EESTI STANDARD

EVS-EN 12896:2006

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

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EESTI STANDARDIKESKUS

EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
Käesolev Eesti standard EVS-EN 12896:2006 sisaldab Euroopa standardi EN 12896:2006 ingliskeelset teksti. Käesolev dokument on jõustatud 28.04.2006 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 12896:2006 consists of the English text of the European standard EN 12896:2006. This document is endorsed on 28.04.2006 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

Käsitlusala:	**Scope:**
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 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.

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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.

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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.

1.3 Network description

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

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

The functional views of the network are described as **layers**. A **projection** is a mechanism enabling the description of the correspondence between the different layers. This mapping between the layers is particularly useful when spatial data from different environments (sources, functional domains) have to be combined. An example of such a situation is the mapping of the public transport network on the road network.

The Geographical Data Files (GDF) standard includes a data model for the geographical description of road networks. It provides a basic network description upon which various layers describing specific aspects of the use of the infrastructure network may be placed. Public transport companies or providers of other associated services may want to couple their applications and information basis to geographical information. In this case, the exchange of data between a Geographical Information System and the public transport applications concerned will become necessary. For this purpose, an interface between the GDF data model and the relevant part of the topological network representation in the reference data model for public transport has been defined.

1.4 Versions, validity and layers

This part of the standard describes a way to handle data **versions**, i.e. data **modifications**, such as modifications of the planned service.

A mechanism to handle parallel hierarchies of elementary data groups (e.g. schedules) and the way to represent relationships between the different hierarchy levels is described, using the concept of **validity conditions**.

This part of the model shall be considered as a user guide for system design.

1.5 Tactical planning: Vehicle-Driver Scheduling and Rostering

The tactical planning (or scheduling) domain of the reference data model describes all the information that is necessary to define the vehicle journeys to be provided as a part of the public transport service, and to schedule (logical) vehicles and drivers to work the blocks and duties necessary to provide the defined service offer to the passengers.

The work of the vehicles necessary to provide the service offer advertised to the public consists of service journeys and dead runs (unproductive journeys necessary to transfer vehicles where they are needed, mainly from the depot into service and vice versa). Vehicle journeys are defined for day types rather than individual operating days. A day type is a classification of all operating days for which the same service offer has been planned. The whole tactical planning process is seen on the level of day types in the reference data model, with all entities necessary to develop schedules. These include a series of entities describing different types of run times and wait times, scheduled interchanges, turnaround times etc.

Chaining vehicle journeys into blocks of vehicle operations, and cutting driver duties from the vehicle blocks, are parts of the main functions of vehicle scheduling and driver scheduling, respectively. The corresponding entities and relationships included in the reference data model allow a comprehensive description of the data needs associated with this functionality, independently of the particular methods and algorithms applied by the different software systems.

The process of ordering driver duties into sequences in order to obtain a balanced work share among the driving personnel over the planning period, and to keep the resulting work time in harmonisation with legal regulations and internal agreements between drivers and the company management, is known as rostering. The reference data model offers a model part covering the information needs associated with some classical rostering methods, widely used in European countries. There may, however, be other (particularly more advanced, dynamic) methods applied in some cases, which would probably need additional, or other entities than described in the rostering part of the reference data model. This part of the model is therefore informative.

1.6 Personnel disposition

The **personnel disposition** domain of the reference data model covers the data needs of the relevant driver management functions with respect to the two major tasks of

— assigning *physical* drivers to the *logical* drivers identified in the scheduled duty plan;

— recording the performance of drivers on the actual day of operation.

The assignment of drivers for the actual operating day to the duty plan set up for the whole planning period is usually done in a staged procedure. The assignment will mostly start from default assignments for the whole period in question, which can be continuously overridden by changes and adjustments due to regular absences of drivers from work, changes initiated by drivers according to their preferences or by the control staff according to operational needs. Short-term adjustments may become necessary to balance unplanned absences and other circumstances principally not known in advance.

Records to document the actual driver activities are usually taken to control the driver performance and compare it with the original plan, and to prepare these data in a suitable way for wage accounting. This mainly refers to the specification of the time worked by each driver on the individual day for each type of activity, and some additional classifications which may result in appropriate modifications of the amount to be paid for the recorded activity in question.

