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

Part 16: Fuel price information and availability (TPEG2-FPI)

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

Partie 16: Disponibilité et informations sur le prix du carburant (TPEG2-FPI)

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO 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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

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 1: *Introduction, numbering and versions* [Technical Specification]
- 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 9: *Service and network information* [Technical Specification]
- Part 10: *Conditional access information* [Technical Specification]
- Part 14: *Parking information* [Technical Specification]
- Part 15: *Traffic event compact* [Technical Specification]
- Part 16: *Fuel price information and availability application* [Technical Specification]
- Part 18: *Traffic flow and prediction application* [Technical Specification]
- Part 19: *Weather information* [Technical Specification]
- The following Parts are planned:
- Part 7: *Location referencing container* [Technical Specification]
- Part 11: *Universal location reference* [Technical Specification]

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

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

— Part 23: *Road and multimodal routes application* [Technical Specification]

— Part 24: *Light encryption* [Technical Specification]

— Part 25: *Electromobility information* [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, in conjunction with ISO/TC 204, established a group comprising members of the former EBU B/TPEG and this committee continued development work. 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

When the Traveller Information Services Association (TISA), derived from former Forums, was inaugurated in December 2007, TPEG development was taken over by TISA and continued in the TPEG Applications Working Group.

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 ISO/TS 21219-2, ISO/TS 21219-3, ISO/TS 21219-4 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.

TPEG2 has a three container conceptual structure: Message Management (ISO/TS 21219-6), Application (many Parts) and Location Referencing (ISO/TS 21219-7). 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 (ISO/TS 21219-1), TPEG2-UML (ISO/TS 21219-2), TPEG2-UBCR (ISO/TS 21219-3), TPEG2-UXCR (ISO/TS 21219-4), TPEG2-SFW (ISO/TS 21219-5), TPEG2-MMC (ISO/TS 21219-6), TPEG2-LRC (ISO/TS 21219-7);

— Special applications: TPEG2-SNI (ISO/TS 21219-9), TPEG2-CAI (ISO/TS 21219-10);

— Location referencing: TPEG2-ULR (ISO/TS 21219-11), TPEG2-GLR (ISO/TS 21219-21), TPEG2-OLR (ISO/TS 21219-22);

— Applications: TPEG2-PKI (ISO/TS 21219-14), TPEG2-TEC (ISO/TS 21219-15), TPEG2-FPI (ISO/TS 21219-16), TPEG2-TFP (ISO/TS 21219-18), TPEG2-WEA (ISO/TS 21219-19), TPEG2-RMR (ISO/TS 21219-23).

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.

This Technical Specification is based on the TISA specification technical/editorial version reference:

SP12009/2.0/002

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

Part 16:
Fuel price information and availability (TPEG2-FPI)

1 Scope

This Technical Specification specifies the TPEG application: Fuel price information and availability (FPI). The FPI application has been specifically designed to support information of fuel stations, their location, fuel types offered and fuel pricing and availability information.

The standardized delivery, via TPEG technology, of fuel price information has the following benefits to end users of a TPEG service:

a) cost savings to driver, through improved ease of access to price information;

b) improved ease of access to price information that may lead to significant cost savings for fleet operators;

c) environmental benefits from drivers not having to drive around to find the cheapest fuel prices;

d) safety improvements for highways authorities, as drivers are less likely to run out of fuel if they are well informed of local availability and prices;

e) as availability of new fuels become more common and more vehicles use them (e.g. biofuels, hydrogen, etc.), drivers will be better informed about availability of fuelling stations.

The TPEG application Fuel price information and availability, as add-on service component next to, for example, traffic information, is laid out to support large numbers of fuel stations and fuel prices with only modest bandwidth requirements.

When the objective is to inform electric vehicles on the location of charging stations and the availability of charging points, the TPEG application TPEG2-EMI (Electro Mobility Information) shall be chosen. TPEG2-FPI contains rudimentary support for electric charging stations. However, a TISA investigation revealed that a simple extension/differentiation of TPEG2-FPI would not be sufficient to address the evolving market needs of the electric vehicle market. Hence, a separate TPEG application was created to serve the information needs of Electric Vehicles and their operators: TPEG2-EMI.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17572-2, *Intelligent transport systems (ITS) — Location referencing for geographic databases — Part 2: Pre-coded location references (pre-coded profile)*

ISO/TS 18234-11, *Intelligent transport systems — Traffic and Travel Information (TTI) via transport protocol experts group, generation 1 (TPEG1) binary data format — Part 11: Location Referencing Container (TPEG1-LRC)*

