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Intelligent transport systems — Public transport user information —

Part 2: Public transport data and interface standards catalogue and cross references

Systèmes intelligents de transport — Informations destinées aux utilisateurs des transports publics —

Partie 2: Données sur les transports publics, et catalogue des normes relatives aux interfaces et références croisées

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems.*

ISO 17185 consists of the following parts, under the general title *Intelligent transport systems — Public transport user information*:

— *Part 1: Standards framework for public information*

— *Part 2: Public transport data and interface standards catalogue and cross references*

— *Part 3: Use cases for journey planning systems and their inter-operation*

Introduction

With the multiple standards that are deployed around the world to provide passenger information, ISO/TC 204 sees a need to identify the range of information provision available to the public. Some of the standards comprise messages and/or services that cover the full scope of the public transport planning and operations enterprise, while others address a narrow scope of passenger information, such as schedule information or bus arrival time prediction.

ISO/TC 204 saw a need to create a catalogue that shows the range and extent of the collection of standards and specifications available. Furthermore, the group identified a need to show the similarities and differences among these standards and specifications for several reasons, for example:

— to match like concepts and messages,

— to understand the overlaps, differences and missing requirements,

— to extend narrow-based standards using the concepts and interfaces developed by the enterprise-based standards.

This Technical Report will be beneficial for all ISO/CEN member countries, as well as non-member countries. It will be a valuable catalogue to help understand the content of the currently available national and regional standards (identified in ISO 17185 Part 1), such as Transmodel, TCIP, Korean ATIS and Japanese ATIS. The intention is that, by deploying these existing national and regional standards from other countries or regions, duplication of cost and time in developing new standards and specifications can be avoided. For those countries that do not have surface public transport information standards, this approach allows the mix and match of standards from different regions, as well as rapid development and deployment that can enhance the usability and convenience of public transport anywhere in the world.

This Technical Report is intended to be fully consistent with those currently available national and regional standards which may be related to international surface public transport. It is designed to serve as a look-up table for developers for the terminology used in different regions for the same concept. For example, the term “trip” in TCIP and GTFS is called “service journey” in Transmodel. This catalogue will expose the differences in language for developers who need to translate data from one standard to another. Principally, this Technical Report, and its scope and approach, will help lower the barriers for developers who need to mix standards; for countries that need to choose the best approach to deploy public transport systems; and, ultimately, for the public wanting a seamless public transport experience wherever they travel.

As Andrew S. Tanenbaum said, “The nice thing about standards is that you have so many to choose from”.[1] This report fully endorses that principle.

1) *Computer Networks*, 2nd ed., p. 254

Intelligent transport systems — Public transport user information —

Part 2: Public transport data and interface standards catalogue and cross references

1 Scope

This Technical Report compares and contrasts public transport standards that were developed by different regions and countries. It uses the CEN Transmodel classes as a reference to compare standard data concept descriptions of public transport user information. The purpose of this Technical Report is to understand the concepts described by existing standards and specifications that cover public transport passenger information.

2 Terms and definitions

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

NOTE Equivalent TCIP or Transmodel term is identified for reference.

2.1
attribute
property of an entity

[SOURCE: CEN EN12896; p. 16 (ref 1), modified — Note 1 has been added.]

Note 1 to entry: Equivalent terms in TCIP / Transmodel: data element (TCIP).

2.2
class
concept within [a] system being modelled

[SOURCE: The Unified Modeling Language Reference Manual; p. 185 (ref 3), modified — Notes 1 and 2 have been added.]

Note 1 to entry: Equivalent terms in TCIP / Transmodel: data concept [US TCIP].

Note 2 to entry: Similar to entity, represents a set of objects with similar behaviour and properties.

2.3
data concept
any of a group of data dictionary structures (i.e., object class, property, value domain, data element concept, data element, data frame, message, interface dialogue, association) referring to abstractions or things in the natural world that can be identified with explicit boundaries and meaning and whose properties and behavior [sic]all follow the same rules

[SOURCE: ISO 14817, p. 3 (ref 4), modified — Note 1 has been added.]

Note 1 to entry: Equivalent terms in TCIP / Transmodel: object, class, entity (Transmodel); data element, data frame (TCIP).