This part of the model is informative.

1.7 Operations monitoring and control

The domain of operations monitoring and control concerns all activities related to the actual transportation process. It is also known as real-time control, or operations management.

The supply basis for each operating day is known as a production plan, composed of the planned work of each available resource (e.g. vehicles and drivers). It includes for instance all dated journeys planned on the considered day, including occasional services.

The transportation control process supposes a frequent detection of the operating resources (in particular vehicle identification and location tracking). Such collected information is compared to the planned data (e.g. work plan for a vehicle or a driver), thus providing a monitoring of these resources.

The monitored data is used for:

— controlling the various resource assignments (e.g. vehicle assignment to a dated block);

— assisting drivers and controllers to respect the plan (e.g. schedule adherence, interchange control);

— alerting on possible disturbances (e.g. delay thresholds, incidents);

- helping the design of corrective *control actions* according to the service objectives and overall control strategy; the model describes a range of such control actions (e.g. departure lag);
- activation of various associated processes (e.g. traffic light priority, track switching);
- passenger information on the actual service (e.g. automatic display of the expected waiting time at stop points); and
- follow-up and quality statistics.

Other aspects, such as communication between actors, are taken into account.

1.8 Passenger information

In its passenger information model part, the reference data model does not only describe the data which are needed for applications providing passengers with the relevant information on the planned as well as on the actual service, but also the data resulting from the planning and control processes which may result in service modifications possibly to be made known to the public. Consequently, the passenger information data model includes data descriptions which go far beyond the planned timetable, which is the main source for the classical timetable information, but does not take into account any dynamic issues.

These additional concepts refer to

- passenger information facilities and their utilisation for passenger queries;
- detailed description of all conceptual components of a passenger *trip*, as possibly needed by an interactive passenger information system when answering a passenger query;
- 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.

Basically, all types of passenger information generally use many elements of the topological network definition, 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. 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.

1.9 Fare collection

The **fare collection** data model aims at a most generic description of the data objects and elements needed to support functions like definition of the fare structure and its parameters, operating sales, validating the consumption and charging customers. These functions and their underlying data structures are handled differently between European countries, and even between the public transport operators within one country. This situation leads to a considerable complexity of the concepts to be taken into account in the attempt to define one single fare collection data model, which aims at covering as many existing solutions and practices as possible.

In order to cope with this complexity, the fare collection data model concentrates on the abstract, generic concepts that form the core of any fare system, independently of how these abstract concepts are implemented by a set of concrete fare products (e.g. tickets or passes) offered for sale to the public. The starting point for the description of these fundamental concepts is the definition of theoretical access rights. These can be combined to immaterial fare products, which are linked to travel documents in order to form sales packages to be sold to passengers. Controls may be applied to these travel documents to validate the utilisation of the public transport system. Prices components are linked to the access rights, fare products and sales packages; they are used to calculate the price to be paid by a customer for a specific consumption (e.g. sale on a vending machine, debiting a value card, post-payment).

1.10 Management information

The data model part supporting management information and statistics provides some additional data descriptions which may be needed apart from the information elements already included in the scheduling, operations management and control, passenger information and fare collection sub-models. Statistical information may of course be provided for any object of interest that is included in the company's specific data model and for which information is recorded in a database, whether for the company management or for other organisational units.

However, some additional information needs and sources are necessary, which cannot be derived from the model parts mentioned above and are specifically related to the evaluation of the operational process, especially to the evaluation of the current timetable and the comparison between the scheduled performance and actual performance. These include:

- events and recordings describing the actual course of vehicle journeys and the resulting service performance;
- the actual status of the planned and advertised interchanges and the resulting service quality; and
- recordings of the actual use of the service offer, i.e. actual passenger rides and trips.

1.11 Multi-modal operation

The multi-modal public transport domain is the co-operation of different public transport modes. The present standard addresses the needs of the following public transport modes:

- bus;
- trolley bus;
- light rail (tramway, metro).

Specific requirements of other transport modes are taken into account whenever possible.

The most significant needs addressed by the data model are dealing with:

- network description;
- resource management;
- operations;
- passenger information; and
- fare collection.