ISO/TS 21219-1, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol expert group, generation 2 (TPEG2) — Part 1: Introduction, numbering and versions (TPEG2-INV)*

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

ISO/TS 21219-3, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol expert group, generation 2 (TPEG2) — Part 3: UML to binary conversion rules*

ISO/TS 21219-4, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol expert group, generation 2 (TPEG2) — Part 4: UML to XML conversion rules*

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

ISO/TS 21219-6, *Intelligent transport systems — Traffic and travel information via transport protocol expert group, generation 2 (TPEG2) — Part 6: Message management container (TPEG2-MMC)*

ISO/TS 21219-7, *Intelligent transport systems — Traffic and travel information via transport protocol expert group, generation 2 (TPEG2) — Part 7: Location referencing container (TPEG2-LRC)*

ISO/TS 21219-9, *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 9: Service and network information (TPEG2-SNI)*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
fuel station
facility which sells fuel and lubricants for motor vehicles

Note 1 to entry: The most common fuels sold are petrol (gasoline in U.S. and Canada) or diesel fuel. Alternate names in use for such a facility are gas station, fuelling station, filling station, service station, petrol station, garage, gasbar, petrol pump or petrol bunk.

4 Abbreviated terms

ACID	Application and Content Identifier
ADC	Application Data Container
CEN	Comité Européen de Normalisation
EBU	European Broadcasting Union
LRC	Location Reference Container
FPI	Fuel price information and availability
MMC	Message Management Container
POI	Point of Interest

SFW	TPEG Service Framework: Modelling and Conversion Rules
SNI	Service and Network Information
TFP	Traffic Flow and Prediction
TISA	Traveller Information Services Association
TMC	Traffic Message Channel
TPEG	Transport Protocol Expert Group
TTI	Traffic and Traveller Information
UML	Unified Modeling Language

5 Application specific constraints

5.1 Application identification

The word “application” is used in this Technical Specification to describe specific subsets of the TPEG structure. An application defines a limited vocabulary for certain type of messages, for example, parking information or road traffic information. Each TPEG application is assigned a unique number called the Application IDentification (AID). An AID is defined whenever a new application is developed and these are all listed in ISO/TS 21219-1.

The application identification number is used within the TPEG2-SNI application ISO/TS 21219-9 to indicate how to process TPEG content and facilitates the routing of information to the appropriate application decoder.

5.2 Version number signalling

Version numbering is used to track the separate versions of an application through its development and deployment. The differences between these versions may have an impact on client devices.

The version numbering principle is defined in ISO/TS 21219-1.

Table 1 shows the current version numbers for signalling FPI within the SNI application ISO/TS 21219-9.

Table 1 — Current version numbers for signalling of FPI

Major version number	2
Minor version number	0

5.3 Ordered Components

TPEG2-FPI requires a fixed order of TPEG components. The order for the FPI message component is shown in Figure 1; the first component shall be the *Message Management Container* (MMC). This shall be the only component if the message is a cancellation message. Otherwise, the MMC component shall be followed by one or more *Application Data Container* component(s) which includes the application-specific information.

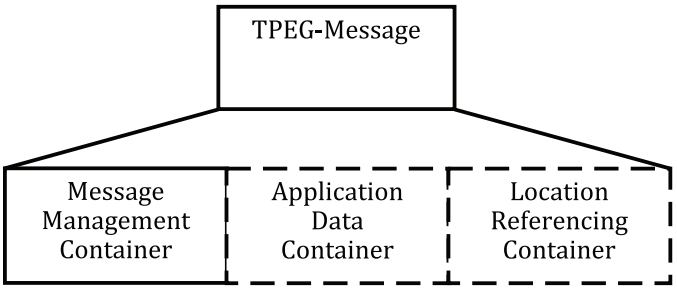

Figure 1 — Composition of TPEG messages

NB: The FPI design centres around the large commonality of information elements, notably for fuel types, (pricing structure: currency, resolution of price information; delivery units) and the relatively slow refresh rate of this information and the expected large volume of FPI information. To give an example of the expected volume, in the USA, approximately 200 000 fuel stations are in operation and, for example, in a radius of 50 km around New York City, one can find approximately 5 000 fuel stations. Consideration of these aspects has guided the design of FPI.

Consequently, the design of the application data container is such that it can contain information for multiple fuel stations at once. The top-level Location Referencing Container of an FPI message shall contain a "Geographic Coverage Area" to indicate the geographic region of interest of the message's content, for receiver geographic filtering purposes. The individual locations of fuel stations are contained in specialized versions of the Application Data Container, as geographic "markers" within this Geographic Coverage Location (see Clause 6 for details). This concept is similar as in TFP, where congested sections of a road are indicated with linear markers with respect to a top-level linear location.