2.4
data element
atomic piece of information related to a person, place, thing, or concept (for example, CPT-PersonFirstName and CPT-Footnote)

[SOURCE: APTA-TCIP-S-01 3.0.3; p. 32 (ref 2), modified — Note 1 has been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: attribute (Transmodel).

2.5
data frame
grouping of data elements primarily for the purpose of referring to a group with a single name, and thereby efficiently reusing groups of data elements that commonly appear together (as an ASN.1 SEQUENCE, SEQUENCE OF or CHOICE) in a TCIP message

[SOURCE: APTA-TCIP-S-01 3.0.3; p. 32 (ref 2), modified — Notes 1 and 2 have been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: Sub model (as in a "diagram") in Transmodel [CEN-Transmodel].

Note 2 to entry: This data concept type may also be used to specify groups of data elements for other purposes as well. A data frame may contain other data frames as well as data elements.

2.6
dialog
ordered sequence of message exchanges between two or more entities

[SOURCE: APTA-TCIP-S-01 3.0.3; p. 33 (ref 2), modified — Notes 1 and 2 have been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: no equivalent in Transmodel.

Note 2 to entry: The rules of the exchange are defined by a dialog pattern. Messages specific to the type of exchange are specified by the dialog.

2.7
entity
object (data) that has its own existence (as opposed to an attribute)

[SOURCE: The Unified Modeling Language Reference Manual; p. 16 (ref 3), modified — Notes 1 and 2 have been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: data concept (TCIP).

Note 2 to entry: Similar to object and class.

2.8
message
grouping of data elements and/or data frames intended to be transmitted as a complete package of information in one direction

[SOURCE: APTA-TCIP-S-01 3.0.3; p. 39 (ref 2), modified — Note 1 has been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: no equivalent in Transmodel.

2.9
object
discrete entity with a well-defined boundary and identity that encapsulates state and behavior; an instance of a class

[SOURCE: The Unified Modeling Language Reference Manual; p. 360 (ref 3), modified — Notes 1 and 2 have been added.]

Note 1 to entry: Equivalent Terms in TCIP / Transmodel: data concept (TCIP).

Note 2 to entry: Similar to class and equivalent to an entity.

3 Abbreviated terms

ADPU	Application Protocol Data Unit (in the context of smart cards)
APTA	American Public Transportation Association
ATIS	Advanced Traveller Information System
CEN	Comité Européen de Normalization
CFMS	Contactless Fare Media System
csv	Comma separated values
EU	European Union
GTFS	General Transit Feed Specification (formally known as the Google Transit Feed Specification)
ID	Identification or identifier
IEC	International Electrotechnical Commission
IFOPT	Identification of Fixed Objects in Public Transport, a preliminary CEN Technical Specification, CEN standard, EN 28701:2009, that provides a Reference Data Model for describing the main fixed objects required for public access to Public transport.
ISO	International Organization for Standardization
ISO/TC 204	ISO Technical Committee 204 on Intelligent transport systems
N/I	Not included
NeTEx	NeTwork and Timetable Exchange. (CEN/TS 16614-, –2, –3). A CEN Technical Specification in XML, based on Transmodel v6 and IFOPT, providing exchange messages for space- and fare-, time-related data.
NTCIP	National Transportation Communications for Intelligent Transportation System Protocol (US Intelligent Transportation System standards body)
Pi	Passenger information
PICC	Proximity Integrated Circuit Card
PICS	Profile Implementation Conformance Statement
PRL	Profile Requirements List
PT	Public Transport
PTV	Public Transport Vehicle
SIRI	Service Interface for Real Time Information (EN 15531–1 to 3 and TS15531–4 and 5). A CEN protocol in XML, based on Transmodel that specifies services about public transport real-time services and vehicles, such as vehicle monitoring, stop monitoring, and more.
SQL	Sequential Query Language
TBT	Technical Barriers to Trade

TCIP	Transit Cooperative Interface Profiles
UML	Unified Modelling Language
UTC	Coordinated Universal Time
UTFS	Universal Transit Fare System
WSDL	Web Services Descriptive Language
XML	Extensible Markup Language

4 Objectives from a data catalogue and cross reference document

The objectives of this catalogue are to:

— Facilitate and promote international cooperation in the area of world-wide public transport (PT) standard activities.

