential to be able to provide efficient, reliable, accurate and well adapted

information. The aim is not only to attract new customers but also to keep the current customer base content with public transport services and, in particular, to assist them during disruptions. The importance of this challenge increases with the rapid evolution of computer and transmission and delivery technologies. While classical information techniques (such as printed material) remain useful, travellers are more and more familiar with modern delivery systems (such as mobile phone, internet, GPS, etc.).

The information on available public transport consists of three main categories of data:

- spatial data: city and network maps, description of routes and service patterns, location of points of sale, etc.;
- temporal data: frequency of services, departure and passing times at stop points, service time spread, etc. This may include disruption data and real-time modifications to the planned schedule;
- information on fares: fare structure principles, discounts and passes, fare of a particular trip, etc.

Many companies add other features to this basic list: information on disturbances, commercial messages, information on city events etc.

The information may be provided in a passive form (printed material giving schedules, dynamic displays on estimated passing times etc.) or interactive. In the latter case, specific requests from customers can be answered, including trip preparation assistance, on-request information about delays, traffic disturbances, strikes, etc. Another emerging way of providing information is its distribution to customers according to their own profile ("push" techniques).

The information so delivered may concern the planned service (e.g. theoretical passing times) or the actual service (delays, modifications to the theoretical service, next stop onboard announcement, etc.).

These various types of information are oriented towards a variety of traveller categories: frequent or occasional travellers, potential travellers, passengers currently travelling, passengers equipped with telematics facilities or not, etc.

Information may be sought in advance (to plan a trip), at the commencement of a journey (for example to find the right stop and service or to buy a ticket), or during the trip to monitor progress and replan in the event of disruption. Data may be delivered through the internet, in station displays or on-board displays, or delivered onto the user's own device. Printed schedules, maps and tariff explanations may still also be relevant.

Most data necessary to provide such information is described in other parts of the reference model (e.g. network description, planned schedules, monitored passing times, fares, etc.). The current part presents the data specifically handled by passenger information functions and explains how it is managed with other data in the main information functions.

With the evolution of Account Based Ticketing, customers may have personalized information services that remember their identity, along with commonly used places and trip preferences and that keep detailed records of their travel usage. Passengers using account based products that charge by use may wish to see their consumption of transport, services, in order to understand their consumption. The customer account entities described in EN 12896-5:2019 may thus be an integral part of the PI delivery services.

Personalization may also be designed to be private; for example, anonymized identity tokens may be used for interactions with the system so that the actual identity of the passenger is not revealed to the transport operator.

5.3.3 Actors and use case types

The delivery of passenger information is normally to both passengers and to staff operating the system so that they can assist passengers. The data may be delivered directly by data services run by the

operator, or by third parties who may integrate it with other data such as maps and advertising. The following table gives an overview of some information technology systems that serve as actors in the Transmodel Passenger Information model. The “Producer” and “Consumer” columns indicate whether the systems will provide or receive the information content. In the last column, examples are given for organizations that might operate such systems. The list in this table is not complete, and may be extended; for example, the additional roles of MEDIA PROVIDER and Identity Provider relevant for EMV and electronic media are not described.

Table 1 — Transmodel Passenger Information Model system actors

Systems	Producer	Consumer	Organizations
Service tendering and timetable registration systems	x	x	Public transport authorities
Fare Management and Planning Systems	x	x	Public transport authorities, public transport operators
Journey planning systems	x	x	Public transport authorities, public transport operators Third parties
Passenger information systems	x	x	Public transport operators
Demand responsive transport (DRT) or Dial-a-Ride Transit (DART) systems	x	x	Demand responsive transport operators
Mapping systems showing public transport journey routes and tariff zones		x	Commercial and non-commercial services providers like Google Maps, Yellow Pages, etc.
General third-party systems using transport information		x	Various
Travel Price comparison engines		x	Various

5.3.4 Use Cases

5.3.4.1 General

The use cases listed here are given at only a summary level (i.e. a one-line description) to indicate the broad scope.

5.3.4.2 Data for to enable Distributed Journey Planning

Use cases to deliver data to coordinate the function of federated distributed journey planners:

- PI-DJ-001: Provide information on stops and their associated coverage by information services;
- PI-DJ-002: Provide information on exchange points;
- PI-DJ-003: Provide information on available dynamic pricing services.

