SLOVENSKI STANDARD
SIST EN 12896:2006

01-junij-2006

Nadomeġļa:
SIST ENV 12896:2003

Cestna transportna in prometna telematika ï Javni prevoz ï Referenļni podatkovni model

Road transport and traffic telematics - Public transport - Reference data model

Straßentransport- und Verkehrstelematik - Öffentlicher Transport - Datenreferenzmodell

Télématique de la circulation et du transport routier - Transports publics - Modele de données

Ta slovenski standard je istoveten z: **EN 12896:2006**

ICS:

35.240.60	Uporabniške rešitve IT v transportu in trgovini	IT applications in transport and trade

SIST EN 12896:2006 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12896

March 2006

ICS 35.240.60

Supersedes ENV 12896:1997

English Version

Road transport and traffic telematics - Public transport - Reference data model

Télématique de la circulation et du transport routier - Transports publics - Modèle de données

Straßentransport- und Verkehrstelematik - Öffentlicher Transport - Datenreferenzmodell

This European Standard was approved by CEN on 3 February 2006.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 12896:2006: E

Contents

Page

Foreword 6
Use of the Transmodel standard 6
Transmodel origins 6
ENV 12896 6
Titan 7
SITP and SITP2 7
CEN TC 278 WG 3 SG 4 7
Structure of this European Standard 7
Conformance 8
Future developments 9

Introduction 10
Rationale for the Transmodel standard 10
Use of the Transmodel standard 10
Applicability of the Transmodel standard 11
Introduction 11
Specification of information architecture 11
Specification of a database 11
Specification of an interface 12
Status of the Transmodel standard 12

1 Scope 13
1.1 General 13
1.2 Overview 13
1.3 Network description 14
1.4 Versions, validity and layers 14
1.5 Tactical planning: Vehicle-Driver Scheduling and Rostering 14
1.6 Personnel disposition 15
1.7 Operations monitoring and control 15
1.8 Passenger information 16
1.9 Fare collection 16
1.10 Management information 17
1.11 Multi-modal operation 17
1.12 Multiple operators' environment 18

2 Terms and definitions 18

3 Requirements 20
3.1 General 20
3.1.1 Introduction 20
3.1.2 Modelling Style 21
3.1.3 Generic Approach and Abstract Views 21
3.1.4 Structures 22
3.2 Description of the Network 26
3.2.1 Elements of topology 26
3.2.2 Infrastructure Description 32
3.2.3 Restrictions 35
3.2.4 Combined Diagram on Topology 37
3.2.5 Additional Aspects to Point 39
3.2.6 Generic Network Concepts 43
3.2.7 Combined Diagram on Generic Network Concepts 49
3.2.8 Network Linear Features 50
3.2.9 Combined Diagram on Network Linear Features 60
3.2.10 Projection 61

