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Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2)

Part 2: UML modelling rules

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National foreword

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2014-09-15

Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) —

Part 2: UML modelling rules

Systèmes intelligents de transport — Informations sur le trafic et le tourisme via le groupe expert du protocole de transport, génération 2 (TPEG2) —

Partie 2: Règles de modelage UML

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Foreword

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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 (see 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*, in cooperation with the Traveller Information Services Association (TISA), TPEG Applications Working Group through Category A Liasion status.

ISO/TS 21219 consists of the following parts, under the general title *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol expert group, generation 2 (TPEG2)*:

— *Part 2: UML modelling rules* [Technical Specification]

— *Part 3: UML to binary conversion rules* [Technical Specification]

— *Part 4: UML to XML conversion rules* [Technical Specification]

— *Part 5: Service framework* [Technical Specification]

— *Part 6: Message management container* [Technical Specification]

— *Part 7: Location referencing container* [Technical Specification]

— *Part 18: Traffic flow and prediction application* [Technical Specification]

The following parts are planned:

— *Part 1: Introduction, numbering and version* [Technical Specification]

— *Part 9: Service and network information* [Technical Specification]

— *Part 10: Conditional access information* [Technical Specification]

— *Part 14: Parking information application* [Technical Specification]

— *Part 15: Traffic event compact application* [Technical Specification]

— *Part 16: Fuel price information application* [Technical Specification]

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— *Part 19: Weather information for travellers application* [Technical Specification]

— *Part 20: Extended TMC locations for applications* [Technical Specification]

— *Part 21: Geographic location referencing* [Technical Specification]

— Part 22: *OpenLR·location·reference* [Technical Specification]

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Introduction

History

TPEG technology was originally proposed by the European Broadcasting Union (EBU) Broadcast Management Committee, who established the B/TPEG project group in the autumn of 1997 with a brief to develop, as soon as possible, a new protocol for broadcasting traffic and travel-related information in the multimedia environment. TPEG technology, its applications and service features were designed to enable travel-related messages to be coded, decoded, filtered and understood by humans (visually and/or audibly in the user's language) and by agent systems. Originally a byte-oriented data stream format, which may be carried on almost any digital bearer with an appropriate adaptation layer, was developed. Hierarchically structured TPEG messages from service providers to end-users were designed to transfer information from the service provider database to an end-user's equipment.

One year later in December 1998, the B/TPEG group produced its first EBU specifications. Two documents were released. Part 2 (TPEG-SSF, which became ISO/TS 18234-2) described the Syntax, Semantics and Framing structure, which was used for all TPEG applications. Meanwhile Part 4 (TPEG-RTM, which became ISO/TS 18234-4) described the first application, for Road Traffic Messages.

Subsequently in March 1999, CEN TC 278/WG 4, in conjunction with ISO/TC 204/WG 10, established a project group comprising members of the former EBU B/TPEG and they continued the work concurrently. Further parts were developed to make the initial set of four parts, enabling the implementation of a consistent service. Part 3 (TPEG-SNI, ISO/TS 18234-3) described the Service and Network Information Application, used by all service implementations to ensure appropriate referencing from one service source to another.

Part 1 (TPEG-INV, ISO/TS 18234-1), completed the series, by describing the other parts and their relationship; it also contained the application IDs used within the other parts. Additionally, Part 5, the Public Transport Information Application (TPEG-PTI, ISO/TS 18234-5), was developed. The so-called TPEG-LOC location referencing method, which enabled both map-based TPEG-decoders and non map-based ones to deliver either map-based location referencing or human readable text information, was issued as ISO/TS 18234-6 to be used in association with the other applications parts of the ISO/TS 18234-series to provide location referencing.

The ISO/TS 18234-series has become known as TPEG Generation 1.

TPEG Generation 2

With the inauguration of the Traveller Information Services Association (TISA) in December 2007 derived from former Forums and the CEN/ISO development project group, the TPEG Applications Working Group took over development work for TPEG technology.

It was about this time that the (then) new Unified Modeling Language (UML) was seen as having major advantages for the development of new TPEG Applications in communities who would not necessarily have binary physical format skills required to extend the original TPEG TS work. It was also realised that the XML format for TPEG described within the ISO/TS 24530-series (now superseded) had a greater significance than previously foreseen; especially in the content-generation segment and that keeping two physical formats in synchronism, in different standards series, would be rather difficult.

