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

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

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

Partie 16: Informations sur le prix des carburants et leur disponibilité (TPEG2-FPI)

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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 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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This first edition cancels and replaces the first edition (ISO/TS 21219-16:2016), which has been technically revised.

The main changes are as follows:

— the document has been changed from a Technical Specification to an International Standard;

— three new FuelKindType values have been added in Table 28.

A list of all parts in the ISO 21219 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 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 can 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 working group 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, later 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, later 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, later 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 of parts of the ISO 18234 series to provide location referencing.

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

0.2 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 Modelling Language (UML) was seen as having major advantages for the development of new TPEG applications in communities who would not necessarily have the 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 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).

TPEG2 is embodied in the ISO 21219 series and it comprises many parts that cover an 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 21219-2, ISO 21219-3 and ISO 21219-4 and the conversion to two current physical formats: binary (see Annex A) and XML (see Annex B); others can 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; this file forms the annex for each physical format.

TPEG2 has a three-container conceptual structure: message management (ISO 21219-6), application (several 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. Note that the list below is potentially incomplete, as there is the possibility that new TPEG2 parts will be introduced after the publication of this document.

— Toolkit parts: TPEG2-INV (ISO 21219-1), TPEG2-UML (ISO 21219-2), TPEG2-UBCR (ISO 21219-3), TPEG2-UXCR (ISO 21219-4), TPEG2-SFW (ISO 21219-5), TPEG2-MMC (ISO 21219-6), TPEG2-LRC (ISO/TS 21219-7).

— Special applications: TPEG2-SNI (ISO 21219-9), TPEG2-CAI (ISO 21219-10), TPEG2-LTE (ISO/TS 21219-24).

— Location referencing: TPEG2-OLR (ISO/TS 21219-22), TPEG2-GLR (ISO/TS 21219-21), TPEG2-TLR (ISO 17572-2), TPEG2-DLR (ISO 17572-3).

— Applications: TPEG2-PKI (ISO 21219-14), TPEG2-TEC (ISO 21219-15), TPEG2-FPI (ISO 21219-16 - this document), TPEG2-SPI (ISO 21219-17), TPEG2-TFP (ISO 21219-18), TPEG2-WEA (ISO 21219-19), TPEG2-RMR (ISO/TS 21219-23), TPEG2-EMI (ISO/TS 21219-25), TPEG2-VLI (ISO/TS 21219-26).

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 with both long-term, unchanging content and highly dynamic content, such as parking information.

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

SP20013/2.1/001.

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

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

1 Scope

This document specifies the TPEG fuel price information and availability (FPI) application. The FPI application has been specifically designed to support information from fuel stations, such as 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 for end users of a TPEG service:

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

b) potentially significant cost savings for fleet operators through improved ease of access to price information;

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 becomes more common, and more vehicles begin to use them (e.g. biofuels, hydrogen, etc.), drivers will be better informed about availability of fuelling stations.

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

The application described in this document (TPEG2-FPI) is not appropriate for cases where the objective is to inform electric vehicles of the location of charging stations and the availability of charging points. In such cases, the TPEG application TPEG2-EMI (electro mobility information) is chosen. This is because while TPEG2-FPI (the application described in this document) contains rudimentary support for electric charging stations, a TISA investigation revealed that a simple extension/differentiation of TPEG2-FPI is insufficient for addressing the evolving market needs of the electric vehicle market. Hence, a separate TPEG application has been created to serve the information needs of electric vehicles and their operators: TPEG2-EMI, specified in ISO/TS 21219-25.

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

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

ISO 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 terms and definitions given in ISO 21219-9 apply.

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

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

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

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. Alternative names in use for such a facility are gas station, fuelling station, filling station, service station, petrol station, garage, gas bar, petrol pump or petrol bunk.

4 Abbreviated terms

For the purposes of this document, the abbreviated terms in ISO 21219-1, ISO 21219-9 and the following apply.