5.4 Extension

The requirement of a fixed component order does not affect the extension of FPI. Future application extensions may insert new components or may replace existing components by new ones without losing backward compatibility. That means, an FPI decoder shall be able to detect and skip unknown components.

5.5 TPEG Service Component Frame

FPI makes use of the "Service Component Frame with dataCRC and messageCount" according to ISO/TS 21219-5.

6 FPI Structure

6.1 General

In this clause, the main structure of FPI and capabilities are defined.

The FPI design centres around the large commonality of information elements, notably for fuel types, pricing structure (currency, resolution of price information; delivery units), the relatively slow refresh rate of this information and the expected large volume of FPI information.

6.2 FPI Structuring concepts

6.2.1 Design

In FPI, for purposes of transmission efficiency, common elements of fuel information are factored out using standard Relational Database theory concepts (the so-called normal forms). Prominently, this is applied for fuel type and pricing structure information ("fuelingDefinitions" in this Technical

Specification). Furthermore, all information is transmitted as tables of information, each under control of a MMC component for validity and update management.

These concepts are described in the following subclauses.

6.2.2 Factoring out definitions

In general, an approach to factor out definitions is more efficient under the following conditions:

a) information is of a composite nature;

b) parts of the information are not the same worldwide (otherwise, a TPEG table would suffice) or more than 255 options exists or are likely to exist (the cardinality of a TPEG table is limited to 255 entries);

c) the amount of duplication in the transmission otherwise needed would significantly affect transmission efficiency.

For FPI, this applies to the fuel names, type and pricing and to fuel brands. Typically, for these data elements, a large number of combinations exist worldwide. Moreover, over time, new types or names may come into existence. Nonetheless, for an individual service provider, only a few combinations are of interest.

Under these conditions, it is advantageous to transmit a separate table with fuel type and pricing structure definitions. Information for a particular fuel station can refer to this item then with a **reference** (the Table Key and Fuel Type Key) rather than duplicating the complete definition every time a fuel station needs to list a price for a particular fuel type with a specific pricing structure.

Table 2 shows a sample from a table for a US-based service provider (e.g. for California). Here, the local fuel names such as “Unleaded”, “Premium” or even “H_2” are used. Delivery units are (US) Gallons for liquid fuels or kg for Hydrogen, and prices are given in US Dollars with a two decimal digit accuracy [e.g. $ 1,34 per (US) Gallon].

Table 2 — Sample table with fueling definitions for the USA

Table Key	(AreaID_Key=01, fuelingDefinitionsID_Key=01)			
Currency unit	US Dollar			
Fuel Type Key	**Fuel name**	**Fuel type**	**Delivery unit**	**Price Resolution**
0	“Unleaded”	Unleaded petrol	Gallon	2 digits
1	“Premium”	high octane unleaded petrol	Gallon	2 digits
2	“Diesel”	Diesel	Gallon	2 digits
3	“H_2“	Hydrogen	kg	2 digits
4	CNG	CNG	gge	2 digits

In Table 2, a line item represents one fuelingDefinition. The field fuel type and delivery unit can be each represented through a standard TPEG table construct as less than 254 variations are expected. The fuel name is obviously represented with a short string and the price resolution with a tiny unsigned integer.

Table 3 shows a sample from a table for a Dutch-based service provider. Here, local names such as “euro-95” and “super-98” are used. Delivery units are now in litres and prices are in Euro, with a price display resolution of 3 digits (e.g. € 1,349 per litre).

Table 3 — Table with fuelling definitions for the Netherlands

Table Key	(AreaID_Key=31, fuelingDefinitionsID_Key=1)			
Currency unit	Euro			
Fuel Type Key	**Fuel name**	**Fuel type**	**Delivery unit**	**Price Resolution**
0	"Euro-95"	Unleaded petrol	Litre	3 digits
1	"Super-98"	high octane unleaded petrol	Litre	3 digits
2	"Diesel"	Diesel	Litre	3 digits

Thus, for every fuel station carrying unleaded, only the *Item Key* of the line item needs to be transmitted to indicate the fuel type meant, rather than the complete definition with the four fields (fuel name, fuel type, delivery unit, pricing resolution). With several thousand fuel prices to be transmitted in dense urban regions, such a mechanism leads to a significant reduction in bandwidth need for a specific repetition rate. This mechanism is used both for fuel type and pricing structure, as for (local) fuel brands. Many fuel stations may have these information items in common.