3.2.11 Interface to the GDF Data Model 66
3.3 Versions, Validity and Layers 67
3.3.1 Introduction 67
3.3.2 General Principles 67
3.3.3 Main Concepts 68
3.3.4 Version Frames 69
3.3.5 Versions 70
3.3.6 Other Aspects 73
3.3.7 Combined Diagram on Versions 74
3.3.8 Explicit Versions 74
3.4 Tactical Planning Components 76
3.4.1 Days 76
3.4.2 Journeys 79
3.4.3 Standard Times 84
3.4.4 Journey Times 88
3.4.5 Driver Trips 90
3.4.6 Interchanges 90
3.4.7 Timing Computation of a Journey 93
3.5 Vehicle Scheduling 94
3.5.1 Tactical Resource Planning 94
3.5.2 Resources for Tactical Planning 94
3.5.3 Vehicle Planning 95
3.5.4 Vehicle Requirements 97
3.6 Driver Scheduling 99
3.6.1 General Remarks 99
3.6.2 Duties 100
3.6.3 Other Aspects of Duties 105
3.7 Schedules and Versions 107
3.7.1 Introduction 107
3.7.2 Main Types of Schedules and Versions 109
3.7.3 Combined Schedules and Versions 111
3.8 Rostering 112
3.8.1 General Remarks 112
3.8.2 Roster Matrices 113
3.8.3 Roster Cycles 115
3.8.4 Roster Designs 115
3.8.5 Roster Assignments 116
3.9 Personnel Disposition 117
3.9.1 Introduction 117
3.9.2 Driver Assignments 118
3.9.3 Driver Accounting 121
3.10 Operations monitoring and control 125
3.10.1 Introduction 125
3.10.2 Dated Operational Plans 126
3.10.3 Resource Detection and Monitoring 130
3.10.4 Vehicle Assignments 134
3.10.5 Monitored Operations 135
3.10.6 Control Actions 138
3.10.7 Events 143
3.10.8 Messages 144
3.11 Passenger Information 145
3.11.1 Introduction 145
3.11.2 Provision of Information 145
3.11.3 Spatial Information 148
3.11.4 Timetable Information 151
3.11.5 Passenger Trip Planning 156
3.11.6 Estimation of Trip Duration 160
3.11.7 Other Information 163
3.12 Fare Collection 164

3.12.1 Introduction 164
3.12.2 Access Rights Specification 166
3.12.3 Fare Structure 171
3.12.4 Fare Products 174
3.12.5 Limiting Fare Parameters 175
3.12.6 Travel Documents 179
3.12.7 Sales 181
3.12.8 Customers 183
3.12.9 Prices 184
3.12.10 Pre-consumption Specification 186
3.12.11 Controls and Validation 188
3.12.12 Fare Version 191
3.12.13 Information on Fares 191
3.13 Management Information 191
3.13.1 Introduction 191
3.13.2 Service Journey Performance 193
3.13.3 Recorded Use of Services 196
3.14 Multi-modal Operation in Public Transport 198
3.14.1 Domain Definition and Limits 198
3.14.2 Network Description 199
3.14.3 Resource Management 202
3.14.4 Vehicle Coupling 204
3.14.5 Operations 206
3.14.6 Other Aspects 207
3.15 Multiple Operators' Environment 207
3.15.1 Introduction 207
3.15.2 Owners and Users of Resources and Network 208
3.15.3 Information from Different Sources 212
3.15.4 Interchanges 214
3.15.5 Fare Collection Functions 214

Annex A (normative) Data Definitions and Main Properties 215
A.1 This Annex 215

Annex B (informative) Additional features of the model 269
B.1 Consistency and Integrity Conditions 269
B.1.1 Introduction 269
B.1.2 Logical Constraints 271
B.1.3 Semantic Constraints 276
B.1.4 Optional Constraints 277
B.2 Introduction to Data Modelling and the Methodology Used 278
B.2.1 Introduction 278
B.2.2 Levels of model 278
B.2.3 Examples of Different Relationships 280
B.2.4 The Reason for Data Modelling 288
B.2.5 Optimisation and the Optimised Logical Model 295
B.2.6 Subtypes 295
B.2.7 Further Notation 297
B.3 Functional Model 298
B.3.1 Introduction 298
B.3.2 Functional Model 302
B.3.3 Definition of Functional Areas 309

Annex C (informative) Changes in this version of Transmodel 316
C.1 Changes between ENV 12896 (Transmodel 4.1) and Transmodel 5.0 316
C.1.1 Introduction 316
C.1.2 Impact of the changes on the entities 317
C.1.3 Impact of the changes on the diagram 332
C.2 Modifications to V5.0 leading to V5.1 334
C.2.1 Introduction 334
C.2.2 How to read this Annex 334