ADC	application data container
CNG	compressed natural gas
MSL	mean sea level
POI	point of interest
TFP	traffic flow and prediction
TMC	traffic message channel

5 Application specific constraints

5.1 Application identification

The word “application” is used in the TPEG specifications to describe specific subsets of the TPEG structure. An application defines a limited vocabulary for a certain type of messages, for example, parking information or road traffic information. Each TPEG application is assigned a unique number, called the application identity (AID). An AID number is defined in ISO 21219-1 whenever a new application is developed.

The AID number is used within the TPEG2-SNI application (ISO 21219-9) to indicate how to process TPEG content. It 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 can have an impact on client devices.

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

Table 1 shows the current version numbers for signalling FPI within the SNI application.

Table 1 — Current version numbers for signalling of FPI

Major version number	2
Minor version number	1

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 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 (ADC) component(s) which includes the application-specific information.

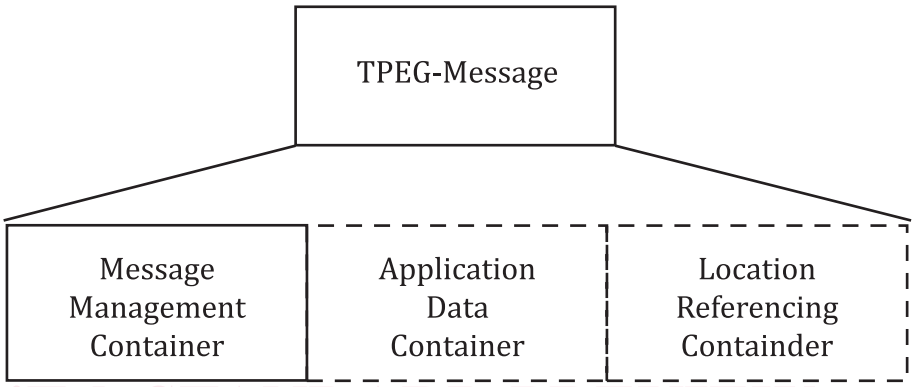

Figure 1 — Composition of TPEG messages

NOTE The FPI design is centred 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, there are approximately 5 000 fuel stations. Consideration of these aspects has guided the design of FPI.

Consequently, the design of the ADC is such that it can contain information for multiple fuel stations at once. The top-level LRC 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 ADC, as geographic "markers" within this geographic coverage location (see Clause 7 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. This means that 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 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). This is applied in particular for fuel type and pricing structure information ("fuelingDefinitions" in this document). Furthermore, all information is transmitted as tables of information, each under the control of an 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 for factoring 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 exist 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 can 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 then refer to this item 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. USD 1,34 per (US) Gallon].

Table 2 — Sample table with fuelling 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

Table 2 *(continued)*

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 fields "Fuel type" and "Delivery unit" can each be represented through a standard TPEG table construct, as less than 254 variations are expected. The fuel name is 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. EUR 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 petrol, only the item key of the line item is required 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 can easily exceed a hundred bytes. However, clients without any pre-existing information (e.g. transit users) shall still 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 for which it transmits information can provide the following lay-out of TPEG FPI messages (all messages include the standard MMC component and, for receiver geographic filtering, an LRC 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 for which it transmits information) 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 can 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 e.g. 25 stations (FPI components: StationFuelingInfoCluster)

— **TPEG FPI message, variant 3:** Station information for a cluster of e.g. 16 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 e.g. 10 stations (FPI components: StationSiteInfoCluster)

— **TPEG FPI message, variant 5:** Station information for a cluster of e.g. 6 stations (FPI components: StationNavLocationCluster)

— **TPEG FPI message, variant 6:** Station information for a cluster of e.g. 4 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. Over time, commuter users can build up the complete fuel station database, including detailed site and location information.

Receivers 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 document, 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 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) can be transmitted in a separate message or, alternatively, several applicationInformation components can 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 this 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 the minimal information which can be presented to the user. The other applicationInformation components (e.g. StationExtraInfoCluster,