As a result TISA set about the development of a new TPEG structure that would be UML based – this has subsequently become known as TPEG Generation 2.

TPEG2 is embodied in the ISO/TS 21219-series and it comprises many parts that cover introduction, rules, toolkit and application components. TPEG2 is built around UML modelling and has a core of rules that contain the modelling strategy covered in Parts 2, 3, 4 and the conversion to two current physical formats: binary and XML; others could be added in the future. TISA uses an automated tool to convert from the agreed UML model XMI file directly into an MS Word document file, to minimise drafting errors, that forms the Annex for each physical format.

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TPEG2 has a three container conceptual structure: Message Management (Part 6), Application (many Parts) and Location Referencing (Part 7). This structure has flexible capability and can accommodate many differing use cases that have been proposed within the TTI sector and wider for hierarchical message content.

Toolkit parts: TPEG2-INV (Part 1), TPEG2-UML (Part 2), TPEG2-UBCR (Part 3), TPEG2-UXCR (Part 4), TPEG2-SFW (Part 5), TPEG2-MMC (Part 6), TPEG2-LRC (Part 7)

Special applications: TPEG2-SNI (Part 9), TPEG2-CAI (Part 10)

Location referencing: TPEG2-ULR (Part 11), TPEG2-ETL (Part 20), TPEG2-GLR (Part 21), TPEG2-OLR (Part 22)

Applications: TPEG2-PKI (Part 14), TPEG2-TEC (Part 15), TPEG2-FPI (Part 16), TPEG2-TFP (Part 18), TPEG2-WEA (Part 19), TPEG2-RMR (Part 23)

TPEG2 also has many location referencing options as required by the service provider community, any of which may be delivered by vectoring data included in the Location Referencing Container.

TPEG2 has been developed to be broadly (but not totally) backward compatible with TPEG1 to assist in transitions from earlier implementations, whilst not hindering the TPEG2 innovative approach and being able to support many new features, such as dealing with applications having both long-term, unchanging content and highly dynamic content, such as Parking Information.

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Part 2:
UML modelling rules

1 Scope

This Technical Specification specifies rules for the creation and extending of TPEG application UML models. The rules are intended to ensure that TPEG application UML models can be interpreted unambiguously for conversion to physical format representations. TPEG application UML models that are defined according to these rules may be used for automatic generation of TPEG standards and for automatic generation of TPEG application physical format descriptions.

This Technical Specification also specifies the preferred structure of TPEG application specifications.

The TPEG abstract data types and the set of TPEG tables of common use are specified in the annexes.

2 Terms, definitions and abbreviated terms

2.1 Terms and definitions

2.1.1
abstract data type
data type of atomic nature

2.1.2
attribute compartment
graphical section of a UML class box positioned directly under the class name compartment

2.1.3
class name compartment
top most graphical section of a class box defining the name of the class and optionally a stereotype, inherited class and package scope

2.1.4
data structure
data type being composed of other data types being either of abstract or complex data type, not having a component header, stereotyped as <<DataStructure>>

2.1.5
component
revisable, named, complex data type, not stereotyped as <<DataStructure>>

2.1.6
component header
data structure consisting of a component identifier, component length indicator and attribute length indicator

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2.1.7
element
component or data structure

2.1.8
link
relation between two or more elements

2.1.9
TPEG Application
set of classes and rules defining TPEG information services at the highest layer of the ISO OSI model

2.2 Abbreviated terms

IPR	Intellectual Property Right(s)
ISO	International Organization for Standardization
LRC	Location Referencing Container
MMC	Message Management Container
OSI	Open Systems Interconnection
PTI	PTI Public Transport Information
TISA	Traveller Information Services Association
TPEG	Transport Protocol Experts Group
UML	Unified Modelling Language

3 TPEG UML model definition

3.1 Allowed UML elements

TPEG UML models are based on the UML standard[1], but only use a subset of the elements defined in the standard. This clause provides a description of the elements of UML that are used for modelling TPEG. This clause also defines restrictions on these elements. TPEG UML models shall only use the UML elements described in this clause. The defined restrictions shall be obeyed.

3.1.1 Class

A class provides a description of the structure of the data stored in an instance of a class. The data are stored in the class attributes.

3.1.2 Abstract class

Abstract classes may be used to define shared properties of specialized child classes.