C.2.3 Requests and proposed modifications 335

Annex D (informative) Transmodel in UML 365
D.1 Introduction 365
D.1.1 General 365
D.1.2 Differences between the two representations 365
D.1.3 Structure of this Annex 365
D.2 Class diagrams 367
D.2.1 Network description 367
D.2.2 Versions, validity and layers 385
D.2.3 Tactical planning components 390
D.2.4 Vehicle scheduling 395
D.2.5 Driver scheduling 397
D.2.6 Schedules and versions 399
D.2.7 Rostering 400
D.2.8 Personnel disposition 402
D.2.9 Operations monitoring and control 403
D.2.10 Passenger information 410
D.2.11 Fare collection 415
D.2.12 Management information 420
D.2.13 Multi-modal operation in public transport 422
D.2.14 Multiple operators' environment 425
D.3 Class dictionary 427
D.4 Generalisations and specialisations 638
D.4.1 Specialisations descent 638
D.4.2 Generalisations climb up 642
D.5 Comparison of notations 650
D.5.1 Relationships/Associations 651

Bibliography 655

Foreword

This European Standard (EN 12896:2006) has been prepared by Technical Committee CEN/TC 278 “Road transport and traffic telematics”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2006, and conflicting national standards shall be withdrawn at the latest by September 2006.

This European Standard supersedes ENV 12896:1997.

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

Use of the Transmodel standard

This European Standard presents version 5.1 of the European Standard EN 12986, known as “Transmodel”. Transmodel 5.1 is a reference standard which provides a conceptual data model for use by organisations with an interest in information systems for the public transport industry.

As a reference standard, it is not necessary for individual systems or specifications to implement Transmodel. However, it needs to be possible to describe (for those elements of systems, interfaces and specifications which fall within the scope of Transmodel):

— the aspects of Transmodel that they have adopted;

— the aspects of Transmodel that they have chosen not to adopt.

For an organisation wishing to specify, acquire and operate information systems, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the organisation, or specific data models for database design or interface specification.

For an organisation wishing to design, develop and supply information systems, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the product suite.

Transmodel origins

ENV 12896

The prestandard ENV 12896 was prepared by the work area Transmodel of the EuroBus project (1992-1994) and by the DRIVE II task force Harpist (1995). The EuroBus/Transmodel and Harpist kernel team was established as a subgroup of CEN TC278 Working Group 3. The results of these projects were based upon earlier results reached within the Drive I Cassiope project and the ÖPNV data model for public transport, a German national standard. The prestandard reflected the contents of deliverable C1 of the Harpist task force, published in May 1995, with modifications resulting from the discussion process in CEN TC278/WG3 between May and October 1995.

The different organisations that have technically contributed to the preparation of the prestandard ENV 12896 were the partners of EuroBus/Transmodel and the Harpist task force: Beachcroft Systems (UK), CETE-méditerranée (F), CTA Systems (NL), Ingénieur Conseil Bruno Bert (F), Koninklijk Nederlands Vervoer (NL),

Leeds University (UK), Régie des Transports de Marseille (F), SNV Studiengesellschaft Verkehr (D), Stuttgarter Straßenbahnen AG (D), TransExpert (F), TransTeC (D) and VSN Groep (NL).

The sponsors of the project were the European Communities (EC, DG XIII, F/5, Drive Programme, 1992-94), the French Ministry of Transportation, the Dutch Ministry of Transportation and the German Federal Ministry of Research and Technology.

Titan

The EC project Titan concerned validation and further development of ENV 12896. The different organisations that have technically contributed to the Titan project were: CETE-Méditerranée (F), Üstra (D), OASA (GR), RATP (F), SLTC (F), Salzburger Stadtwerke AG (A), TransExpert (F), TransTeC (D), Synergy (GR), TRUST EEIG (D).

The sponsoring partner was the French Ministry of Transport (DTT/SAE). The project was co-funded by the European Communities and some of the partners, in particular the pilot sites – Lyon (F), Hanover (D) and Salzburg (A).

SITP and SITP2

The French-led project SITP (Système d'Information Transport Public) was sponsored by the French Ministry of Transport (Direction des Transports Terrestres – DTT), the companies Gemplus (F) and Setec ITS (F), and the Transmodel Users' Support Team EEIG (F and D).