— Encourage the PT industry to adopt a coherent and consistent reference data model standard for PT where PT operators will benefit from a larger market base, lowering costs and enhancing inter-operability among the systems they procure.

— Enhance economic trade by enabling standards to apply across country boundaries.

— Support PT to build interoperable applications that will work across country boundaries.

In addition, there are many countries that do not have national standards for traveller information. It is hoped that this catalogue will define the scope of functions that are currently defined, and the areas needing further work to support PT passengers.

5 Methodology

5.1 Business plan and survey

This Technical Report was conceived in 2006 as part of a business plan and an initial survey (see Annex A). The business plan included the following:

— Purpose of developing a data catalogue of worldwide standards on public transportation information.

— Benefits to national standards bodies.

— Justification for the data catalogue.

— Project work plan.

— Resources needed.

In addition, a survey for collecting information was attached to the business plan. The survey results are described in this Technical Report.

5.2 Public transport standards typology

As part of earlier discussions between CEN TC 278 WG 3 and ISO TC 204 (from 2000 to 2002), a set of criteria was defined to compare the TCIP and Transmodel standards. Three measures were defined:

— Equivalence: implies the elements are the same.

— Similarity: elements are similar, that is they overlap in some areas and differ in others.

— Difference: elements are different and are not reconcilable.

In this context, an element was described as a "data element or attribute, or data concept or entity". However, the purpose of the two standards is fundamentally different and, over the ensuing years, they have moved further apart in terms of their use and application.

In partitioning standards, ISO and other standards bodies are developing "abstract" versus "implementation" standards. Furthermore, wide adoption of internet standards and information technology best practices has helped modularize standards into different classes.

Table 1 — Information service standards' typology

	Service invocation (method)	**Information transfer**
Implementation specifications [how]	**Interface:** TCIP Protocol Interface Compliance Specification (Protocol Requirements List) (Volume IV) / NTCIP 2306 Center to Center Web Services SIRI NeTEx Korean ATIS	**Encoding:** TCIP XML Schema (Volume III) SIRI XML Schema NeTEx GTFS
Abstract model [what]	**Behaviour:** TCIP Building Blocks (patterns) (Volume I) SIRI NeTEx	**Content:** Transmodel SIRI NeTEx TCIP Data Dictionary/ Data Frames/ Data Messages / Dialogs (Annexes A – D)

Generally, the difference between an abstract model and implementation specification is "*what* is the domain?" versus "*how* is it designed and implemented?" The abstract model describes the content (semantics), logical relationships and completeness of the business domain, while the implementation specification documents describe the design for a specific technology based on how a part of the domain will be implemented. For example, there are several ways of invoking an exchange to acquire data (such as, SQL, web services and messaging services) and there are several encoding formats to access the data, including comma separated value file format (csv), XML or protocol buffer.

The reason to segment the standards space into the various categories is to illustrate the differences between the content, behaviour and implementation approaches of these standards. Transmodel, which is used as the reference model, is not a standard that can be implemented out of the box. It is an abstract data model whose data concepts (and the relationships between the data concepts) help users understand the business rules that apply to implementable standards. Transmodel captures the domain rules in a logical, consistent manner.

Given this classification framework, Transmodel is positioned as an abstract model that describes the semantics and business rules. Other standards, like TCIP, are implementation standards that include syntax (data formats) and some semantics. TCIP also includes behavioural specifications, that is, how information is exchanged in a business to business messaging environment. Most implementation standards, like TCIP, do not explicitly define a data model which describes entities/objects, logical relationships and business rules consistent with data modelling methodology. By mapping the implementation standards to an abstract standard, the implementation standard achieves the benefits of the semantic inter-operability of the data model.

The detailed mapping creates a catalogue on several levels of resolution. These include the following:

— typology (abstract/implementation; semantic/behaviour);

— business area;

— data concept;

— data concept attribute.

In addition, some responses of the survey included conformance and testing approaches, approaches to handling data versioning and measuring data quality. In many cases, conformance statements and tests are similar since the base standards upon which the public transport standard is based are the same, for example, XML. For that reason, conformance approaches show the similarities and collaborative methods that an implementer may use to integrate multiple message standards.

