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

Part 4: UML to XML conversion rules

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National foreword

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

Part 4: UML to XML conversion rules

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

Partie 4: Règles de conversion d'UML en XML

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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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and TISA shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 Liaison status.

ISO/TS 21219 consists of the following parts, under the general title *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts 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 versions* [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 application* [Technical Specification]

— *Part 20: Extended TMC location referencing* [Technical Specification]

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

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

— Part 23: *Roads·and·multi-modal·routes·application* [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 Modelling 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 realized 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 minimize 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.

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. The following classification provides a helpful grouping of the different TPEG2 parts according to their intended purpose:

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 has been developed to be broadly (but not totally) backward compatible with TPEG1 to assist in transitions from earlier implementations, while 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.

This Technical Specification is based on the TISA specification technical/editorial version number: TPEG2-UXCR/2.0/001.

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Part 4: UML to XML conversion rules

1 Scope

This Technical Specification specifies the rules for converting TPEG application UML models to the tpegML format description. It contains the XML format definition of the abstract data types defined in TISA Specification SP09003. Rules for converting compound data types are also defined.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8601:2004, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO/TS 21219-2, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 2: UML modelling rules*

ISO/TS 21219-5, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 5: Service framework (TPEG2-SWF)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

The terms and definitions in ISO/TS 21219-2 and the following apply.

3.1.1
Specification Identification
string that uniquely identifies a certain version of a certain TPEG application or toolkit

EXAMPLE The TPEG Traffic Event Compact application, version 2.0 is identified by the Specification Identification string “TEC_2_0”.

3.1.2
Specification Name
string that verbosely describes a certain TPEG application or toolkit

EXAMPLE The TPEG Traffic Event Compact application, “TrafficEventCompact”.

3.1.3
application namespace prefix
string of the lower case application/toolkit abbreviation as defined in the UML tagged value “ApplicationAbbreviation”

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3.2 Abbreviated terms

The abbreviated terms in ISO/TS 21219-2 and the following apply.

XML eXtensible Markup Language

XSD XML Schema Definition

UML Unified Modelling Language

app a placeholder for an application namespace prefix to create examples in this Technical Specification. It is replaced by the lowercase application abbreviation of the relevant TPEG application.

4 Rules for UML to XML format description conversion

NOTE In the course of ISO processing, XML-compliant quotation marks are replaced with non-compliant quotation marks. When taking over material from these sections, be advised to substitute any double quote to the XML-compliant equivalent quotation mark (Unicode U +0022).

4.1 Definition of XML format description

The xml format description of TPEG applications is included in application and toolkit specifications as a normative annex. This annex shall be named according to the following scheme:

[Specification Identification], tpegML representation

The annex shall have two subclauses: Introduction and Application data type definition. The content of these subclauses is subject to the specifications in this clause.

The introduction shall use a similar formulation as in the following:

> This chapter defines the tpegML format representation of the *[specification or toolkit name]* message components, datastructures and its attributes. For further descriptions of these objects see the related clauses [reference to clauses] in this Technical Specification.

The application data type definition shall follow the rules that are specified in 4.10.

4.2 The tpegML schema definition

The xml format of TPEG applications will be described according to „XML Schema Definition".

Each tpegML schema shall contain at least the following definitions:

— Default namespace shall be set to the tpegML schema itself;

— Target namespace shall be set to the tpegML schema itself;

— The XSD elements shall be qualified;

— The *elementFormDefault* should be set to "*qualified*";

— The *attributesFormDefault* should be set to "*qualified*";

— The prefix and namespace of service framework tpegML schema shall be declared and imported (see TISA Specification SP10007).

The path to the tpegML schema shall have following syntax:

"http://www.tisa.org/TPEG/[SpecificationIdentification]"

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with

[Specification Identification] = [upper case Application or Toolkit abbreviation]_[Major version number]_[Minor version number]

The *schemaLocation* of all imported schemas must be changed to local path for the validating process.

Accordingly, the resulting start tag of tpegML schema shall be:

```
<xs:schema xmlns="http://www.tisa.org/TPEG/[Specification Identification]"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.tisa.org/TPEG/[Specification Identification]"
  xmlns:sfw="http://www.tisa.org/TPEG/ServiceFramework_0_0"
  elementFormDefault="qualified"
  attributeFormDefault="qualified">
  <xs:import namespace="http://www.tisa.org/TPEG/ServiceFramework_0_0"
    schemaLocation="http://www.tisa.org/TPEG/ServiceFramework_0_0.xsd" />
  …
</xs:schema>
```

4.3 The tpegML xml file definition

For the xml file defined by the tpegML schema definition in 4.2, the following shall apply:

— No default name space shall be used. All elements and attributes shall have namespace prefixes. This enhances readability and prevents attribute naming problems with imported xsds.