SITP built on the prestandard ENV 12896 (issued May 1997) and the results of the EC project Titan (1996-1998). SITP produced the extensions requested of ENV12896; these were validated during 1999-2000. A successor project, SITP2, developed the standard further during 2001-2002.

CEN TC 278 WG 3 SG 4

During 2002-2003, CEN convened a new subgroup of TC 278 WG3 to consider how Transmodel should be taken forward. It considered responses to previous drafts of Transmodel as well as the work of SITP/SITP2, the German VDV specifications, and a range of UK projects.

SG4 was led by the UK Department for Transport, with participants from VDV (D), RATP (F), HÜR (DK), Setec (F), TRUST E.E.I.G. (Transmodel Users' Support Team) (F and D) and Centaur Consulting (UK).

This document, and additional guidance documents (originally produced under SITP) for how it can be used, may be found at www.transmodel.org. Other sites which make this available include www.sitp.its.setec.fr.

Structure of this European Standard

The present European Standard is composed of two parts:

— the normative part (main document and Annex A);

— the informative part (Annexes B, C and D).

The main document presents:

— the history (Foreword) and the rationale (Introduction) of the proposed standard;

— the executive summary of the reference data model (1. Scope);

— the definitions of the terms as they are used in this document (2. Terms and definitions);

— the technical requirements in form of detailed textual descriptions and diagrams (Clause 3. Requirements).

A series of Annexes provides:

— the definitions of the concepts (entity definitions), together with the main properties of the concepts (main attributes, identifiers, super-types) (Annex A, normative);

— modelling convention: consistency and integrity conditions, introduction to data modelling and the methodology used, and a functional model (Annex B, informative);

— modifications to ENV 12896 (Annex C, informative);

— UML presentation of the reference data model (Annex D, informative).

Conformance

A specification which cites Transmodel needs to include comparisons of the specification against the Transmodel reference data model in at least two conformance levels:

— level 1 (the global level) identifies which data domains within the specification are drawn from the Transmodel data domains, and which are not;

— level 2 (the detailed level) compares the data model within the specification against the Transmodel entities.

The level 1 conformance statement shall be presented as a table based on one of the following:

— the Transmodel data domains as described in the normative part of the document: description of the network, versions/validity/layers, tactical planning components, vehicle scheduling, driver scheduling, schedules and versions, rostering, personnel disposition, operations monitoring and control, passenger information, fare collection, management information, multi-modal operation, multiple operators' environment;

— alternatively, the corresponding diagrams as presented in this document, either in the forms in the main text or in the equivalent UML forms in the informative Annex (Annex D).

The level 2 conformance statement shall be presented as a table in which the data concepts used in the specification are described as:

— "Unmodified": concepts in the specification which have the same definition, properties and relationships as in the corresponding Transmodel domain;

— "Modified": concepts in the specification which are similar to a Transmodel concept but which differ in the details of certain attributes and/or relationships (e.g. attributes added);

— "Alternative": concepts or groups of concepts in the specification which model the same concepts as Transmodel but in a significantly different way;

— "Additional": concepts in the specification which are not drawn from Transmodel;

— "Omitted": concepts in Transmodel which are not used in the specification.

Future developments

The developers of this standard recognise that there is continual development in the business practice of the public transport industry, and that Transmodel needs to continue to evolve to fulfil its needs. In version 5.1, the particular weaknesses that have been identified during consultation are the following:

— **Metadata**. Transmodel at present does not provide adequate support for data management and data protection. Future versions will aim to identify metadata such as currency, accuracy, ownership and permissions.

— **Long distance and multimodal journeys**. Transmodel focuses on city-based travel. For longer journeys, aspects such as check-in time or seat reservation will need to be covered, including travel preferences such as aisle/window seat, smoking/non-smoking, dietary needs etc.

