TECHNICAL SPECIFICATION

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

Part 3:
UML to binary 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 3: Règles de conversion d'UML à système binaire

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Contents

Page

Foreword

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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]

— *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]

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.

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-UBCR/1.1/001.

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

Part 3:
UML to binary conversion rules

1 Scope

This Technical Specification specifies the rules for converting TPEG application UML models to the TPEG binary format description. It contains the binary format definition of the abstract data types defined in ISO/TS 21219-2. 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/TS 18234-2:2013, *Intelligent transport systems — Traffic and travel information (TTI) via transport experts group, generation 1 (TPEG1) binary data format — Part 2: Syntax, semantics and framing structure (TPEG1-SSF)*

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*

ISO/IEC/IEEE 60559, *Information technology — Microprocessor Systems — Floating-Point arithmetic*

3 Abbreviated terms

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

LSB Least Significant Bit

MSB Most Significant Bit

4 Rules for UML to binary format description conversion

4.1 Definition of binary format description

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

[Full application name], TPEG-binary representation

The annex shall have four subclauses: *Introduction*, *Application framing and signalling*, *Application components* and *Application datastructures*. 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 application framing and the format of the *[Full application name]* message components, datastructures and its attributes for the TPEG binary representation of *[application abbreviation]* as described in *[reference to TPEG framework]*. For further descriptions of these objects see the related clauses *[reference to clauses]* in this specification.

The Application framing and signalling subclause shall have three parts: Application identification, Version number signalling, and Application framing. The Application identification part shall define the Application Identifier (AID) that is used for the application. The Version number signalling shall define the major and minor version number of the application that are signalled within the SNI application. The Application framing part shall state in what kind of service component the application shall be transmitted. TPEG Service Component (SC) types are defined in ISO/TS 21219-5. Currently, the following Service Component types are defined:

— *ServCompFrame* – Standard SC

— *ServCompFrameProtected* –SC with data CRC

— *ServCompFrameCountedProtected* – SC with message count and data CRC

— *ServCompFramePrioritisedProtected* – SC with group priority and data CRC

— *ServCompFramePrioritisedCountedProtected* – SC with group priority, message count and data CRC

The wording shall be similar to the following:

> TPEG binary format messages of the *[Full application name]* type are transmitted in Service Component Frames of the *[Service Component Frame type]* type. Service Component Frames are described in *[reference to TPEG framework]*.

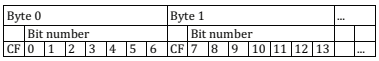
The *Application components* description shall have a first subclause with title *List of generic component IDs*. This clause contains unique component IDs for each application UML class that is not stereotyped as <<DataStructure>>. The component IDs should be ordered in the order of appearance in the model.

The list of generic component IDs subclause is followed by subclauses providing the binary format description of each application UML class that is not stereotyped as <<DataStructure>>. This binary format description shall follow the rules as specified in 4.5. The generic component ID of each component defined in the list of generic component IDs shall be inserted in the binary format description where the rules of 4.5 read 'gcid'.

The *Application datastructures* description shall provide the binary format description of each application UML class that is stereotyped as <<DataStructure>>. This binary format description shall follow the rules as specified in 4.5.

4.2 Abstract data types

This section presents the binary format definition of the abstract data types that are defined in the TPEG UML modelling rules document ISO/TS 21219-5.

Data type	Binary format definition
BitArray	**<BitArray>**:= m * **<byte>**[1..*]; : Byte containing bits. MSB signals following bytes Bit set (= 1) signals logical true Bit not set (= 0) or not present signals logical false The bits in a BitArray are encoded in a sequence of bytes, where the first bit of each byte (MSB) is a continuation flag (marked as CF in the figure below). If this bit is set (=1) there follows at least one more byte in this BitArray. The last byte always has the continuation flag not set (=0). A BitArray represents a list of Boolean values which is implemented in the same way as for all lists. The first byte holds bits numbered from zero to six in that order. The second byte holds bits numbered seven to 13, again in that order, and so on. The ordering is sequential from first bit (MSB) to last bit (LSB).  Byte 0 | Byte 1 | ... Bit number | Bit number CF 0 1 2 3 4 5 6 | CF 7 8 9 10 11 12 13 | ... **Figure 1 — Binary format coding of BitArray** NOTE: If all bits after a certain bit in a BitArray are not set, the remaining bytes containing only unset bits may be removed. The continuation flag of the new last byte is set to false. Decoders shall interpret undefined bits as logical value false. EXAMPLE: BitArray = 05 hex: Bit 4 and bit 6 are set, the BitArray consists of only one byte (continuation flag not set).
Boolean	The TPEG binary format knows three representations for Booleans. - Mandatory Booleans are stored in the selector of a class - Multiple mandatory Booleans are stored in **<MultipleBooleans>** - Single, optional Booleans are stored in a table of type typ008:OptionalBoolean as defined in ISO/TS 21219-2 The default value of a Boolean is *false*.
DataStructure	**<DataStructure>**:= : Name of data structure **<...>**, : Content of data structure ...;
DateTime	**<DateTime>**:= : Date and time **<IntUnLo>**; : Number of seconds since 1970–01–01T00:00:00 Universal Coordinated Time (UTC) NOTE The formula for date and time calculation is given in Annex D of ISO/TS 18234-2:2013.