6 Public transport standard description results

6.1 Public transport standard overview

The survey included 10 sections. The sections requested three types of information: general information on the standards and its lineage; detailed information on the content of the standard with respect to a reference standard; and conformance and quality/versioning requirements associated with implementation of the standard. Specifically, the 10 topics addressed were as follows:

1. Name.
2. Standard type (see Table 1).
3. Scope.
4. History and ongoing maintenance schedule.
5. Methodology and approach to development.
6. Business areas covered (mapping to Transmodel and TCIP business areas).
7. Conformance and interoperability with other standards (e.g. XML, IEEE 1512).
8. Conformance provisions.
9. Handling of data version (temporal aspects of data).
10. Handling of data quality (metadata aspects).

The reference standard that was used as the cross reference was Transmodel because it provides a comprehensive abstract model of the PT data across most business areas, including data semantics and business rules. Some standards go beyond Transmodel (such as TCIP), however, only in a few areas.

6.2 Mapping of Transmodel artefacts to regional standards

6.2.1 Areas mapped to Transmodel

Although the detailed data concept and attribute mapping only covers PT passenger information, some standards include many more business areas. This clause includes four areas where elements of Transmodel are mapped to regional standards:

— General information (no mapping);

— Business areas (includes all business areas beyond the scope of this Technical Report);

— Data concepts and attributes;

— Conformance.

6.2.2 General standard information

The general information related to each standard incorporated in the catalogue included the following questions.

1. What is the standard name?
2. What type is the standard? Semantics/message/abstract/implementation?
3. What is the scope of the standard?
4. What year was the standard published?
5. Has the standard been implemented?
6. Who published the standard?
7. What was the methodology used to develop the standard?
8. Please list a short history of the development process:
9. Please describe the ongoing maintenance:

China	
What is the standard name?	Data Bus Interface Communication Specification of Intelligent Service Terminal for City Bus and Trolley-Bus Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center
What type is the standard? Semantics/message/abstract/implementation?	Data format, data frame, message frame, public transport information gathering/ publishing/ exchanging between intelligent service terminal and expansion of peripheral as well as control centre.
What is the scope of the standard?	Data Bus Interface Communication Specification of Intelligent Service Terminal for City Bus and Trolley-Bus defines the system construction, interface specification between intelligent service terminal and expansion of peripheral for city bus and trolley-Bus. Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center defines the communication protocol, communication connection, message handling, data format, information gathering/ publishing/ exchanging between intelligent service terminal on the city/trolley-Bus and control centre.
What year was the standard published?	Data Bus Interface Communication Specification of Intelligent Service Terminal for City Bus and Trolley-Bus: cd Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center: 2012/11/05
Has the standard been implemented?	Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center: implemented since 2013/04/01 Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center: will be implemented in 37 transit cities this year.
Who published the standard?	Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center: implemented since 2013/04/01 Data Communication Protocol between Intelligent Service Terminal for City Bus and Trolley-Bus and Control Center: will be implemented in 37 transit cities this year.
What was the methodology used to develop the standard?	Defining the public transport information communication and interface specification between intelligent service terminal and expansion of peripheral as well as control centre for city bus and trolley-Bus.
Please list a short history of the development process:	Proposed in February 2013, started on November 2013, form the draft in 2014 and now collecting advices.

China	
Please describe the ongoing maintenance:	Collect advice from the industry to update the standard.

Japan	
What is the standard name?	Standards for Public Transport Information
What type is the standard? Semantics/message/abstract/implementation?	Data format for gathering/publishing/exchanging public transport information
What is the scope of the standard?	Defining the elements and attributes of data format for gathering/publishing/exchanging public transport information
What year was the standard published?	XML1.1ver. 2006
Has the standard been implemented?	Approx. 150 high way bus operators have adopted since 2006
Who published the standard?	Ministry of Land, Infrastructure and Transport
What was the methodology used to develop the standard?	Defining the elements and attributes of data format for static and real-time public transport information
Please list a short history of the development process:	Start study data format in 1997 First field trials to provide bus static information in Yokohama (1997) and Okinawa (2000) Field trials to provide static and real-time information in Sapporo (2000), Gifu/Hiroshima (2002), Nagoya (2004), Kyoto (2005) and Fukuoka/Ooita (2006) Large scale field trials have been carried out in 150 high way bus operators since 2006
Please describe the ongoing maintenance:	Reviewing field trial results and planning for improvements of data format