5.3.4.3 Data for Operator Applications for the General Public

Use cases to deliver passenger information to customers using operator provided systems:

- PI-OP-001: Provide information for printed timetables, including journeys, operational days, footnotes;
- PI-OP -002: Provide information for in station and on board displays of arrivals and departments;
- PI-OP -003: Provide information for on-board stop arrival and connection information;
- PI-OP -004: Provide information for network and line maps;
- PI-OP -005: Provide information for station signage;
- PI-OP -005: Provide information for station facilities.

5.3.4.4 Data for Passenger Applications

Use cases to deliver passenger information direct to customers using electronic delivery channels:

5.3.4.4.1 Stop and Interchange Data for Passenger Applications:

- PI-CU-SP-001: Find nearby stops and stations for a given location;
- PI-CU-SP-002: Provide information on accessibility of stops;
- PI-CU-SP-003: Provide information on orientation at stops and interchanges;
- PI-CU-SP-004: Provide information to navigate through stops and interchanges;
- PI-CU-SP-005: Provide information about facilities available at a stop.

5.3.4.4.2 Network Data for Passenger Applications:

- PI-CU-ND-001: Provide information on available lines and networks;
- PI-CU-ND-001: Provide information on operators and their customer service contact points.

5.3.4.4.3 Schedule Data for Passenger Applications:

- PI-CU-TI-001: Provide information for electronic Timetables for a given route, including journeys, operational days, footnotes;
- PI-CU-TI-002: Provide trip plans optimized for various criteria (time, ease of access, number of changes, price etc);

- PI-CU-TI-003: Provide information on arrivals and departures;
- PI-CU-TI 004: Provide network maps;
- PI-CU-TI 005: Provide route maps;
- PI-CU-TI 006: Provide information for facilities available on a service.

5.3.4.4.4 Fare Data for Passenger Applications:

- PI-CU-FM-001: Provide information on tariff zones and tariff time bands;
- PI-CU-FM-002: Provide fares for a specific trip;
- PI-CU-FM-003: Provide fares for a repeated trip;
- PI-CU-FM-004: Provide information on available fare products;
- PI-CU-FM-005: Provide detailed conditions of carriage, purchase, distribution etc on a given fare product;
- PI-CU-FM-006: Provide information on how and where to purchase a fare;
- PI-CU-FM-007: Provide information on how and where to fulfil a travel document for a fare;
- PI-CU-FM-008: Provide details about an individual fare product

5.4 Public Transport Passenger Information – Conceptual MODEL

5.4.1 General

This subclause presents the Passenger Information Model, using UML Class diagrams to show the entities and their relationships.

5.4.2 Trip Description

5.4.2.1 General

The Trip Description Models describe the trips and fares that passengers may make on transport networks, in particular public transport, but possibly also including legs made by car, cycle, walking, ride sharing or other private modes. They are mostly views of data that can be assembled from the underlying timetable and fare data. The following submodels are described as UML models:

- Passenger Trip Model.
- Passenger Travel Model.
- Passenger PT Connection Leg Model.
- Monitored Trip Model.
- Passenger Fare Offer Model.
- Trip Duration Model.
- Trip Interchange Duration Model.

5.4.2.2 Passenger Trip Model

5.4.2.2.1 General

The Passenger Trip Model describes the passenger TRIPs that TRANSPORT CUSTOMERs can make on both public and private transport; they can be used to relate passenger information services such as trip planners to Transmodel data elements.

Computer-aided tools assist potential travellers in preparing their trips. A trip planner proposes one or more trip solutions to travel between one or more places. The proposition takes into account the user's constraints and preferences, such as a minimal trip duration, or a minimal number of interchanges, or the cheapest fare, etc. This involves an optimization process by the trip planning engine using the given parameters.

Trip planning systems require as input an origin and destination for the trip and some indication of time of travel; in response, the system proposes a TRIP PATTERN, an itinerary composed of "ride legs" on PT vehicles, together with access or connection LEGs between the public transport LEGs. Usually it is important to provide a time constraint for arrival or departure as well, but some planners allow the system to propose the dates with the cheapest travel instead. Given a trip pattern proposal, it is possible to compute a precise duration of the trip (taking into account for instance the latest arrival time desired by the traveller) or a mean duration. It is also possible to calculate the corresponding fare, the suitability for persons of reduced mobility, etc.