— **Fares and tickets**. Transmodel splits passenger information and fare collection into separate areas and therefore does not deal with the issue of ticketing as a whole. This should be reviewed against the provisions of other emerging standards, including as the CEN work in EN 1545 and on IOPTA Data Structures. Further loyalty schemes are not addressed, ie the accumulation of transferable and redeemable 'points'.

— **Journey add-ons**. Transmodel does allow user-definable components to be added to sales products. However it does not make provision for specific common add-ons to journeys, such as inclusive meals or newspapers.

These areas form the basis of work items to extend and refine the standard in the next phase of Transmodel development. Additionally, CEN welcomes input from users of this standard as to where Transmodel needs extension or refinement.

The presentation of this European Standard has also been reviewed. A UML version has been included in this version as an informative Annex (Annex D). It is expected that future versions of this standard may be developed and presented using UML normatively.

Introduction

Rationale for the Transmodel standard

Public transport services rely increasingly on information systems to ensure reliable, efficient operation and widely accessible, accurate passenger information. These systems are used for a range of specific purposes: setting schedules and timetables, managing vehicle fleets, issuing tickets and receipts, providing real time information on service running, and so on.

To operate most effectively, such systems increasingly need to exchange information with each other. This integration can be difficult when systems are provided by different suppliers. This difficulty is usually not for technical reasons, since the widespread usage of technologies such as the Internet Protocol Suite and Relational Database Management Systems have allowed data exchanges to be configured fairly simply. Rather, it is because one system will often not understand the meaning of the data that is used by another.

Thus, it will be much easier to achieve the goal of interoperating systems, if all the systems in question are using similar definitions, structures and meanings for their data. This applies both to connecting different applications within an organisation, and also to connecting applications between interworking organisations (for instance, a public authority and a transport operator).

The Transmodel standard presented in this European Standard provides a framework for defining and agreeing data models, and covers the whole area of public transport operations. By making use of this European Standard, and of data models derived from it, it will be possible for operators, authorities and software suppliers to work together much more easily towards integrated systems. Moreover, the breadth of the standard will help to ensure that future systems developments can be accommodated with the minimum of difficulty.

Use of the Transmodel standard

Transmodel may prove of value to:

— organisations within the public transport industry that specify, acquire and operate information systems;

— organisations that design, develop and supply information systems for the public transport industry.

For an organisation within the public transport industry wishing to specify, acquire and operate information systems, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the organisation. This will enable the organisation to specify its database structures and/or its system interfaces, in such a way that separate modules can be openly tendered but will still integrate easily. The organisation also has a greater likelihood that information exchange interfaces with external organisations will be easily achieved.

For an organisation wishing to design, develop and supply information systems for the public transport industry, Transmodel may be distilled, refined, or adapted to form a comprehensive data model for the product suite. This will enable the organisation to develop its products in such a way that separate modules will integrate easily, but also so that they may be sold separately to clients seeking Transmodel-compliant systems.

Transmodel is a large and complex model, and allows for great flexibility. Consequentially it takes some skill and resource to apply it effectively. For this reason it is expected that, in many circumstances, many organisations will cooperate to develop a data model or specification for a particular aspect of information systems – perhaps for a particular interface, as between a ticket machine and a management system, or a particular organisational boundary, as between two connecting transport operators.

For such a body, Transmodel provides a wider setting and a starting point. The body can refine specific elements of Transmodel, or develop a specific subset or 'profile' of the Transmodel data model. The resulting specification will then be easier for user organisations to build into a coherent overall systems framework, since it will coexist more readily with other Transmodel-based specifications.

For all of these potential users, the adoption of Transmodel as a basis for development means a common language is being used. Thus, users will understand and assess the claims of suppliers better, and specification developers will be more likely to be working in alignment with each other.

Applicability of the Transmodel standard

Introduction

Transmodel may be applied to any framework for information systems within the public transport industry, but there are three circumstances to which it is particularly suited:

— specification of an organisation's 'information architecture';

— specification of a database;

— specification of a data exchange interface.