3.1.3 Attribute

An attribute provides a data type description of data that is stored in a class. Attributes can be either of primitive data type or compound data type. Within a class, an attribute has a multiplicity. If not explicitly indicated, the multiplicity is one. Other multiplicities may be indicated between square brackets: [minOccurs .. maxOccurs].

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Attribute multiplicity shall be interpreted as listed in Table 1. If no multiplicity is indicated, a multiplicity of *one* (mandatory attribute) is implied.

Table 1 — TPEG multiplicity

Multiplicity	TPEG meaning
1	mandatory attribute
1..n	mandatory list of attributes
0..1	optional attribute
0..n	optional list of attributes

Attributes in classes are always modelled as public. Each attribute must have a data type. Attributes occur in the order as listed in the class definition in TPEG physical formats, unless this is overruled by the stereotype <<UnorderedComponentGroup>> .

3.1.4 Dependency

Graphical representation used for ordered components (attributes stereotyped as <<OrderedComponentGroup>>) and DataStructures to show the hierarchical structure of the UML model.

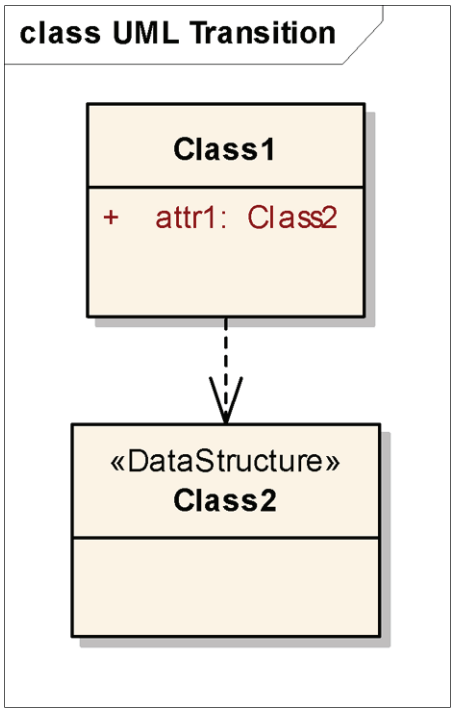

Figure 1 — UML dependency relation

3.1.5 Aggregation

An aggregation is an association representing a part-whole relationship. The containing object may have objects of the contained class, but the contained class is not life cycle dependent of the containing class. Classes included by aggregation may occur in random order in TPEG physical formats.

NOTE Using aggregations in TPEG UML Models is deprecated. Instead of using aggregations, the aggregated class should be included as attribute. The attribute can then either be stereotyped as <<OrderedComponentGroup>> or <<UnorderedComponentGroup>> (see 3.1.8 for details).

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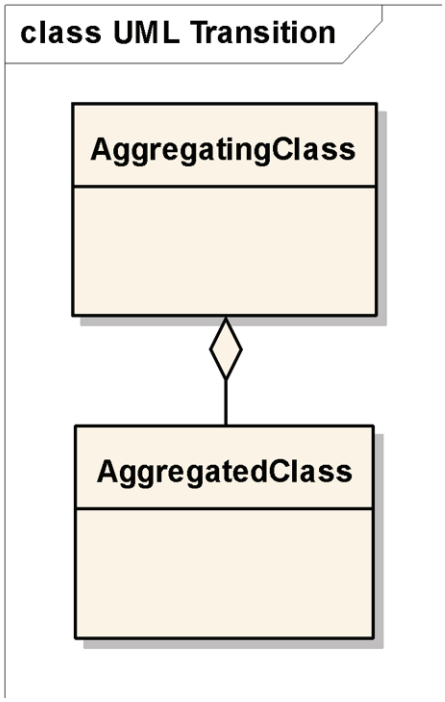

Figure 2 — UML aggregation relation

3.1.6 Composition

A composition is a stronger variant of the aggregation association. The contained object can only exist within the container class. Classes included by composition may occur in random order in TPEG physical formats.

NOTE Using compositions in TPEG UML Models is deprecated. Instead of using compositions, the composed class should be included as attribute. The attribute can then either be stereotyped as <<OrderedComponentGroup>> or <<UnorderedComponentGroup>> (see 3.1.8 for details).