— The name space of the applications and toolkits should be defined by using the application namespace prefix.

— The document encoding shall be "UTF-8".

Accordingly, the xml document will look similar to this example ("app" and "APP" used as placeholders):

```
<?xml version="1.0" encoding="UTF-8"?>
<app:applicationRootElement
  xmlns:app="http://www.tisa.org/TPEG/APP_0_0"
  xmlsns:mmc="http://www.tisa.org/TPEG/MMC_0_0"
  xmlsns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes0_0"
  xmlsns:sfw="http://www.tisa.org/TPEG/ServiceFramework_0_0"
…
</app:applicationRootElement>
```

The xml files defined by this Technical Specification can hold one application message only (UML class tagged as "ApplicationRoot"). To encode several TPEG application messages, an xml framing has to be applied, for example as defined in TISA Specification SP10007.

4.4 XML data type ranges

XML data type	Range
xs:byte	–128 .. 127
xs:short	–32768 .. 32767
xs:int	–2147483648 .. 2147483647
xs:integer	-infinite .. infinite
xs:unsignedByte	0 .. 255
xs:unsignedShort	0 .. 655535
xs:unsignedInt	0 .. 4294967295
xs:float	m * 2^e, where –2^24<m<=2^24 and –149<e<=104

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4.5 Abstract data types

The UML attributes of abstract data types shall be converted to the XSD local elements using the "TPEG Data Types" schema [see Annex A]. The "TPEG Data Type" schema contains the XSD definition for all TPEG abstract data types. To use "TPEG Data Types" schema, the <xs:schema/> tag shall contain the definition for the namespace http://www.tisa.org/TPEG/TPEGDataTypes_[MajorVersion]_[MinorVersion], where the version numbers are the release versions of the specification as released by TISA. Additionally, the schema shall be imported by adding the <xs:import/> element (see XSD example). The definition of the "schemaLocation" attribute within the <xs:import /> element can differ from the defined namespace URI but it must contain the valid URI where the "TPEG Data Type" schema is to be found.

To achieve a common appearance of all tpegML schemas it is recommended to use "tdt" prefix for the "TPEG Data Types" namespace.

When using an UML attribute of abstract data type, the tpegML schema shall contain the following definition:

```
<xs:element name="UMLAttributeName" type="tdt:AbstractDataType"/>
```

where *UMLAttributeName* is the name of the attribute as defined in UML, *tdt* is the prefix of the "TPEG Data Types" namespace and *AbstractDataType* is one of the abstract data types defined in TISA Specification SP09003.

The syntax of abstract data types in tpegML format is described in Annex A.

XSD example:

```
<xs:schema xmlns="http://www.tisa.org/TPEG/[Specification Identification]"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.tisa.org/TPEG/[Specification Identification]"
  xmlns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes_0_0"
  elementFormDefault="qualified"
  attributeFormDefault="qualified">
<xs:import namespace="http://www.tisa.org/TPEG/TPEGDataTypes_0_0"
  schemaLocation="http://www.tisa.org/TPEG/TPEGDataTypes_0_0.xsd"/>
<xs:complexType name="class1">
  <xs:sequence>
    <xs:element name="attr1" type="tdt:FixedPercentage"/>
    <xs:element name="attr2" type="tdt:Boolean"/>
  </xs:sequence>
  </xs:complexType>
</xs:schema>
```

XML example:

```
<?xml version="1.0"?>
<app:class1 xmlns:app="http://www.tisa.org/TPEG/[Specification Identification]">
  <app:attr1>3</app:attr1>
  <app:attr2>true</app:attr2>
</app:class1>
```

4.6 TPEG standard tables

The UML attributes of the TPEG standard table type shall be converted similar to abstract data types. The "TPEG Data Types" schema contains definition for all TPEG standard tables.

The syntax of abstract data types is described in Annex A.

XSD example:

```
<xs:schema xmlns="http://www.tisa.org/TPEG/[Specification Identification]"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    targetNamespace="http://www.tisa.org/TPEG/[Specification Identification]"
    xmlns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes_0_0"
    elementFormDefault="qualified"
    attributeFormDefault="qualified">
<xs:complexType name="class1">
  <xs:sequence>
    <xs:element name="attr1" type="tdt:typ001_LanguageCode"/>
```


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```
    <xs:element name="attr2" type="tdt:typ002_SpecialDay"/>
  </xs:sequence>
  </xs:complexType>
</xs:schema>
```

XML example:

```
<?xml version="1.0"?>
<app:class1 xmlns:app="http://www.tisa.org/TPEG/[Specification Identification]"
    xmlns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes_0_0">
  <app:attr1 tdt:table="typ001_LanguageCode" tdt:code="33" />
  <app:attr2 tdt:table="typ002_SpecialDay" tdt:code="2" />
</app:class1>
```

4.7 Application tables (stereotype <<enumeration>>)

The UML class with stereotype <<enumeration>> shall be converted to the XSD with the same syntax as TPEG standard tables. The colon in the class name shall be replaced by an underscore "_". The value of the attribute "table" shall always contain this class name as fixed value.

To use a UML attribute of the application table type, the XSD shall contain the following complex type.

XSD example:

```
<xs:complexType name="xxxyyy_applicationTableName">
  <xs:attribute name="table" type="xs:string" fixed="xxxyyy_applicationTableName"
use="required"/>
  <xs:attribute name="code" use="required">
    <xs:simpleType>
      <xs:restriction base="xs:unsignedByte">
        <!-- here the restrictions can be defined-->
      </xs:restriction>
    </xs:simpleType>
  </xs:attribute>
</xs:complexType>
```

where *applicationTableName* is the name of the application table, xxxyyy is the application table prefix [1], and *code* is an integer value up to 255

Accordingly the UML attribute of this type shall be:

```
<xs:element name="UMLAttributeName" type="xxxyyy_applicationTableName">
```

4.8 Switching tables

Each child table of a switching table group shall be converted to the XSD according to rule 4.7. The abstract parent class of a switching table group will be defined as standard application table with following conditions:

— The "table" attribute shall be defined as enumeration of all child table names;

— The "code" attribute shall not have any restrictions and shall always be set to "xs:unsignedByte" type.

The XSD example of the abstract blank class for a switching table group:

```
<xs:complexType name="SubTableType">
  <xs:attribute name="table" use="required">
    <xs:simpleType>
      <xs:restriction base="xs:string">
        <xs:enumeration value="xyz101_SubTableType1"/>
        <xs:enumeration value="xyz102_SubTableType2"/>
        …
        <xs:enumeration value="xyz10N_SubTableTypeN"/>
      </xs:restriction>
    </xs:simpleType>
  </xs:attribute>
  <xs:attribute name="code" type="xs:unsignedByte" use="required"/>
</xs:complexType>
```

The XSD example for usage of a switching table type linked to a main table:

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```
<xs:complexType name="someClass">
…
  <xs:element name="mainTable" type="xyz100_TableType"/>
  <xs:element name="switchedTable" type="SubTableType"/>
…
</xs:complexType>
```

XML example for usage of a switching table depending on the set main table value:

```
<someClass>
  <mainTable table="xyz100_MainTableType" code="1" />
  <switchedTable table=" xyz101_SubTableType1" code="100" />
</someClass>
…
<someClass>
  <mainTable table="xyz100_MainTableType" code="2" />
  <switchedTable table="xyz101_SubTableType2" code="20" />
</someClass>
```

There is no formal specification of the lookup value in the main table and the related switching table to choose. The default relation is supposed to be 1 to 1. The special relation shall be defined in application or toolkit specification.

If the restriction of the switching table "code" attribute is checked, the defined table for selected switching table name shall be used.

4.9 Stereotype <<external>>

The class with the stereotype <<external>> defines a type which is defined in an external specification. To use the <<external>> type, the external specification shall provide either XML schema definition or binary representation of this type. This rule defines usage of <<external>> type for the following external specifications:

— TISA TPEG application specification containing the <<external>> type;

— Non-TISA specification containing XML schema definition for the <<external>> type;

— Non-TISA specification containing only binary definition for the <<external>> type.

4.9.1 TPEG application <<external>> type

To use a class with the stereotype <<external>> defined in a TISA TPEG application specification, the prefix and the namespace of the <<external>> TISA TPEG application shall be defined and imported. The prefix will be used then to qualify the <<external>> type. The prefix shall be set to the value defined by the "tpegMLprefix" class tagged value. The namespace URI shall be set to the value defined by the "tpegMLuri" class tagged value.

Additionally, the XML schema defined by the namespace shall be imported by adding the <xs:import/> element (see XSD example). The definition of the "schemaLocation" attribute within the <xs:import/> element can differ from the defined namespace URI but it shall contain the valid URI where the <<external>> TPEG application XML schema is to be found.

The local element from <<external>> type shall be defined with type name set to class name from which the class stereotyped as <<external>> is derived. The name of class stereotyped as <<external>> is a placeholder only for the name of the class defined in a TPEG application specification.

Abstract classes may neither be imported nor used via this method. Instead each child class type needs to be imported.

XSD example:

```
<xs:schema xmlns="http://www.tisa.org/TPEG/[Specification Identification]"
      xmlns:xs="http://www.w3.org/2001/XMLSchema"
      targetNamespace="http://www.tisa.org/TPEG/[Specification Identification]"
      xmlns:tdt="http://www.tisa.org/TPEG/TPEGDataTypes
      <!-- Here, the external namespace is included: -->
```


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