Specification of information architecture

An 'information architecture' refers to the overall structure of information used by an information system, which is used to determine:

— the structure of data held in system databases;

— the structure of data exchanged across interfaces between systems.

It may be used as a strategic guide to system planning and evolution, and as the basis for the specification and acquisition of individual systems.

An information architecture made up of independent modules with well defined interfaces is easier to maintain. A malfunctioning module can be taken out of service or completely replaced without disrupting the rest of the system. This is particularly beneficial for on-line or safety critical systems. The modules can also be more easily reconfigured on to hardware located elsewhere on the network to fit in with changes in organisational arrangements for managing the business and data administration processes.

The information architecture itself should be evaluated from time to time to make sure that it is still meeting the needs of the organisation. Technological changes in communications and computing are continuously bringing forward new opportunities for evolving the systems supporting the business.

Specification of a database

At a more technical level, an organisation's systems will have a collection of data in one or more databases, which may be associated with individual applications or may be common to many applications.

In either case, Transmodel can serve as a starting point for the definition of a database schema, which will be used for the physical implementation of databases. Whether applications access a common database built to this schema, or have their own databases and exchange data built to consistent schemas, the use of an overall reference data model assists integration.

Technical constraints (such as memory capacity restrictions of smart cards) may affect the detail and complexity of the data models that can be used in particular data storage devices. Transmodel does not itself specify a level of detail to adopt.

Specification of an interface

Public transport organisations may require different applications to exchange data with each other. Also, public transport organisations may exchange data with other organisations. In either case, the reference data model can be used to help design the interfaces.

Again, technical constraints (such as bandwidth limitations of radio communications links) may affect the detail and complexity of the data models that can be used for particular interfaces. Transmodel does not itself specify a level of detail to adopt.

Status of the Transmodel standard

Transmodel 5.1 is a reference standard which provides a conceptual data model for use by organisations with an interest in public transport information systems. As such, it is a full standard.

The status of Transmodel as a reference standard means that it is not necessary for individual systems or specifications to implement Transmodel. However, it needs to be possible to describe (for those elements of systems, interfaces and specifications which fall within the scope of Transmodel):

— the aspects of Transmodel that they have adopted;

— the aspects of Transmodel that they have chosen not to adopt.

Thus, the status of Transmodel as a ratified standard is not a constraint on those developing, acquiring or operating systems. They are free to use Transmodel to the extent appropriate to their particular circumstance.

It is expected that many developers and users will choose to use specific Transmodel-based specifications, rather than refer directly to Transmodel. To facilitate this, those bodies developing specific standards and specifications based on Transmodel should document particularly carefully how their output uses (and differs from) Transmodel.

1 Scope

1.1 General

The European reference data model for public transport is an offer to public transport companies and other providers of services related to the process of passenger transportation and information, to suppliers of software products supporting these processes, and to consultants and other experts acting in the field of public transport in the widest sense.

The reference data model can support the development of software applications, their interaction or combination in an integrated information system, and the system‘s organisation and information management which rules the utilisation of the existing telematics environment in a company (or group of companies) running computer applications supporting the different functional areas of public transport.

Although primarily designed to document the information needs of a public transport company in a well defined and structured way, the reference data model can also serve as a starting point and reference for the definition of a database schema. A database schema is needed for the physical implementation of data storage systems to be used by applications directly, or for exchange of data between applications via interfaces. Apart from that, such a database will often additionally be used as a source of information for the company management and/or as an information pool for all employees who may need access to the information basis of the company.

1.2 Overview

The data model describes elementary data needed for

— network description; and

— versions management,

that are used in several functional domains as basic concepts.

The data model describes the information needs related to the following functional domains:

— tactical planning (vehicle scheduling, driver scheduling, rostering);

— personnel (driver) disposition;

— operations monitoring and control;

— passenger information;

— fare collection;

— management information and statistics.

The standard takes into account the:

— multi-modal public transport operation;

— multiple operators environment.