6.2.3 Transmission of tables of information

A service provider, transmitting fuel price information and availability, needs to be able to provide a TPEG client with a large volume of data at a relatively low transmission bandwidth. This makes it challenging to apply the typical TPEG concept that a single TPEG message equates with a single content item, in this case, a fuel station. The total volume of data per fuel station may easily exceed a hundred bytes. However, clients without any pre-existing information (e.g. transit users) still must be able to have useable data in a short amount of time (~10 min to ~20 min). Some form of transmission at high repetition rates for minimum content, augmented with low repetition rate for additional detailed content is required.

Clustering of (partial) content. The design direction taken for FPI is to allow service providers to arrange their transmissions flexibly, depending on the volume of data to be transmitted and the available bandwidth. That is, the unit of control (a TPEG message) is separated from the unit of content (Fuel Station). Instead, a TPEG message can contain partial content for a cluster of stations (e.g. station locations, or fuelling information) or complete content for a single fuel station.

A large bandwidth service provider with fewer fuel stations to transmit information for may provide the following lay-out of TPEG FPI messages (all messages include the standard MMC component and, for receiver geographic filtering, a LocationReferencingContainer indicating the geographic coverage area).

— **TPEG FPI message, variant A**: Fuel definitions (FPI Component: fuelingDefinitions)

— **TPEG FPI message, variant B:** Station Information for a cluster of 1 station (FPI components: StationFuelingInfoCluster, StationExtraInfoCluster, StationSiteInfoCluster and StationMapLocationCluster).

Both message variants are transmitted at a high repetition rate.

Conversely, a small bandwidth service provider (with more fuel stations to transmit information for) can capitalize on the fact that most of the fuel station information is rather static, (location, site information, etc.).

Thus, a small bandwidth service provider may utilize the following lay-out of TPEG FPI messages.

High repetition rate messages (with standard inclusion of the MMC component and, for receiver geographic filtering, a LocationReferencingContainer indicating the geographic coverage area).

— **TPEG FPI message, variant 1**: Fuel definitions (FPI Component: fuelingDefinitions)

— **TPEG FPI message, variant 2:** Station Information for a cluster of N1 stations
(FPI components: StationFuelingInfoCluster)

— **TPEG FPI message, variant 3:** Station Information for a cluster of N2 stations
(FPI components: StationPOILocationCluster)

Low repetition rate messages (with standard inclusion of the MMC component and, for receiver geographic filtering, a LocationReferencingContainer indicating the geographic coverage area).

— **TPEG FPI message, variant 4**: Station Information for a cluster of N stations
(FPI components: StationSiteInfoCluster)

— **TPEG FPI message, variant 5**: Station Information for a cluster of M1 < N stations
(FPI components: StationNavLocationCluster)

— **TPEG FPI message, variant 6**: Station Information for a cluster of M2 < N stations
(FPI components: StationExtraInfoCluster)

In this case, a low bandwidth service provider can tailor the repetition rate and content of message variants to its local situation and demands. Transit users, without any pre-existing information, are quickly served with the high repetition messages containing the basic location and fuel price information. Commuter users may build up over time the complete fuel station database, including detailed site and location information.

Receivers will link the content tables together based on the unique identification of a fuel station, i.e. the triplet (areaID_Key, stationID_Key) and the fuel definition table (areaID_Key,fuelingDefinitionsID_Key).

NOTE This relational database technology is well known. For utmost clarity, in this Technical Specification, the identifiers used as table keys have been given the suffix “_Key”.

6.2.4 MMC usage and FPI message combinations

FPI can make use of both monolithic and multi-part message management for transmission of the fuel station and fuelling definition tables (see ISO/TS 21219-6). The unit of content update shall always be an individual message in case of monolithic message management, or a message part in case of a multi-part message.

In case of a choice (for example, in a TPEG profile) for monolithic message management, then each FPI table (represented by the top-level applicationInformation components) may be transmitted in a separate message or, alternatively, several applicationInformation components may be transmitted together in a single message. The choice largely depends on the desirable repetition rates for these components. Components with an equal repetition rate can advantageously be combined in a single message.

With monolithic message management, each message shall have a unique message ID to distinguish it from other messages. If at least one information element changes for any of the contained fuel stations, then the versionID of the message shall be increased.

In case of a choice for multi-part message management, then the respective information parts for a cluster of Fuel Stations can be transmitted as partial messages. A single ”MMCMasterMessage” in that case can indicate the respective partial messages together comprising of the total information. The minimal information, i.e. StationFuelingInfoCluster and one of the LocationInfoClusters shall be signalled as mandatory, since together they comprise of the minimal information which can be presented to the user. The other applicationInformation components (e.g. StationExtraInfoCluster,