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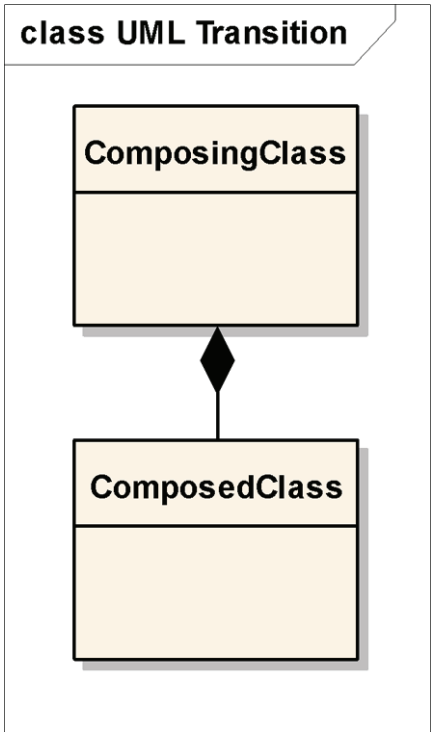

Figure 3 — UML composition relation

3.1.7 Specialization

A specialization relates a parent class to a child class. The child class inherits properties from the parent class. Classes shall not inherit from multiple parent classes. Classes shall only inherit from classes with the same stereotype.

Derived classes copy all attributes from the parent class. Parent classes shall contain no aggregations or classes not stereotyped as <<DataStructure>> . Parent classes shall be modelled as abstract class. In future versions of a standard, parent classes shall not be extended. Classes shall not be both parent and child class.

NOTE Extending parent classes in future versions of a standard breaks backwards compatibility.

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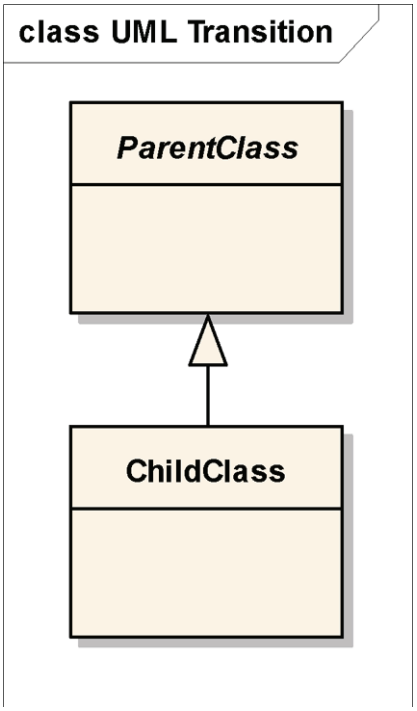

Figure 4 — UML specialization relation

3.1.8 Stereotype

A stereotype is used to provide an additional classification of UML properties. A physical format specification may use stereotype information to select a rule set for converting UML to the physical format.

The stereotypes as listed in Table 2 may be used for UML modelling of TPEG applications. Other stereotypes shall not be used.

Table 2 — TPEG stereotypes

UML element	Stereotype	TPEG meaning
Package	TPEG Application	self standing protocol specification for a given application
Package	TPEG Toolkit	specification of general interest being referenced by different other specifications
Package	TPEG DataTypes	specification defining data structures and tables belonging to one single package
Class	DataStructure	TPEG data structure
Class	Enumeration	list of defined, constant expressions not containing attributes or sub data elements
Class	External	TPEG Component defined in an external document
Attribute	OrderedComponentGroup	Attribute is of component type, and belongs to the group of components occurring in the order as defined by the attribute order
Attribute	UnorderedComponentGroup	Attribute is of component type, and belongs to the group of components that may occur in random order, after all other attributes.

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3.1.9 Tagged values

Tagged values may be used to provide additional information on a UML element, used for the creation of the specification document.

Only the tagged values listed in Table 3 shall be used.

Table 3 — Allowed tagged values

Tag	TPEG meaning	Example
ApplicationAbbreviation	Abbreviation of the application name	TEC
ApplicationName	Name of the application	Traffic Event Compact
ApplicationRoot	Root class of an application	TECMessage
TableEntryExample	Comment for a table entry	
Documentation	Description of generic properties of a class	
Description	Description of single attributes within a class	

In UML packages that are stereotyped as <<TPEG Application>> , the ApplicationAbbreviation, ApplicationName and ApplicationRoot tagged values are mandatory.

3.1.10 Notes

Notes may be used to provide additional information that is used for generating the specification document.