Korea	
What is the standard name?	Technical Regulation of Bus Information Exchanges (C2C)
What type is the standard? Semantics/message/abstract/implementation?	Messages for exchanging between bus information centers
What is the scope of the standard?	Defining the messages and protocols of information for exchanging bus manage centers (local governments)
What year was the standard published?	“Enacted by MLTM in November 2005
Has the standard been implemented?	Revised in March 2010”
Who published the standard?	Yes. Approx. 60 bus operators have adopted since 2004
What was the methodology used to develop the standard?	Ministry of Land, Transport and Maritime Affairs
Please list a short history of the development process:	Consensus
Please describe the ongoing maintenance:	“MLTM & standardization organization have been studied interfaces and data format since 2000.

US – Transit Communications Interface Profiles	
What is the standard name?	APTA TCIP-S-001 3.0.0, APTA Standard for Transit Communications Interface Profiles
What type is the standard? Semantics/message/abstract/implementation?	Semantics and Message
What is the scope of the standard?	
What year was the standard published?	2006
Has the standard been implemented?	
Who published the standard?	American Public Transportation Association
What was the methodology used to develop the standard?	Consensus
Please list a short history of the development process:	Initially developed by NTCIP (1400 Series), Later replaced by APTA version which incorporated additional material.

US – Transit Communications Interface Profiles	
Please describe the ongoing maintenance:	

NEPTUNE –AFNOR French Ticketing Codification	
What is the standard name?	Profil d'echange NEPTUNE – AFNOR French Ticketing Codification reference NF P 99–506
What type is the standard? Semantics/message/abstract/implementation?	data and message format linked to a data model (Transmodel 4.1 and IFOPT)
What is the scope of the standard?	This data exchange profile has the objective to describe precisely all the data elements necessary for a thorough description of the public transport offer (space and time-related data) in order to be able to present this information to the users in a homogeneous way, independently from the media (internet, paper) and also to exchange this information between multimodal information systems.
What year was the standard published?	2009
Has the standard been implemented?	yes, around 50 (reference implementation together with the software CHOUETTE www.chouette.mobi)
Who published the standard?	AFNOR
What was the methodology used to develop the standard?	standard based on an UML data model and XSD/XML for the data exchange structure and protocol
Please list a short history of the development process:	This standard is based on the European specification TRIDENT (2002), based on Transmodel V4.1. The current version incorporates several features of the IFOPT standard (EN 28701) such as equipment, accessibility and stop typology.
Please describe the ongoing maintenance:	maintenance in ensured by the working group in charge of this particular topic (gt7 of AFNOR CN03)

Service Interface for Realtime Information (SIRI CEN)	
What is the standard name?	Service Interface for Realtime Information (SIRI) EN 15531–1 — Business case EN 15531–2 — Communication EN 15531–3 — Services TS 15531–4 - Facility monitoring service TS 15531–5 - Situation exchange service
What type is the standard? Semantics/message/abstract/implementation?	Data and message format linked to a data model (Transmodel 5.1)
What is the scope of the standard?	SIRI is an exchange format for real-time information about PT services, vehicles, events and facilities. SIRI defines very broadly the concept of real time as being any changes to the information introduced after the timetable publication (SIRI's information scope being limited to one single day). The most widely known SIRI service provides the estimated passing time at a specific stop (Stop Monitoring Service. But SIRI offers many other services: General Messaging Service, Vehicle Monitoring Service, Situation Exchange, Facility Monitoring, Production Timetable Service, Estimated Timetable Service, Stop Timetable Service, Connection Timetable Service and Connection Monitoring Service.
What year was the standard published?	2006
Has the standard been implemented?	Yes, all over Europe, and also worldwide (US, Israel...)
Who published the standard?	CEN TC278/WG3/SG7
What was the methodology used to develop the standard?	Conceptual model relying on Transmodel. SIRI offers a set of Web services (SOAP) for accessing the information. Initially targeted exchanges are mainly inter-system communication (AVMS to passenger information system for example), and SIRI 2 (2014) has completed it with the ability to communicate with end user's devices (mainly mobile phones and web browsers).