A TRIP PATTERN describes a complete spatial movement of a passenger from an origin PLACE to a destination PLACE, using public transport vehicles and other modes including possibly walking and non-public transport legs.

An important component of a TRIP PATTERN is therefore the LEG. Each LEG describes a movement of a user in a single vehicle, or a pedestrian mode such as walking. LEGs may be of different types (PT RIDE LEG, ACCESS LEG, PT CONNECTION LEG, OTHER LEG, etc.) depending upon the mode of transport used to make them:

- A PT RIDE LEG is that part of a passenger trip taken on a single PT vehicle, from one SCHEDULED STOP POINT to another. A PT RIDE LEG is carried out on only one JOURNEY PATTERN.
 - The reference to a SCHEDULED STOP POINT may be further qualified by a STOP ASSIGNMENT to indicate the use of a specific QUAY (i.e. platform, bay, gate, etc.) within a physical STOP PLACE associated with the SCHEDULED STOP POINT, and even a specific BOARDING POSITION within a QUAY.
 - A PT RIDE LEG may indicate start and end times at a stop by reference to the passing times of a SERVICE JOURNEY.
- An ACCESS LEG describes a non-public transport LEG made between an arbitrary origin or destination PLACE and a SCHEDULED STOP POINT, when accessing public transport.
- A PT CONNECTION LEG may be used to describe details of the interchange made from one SERVICE JOURNEY to another over a CONNECTION between two SCHEDULED STOP POINTs.
 - To prescribe a detailed path A PT CONNECTION LEG may further reference a NAVIGATION PATH as described in EN 12896-2:2016.
- An OTHER LEG can be used to describe a leg on another mode of transport (for example by car) making up a trip, from an origin PLACE to a destination PLACE. The origin and destination may be a STOP PLACE or some other type of place such as an ADDRESSABLE PLACE, POINT OF INTEREST,

etc. If it is a STOP PLACE, it may be related to a specific SCHEDULED STOP POINT and hence a CONNECTION by means of a STOP ASSIGNMENT.

A TRIP PATTERN may be subdivided into TRIPs, each TRIP grouping a number of TRIP LEGs that have a common characteristic (such as being covered by a single fare or falling within a single validation process such as a metro). TRIPS may be specialized as PT TRIPS, involving only ACCESS LEGs and public transport LEGs, NON-PT TRIPS, involving no public transport LEGs, and MIXED TRIPS, involving public transport LEGs and private mode legs.

LEGs may also be further described in several ways:

- ACCESSIBILITY ASSESSMENTS (see EN 12896-1:2016) can be associated with individual RIDE LEGs and PT CONNECTION LEGs as well as for the overall TRIP to describe the accessibility characteristics such as 'StepFreeAccess' 'WheelchairAccess' etc.
- Detailed instructions to a passenger on how to follow a particular leg (in particular an ACCESS LEG or a CONNECTION LEG) can be specified using PATH GUIDANCE elements.
- One or more spatial projections of a leg suitable for plotting on a map or maps may be specified using a LEG TRACK.

A TRIP PATTERN describes a trip made from a scheduled timetable. It may be complemented at runtime by a MONITORED TRIP PATTERN, which augments the planned trip with real-time updates – see subclauses below.