3.2 Modelling rules and recommendations

TPEG UML models are used to generate TPEG specifications. A fundamental assumption is that applications will develop and new features will be added. Correct designs permit applications to be upgraded and extended over time, providing new features to new decoders, and yet permit existing decoders to continue to operate. This clause describes design principles that shall be obeyed when building and upgrading TPEG applications.

3.2.1 Order of elements

In a physical format, attributes shall occur in the same order as listed in the UML class definition.

When components may occur in any order (independent of the order in which they are listed in the UML class definition), they should be modelled as attributes with the stereotype <<UnorderedComponentGroup>> and of the type of the corresponding class. The unordered components shall be linked by the embedding class using a dependency relation.

When components shall occur in a specific order, they shall be modelled as attributes with the stereotype <<OrderedComponentGroup>> and of the type of the corresponding class. The ordered components shall be linked by the embedding class using a dependency relation.

Mandatory attributes should occur *before* optional attributes. Mandatory Booleans should occur *after* the other mandatory attributes. Optional attributes should occur *after* mandatory attributes. Components shall occur *after* all other attributes. Ordered components shall occur *before* unordered components.

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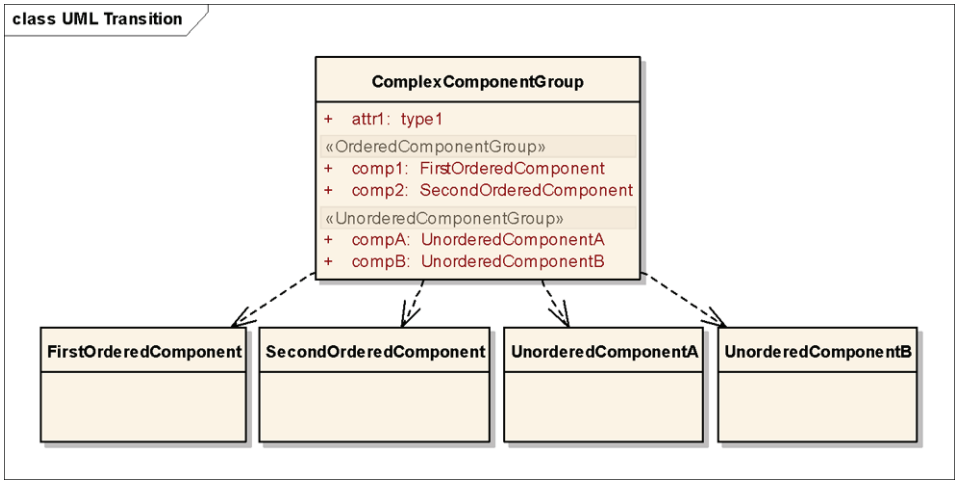

Figure 5 — Ordering of class elements

NOTE Special rules for extending TPEG UML models for newer revisions of a standard are provided in 3.3. Extending TPEG UML models in a backwards compatible way may break the recommendations for ordering mandatory and optional elements described in 3.2.1.

3.2.2 Stereotypes

3.2.2.1 TPEG Application

The <<TPEG Application>> stereotype is used to identify a UML package as TPEG Application.

3.2.2.2 TPEG Toolkit

TPEG Toolkits are used to share common functionality between different TPEG Applications. For example the Location Referencing Container and Message Management Container are toolkits that are used by all TPEG applications. A TPEG Application therefore can refer to a data type definition not specified in the same model.

TPEG Toolkits are designed such that its root components are defined as templates which can be used as external reference within other packages. A TPEG Application using a toolkit template therefore needs to specify a unique interface class for this instantiation of the imported toolkit interface's component.

All subsequent components in a toolkit are defined as out of the scope of the TPEG application, i.e. the toolkit on its own defines subcomponents beginning with local identifiers.

The <<TPEG Toolkit>> stereotype is applied at UML package level.

3.2.2.3 TPEG DataTypes

General TPEG datatypes and TPEG Application specific datatypes are defined in separate UML packages. This only applies for elementary data types and classes that are stereotyped as <<DataStructure>> .

The <<TPEG DataTypes>> stereotype is applied at UML package level.

3.2.2.4 DataStructure

The TPEG binary format distinguishes between *components* and *datastructures*. In this physical representation, a componenent is a compound data type, containing a header, providing type and length information. The type information of a component shall be unique within an application. A datastructure is a compound datatype not containing this type and length information.

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