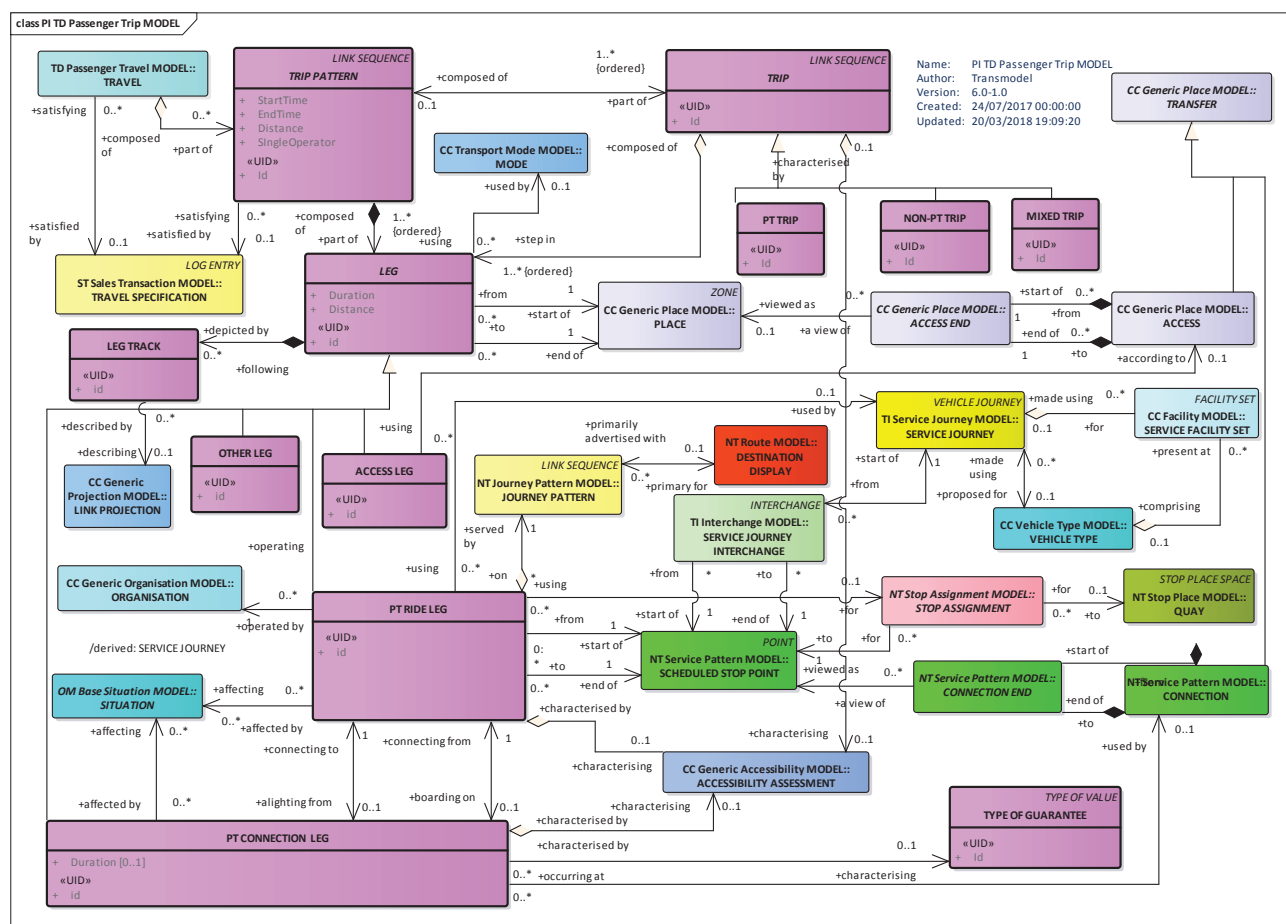


Figure 3 — Passenger Trip MODEL (UML)

5.4.2.2.2 Examples of Passenger Trips

The different types of legs may be used to describe many different types of trips. For example:

- Simple trip from one bus stop to another
 - TRIP PATTERN [TRIP REASON = *go to work*]
 - PT TRIP
 - PT RIDE LEG [MODE = *bus*]
- Walk to a bus stop, catch the bus, walk to the shop
 - TRIP PATTERN TRIP REASON = *go shopping*
 - PT TRIP
 - ACCESS LEG [MODE = *walk*]
 - PT RIDE LEG [MODE = *bus*]
 - ACCESS LEG [MODE = *walk*]
- Walk to the station, catch the train, change to the metro, walk to the work
 - TRIP PATTERN [TRIP REASON = *go to work*]
 - PT TRIP
 - ACCESS LEG [MODE = *walk*]
 - PT RIDE LEG [MODE = *rail*]
 - PT CONNECTION LEG [MODE = *walk*]
 - PT RIDE LEG [MODE = *metro*]
 - ACCESS LEG [MODE = *walk*]
- Catch a taxi to the park, walk through the park to the stadium
 - TRIP PATTERN [TRIP REASON = *go to match*]
 - NON-PT TRIP
 - OTHER LEG [MODE = *taxi*]
 - ACCESS LEG [MODE = *walk*]
- Cycle
 - TRIP PATTERN [TRIP REASON = *go to work*]
 - NON-PT TRIP