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

Part 18: Traffic flow and prediction application (TPEG2-TFP)

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

Partie 18: Flux de trafic et application de prédiction (TPEG2-TFP)

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation 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 ISO/TS 21219-18:2015, which has been technically revised.

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

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 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, 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 of 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 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 ISO 21219-2, ISO 21219-3 and ISO 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 minimize drafting errors, that 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 may be incomplete, e.g. new TPEG2 parts may be introduced after publication of this document.

— Toolkit parts: TPEG2-INV (ISO/TS 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/TS 21219-9), TPEG2-CAI (ISO/TS 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/TS 21219-14), TPEG2-TEC (ISO/TS 21219-15), TPEG2-FPI (ISO/TS 21219-16), TPEG2-TFP (ISO 21219-18), TPEG2-WEA (ISO/TS 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 having 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: SP17001.

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

Part 18: Traffic flow and prediction application (TPEG2-TFP)

1 Scope

This document specifies the TPEG application Traffic Flow and Prediction (TFP). It has been specifically designed to provide information to a variety of receivers using different channels, including in the first instance digital broadcasting and Internet technologies. Traffic flow and prediction messages are intended for in-car applications and can also be presented directly to the user by textual, voice and graphical output devices.

TFP is status oriented, i.e. the transmitted information continuously updates the receiver's knowledge for a dedicated road network. In particular the traffic states are delivered any time and for all road sections of the network, even when there are no abnormal traffic situations.

Generally, TFP focuses on the following requirements:

— provides dynamic navigation systems with up-to-date traffic state information;

— ensures travel safety for the driver;

— enables the calculation of alternative routes;

— avoids delays (e.g. traffic jams);

— lowers traffic load on over-saturated parts of the network;

— keeps the driver informed about current and upcoming traffic;

— compact and efficient coding of the traffic information.

2 Normative references

There are no normative references in this document.

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:

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

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

3.1
Message Management Container
concept applied to the grouping of all message elements, including Message Management Information, of a TPEG-Message together in one place

3.2
Location Referencing
means to provide information that allows a system to accurately identify a location

Note 1 to entry: The content of a location reference allows the location to be presented in a graphical or textual manner to the end-user (e.g. coloured network graphs) as well as to be used for navigational systems purposes.

3.3
Location Referencing Container
concept applied to the grouping of all the Location Referencing elements, of a TPEG-Message, together in one place

Note 1 to entry: See ISO/TS 21219-7 for full details of the Location Referencing container.

4 Abbreviated terms

ACID	Application and Content Identifier
ADC	Application Data Container
AID	(TPEG) Application IDentification
CEN	Comité Européen de Normalisation
EBU	European Broadcasting Union
ITS	Intelligent Transport Systems
LRC	Location Referencing Container
MMC	Message Management Container
OSI	Open Systems Interconnection
SFW	(TPEG) Service Framework
SID	Service and Network Information
SNI	Service and Network Information
TISA	Traveller Information Services Association
TFP	Traffic Flow and Prediction
TMC	Traffic Message Channel
TPEG	Transport Protocol Expert Group
TTI	Traffic and Traveller Information
UML	Unified Modelling Language
XML	Extensible Markup Language
XSD	XML Schema Definition

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 message, e.g. 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. 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 signaling TFP within the SNI application.

Table 1 — Current version numbers for signalling of TFP

major version number	**1**
minor version number	**1**

5.3 Ordered components

TPEG2-TFP requires a fixed order of TPEG components. The order for the TFP message component is shown in Figure 1; the first component shall be the *Message Management Container.* 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* components, which includes the traffic flow information. This shall be followed by the *Location Referencing Container* component, if the LRC is present in this message (see also 7.1).

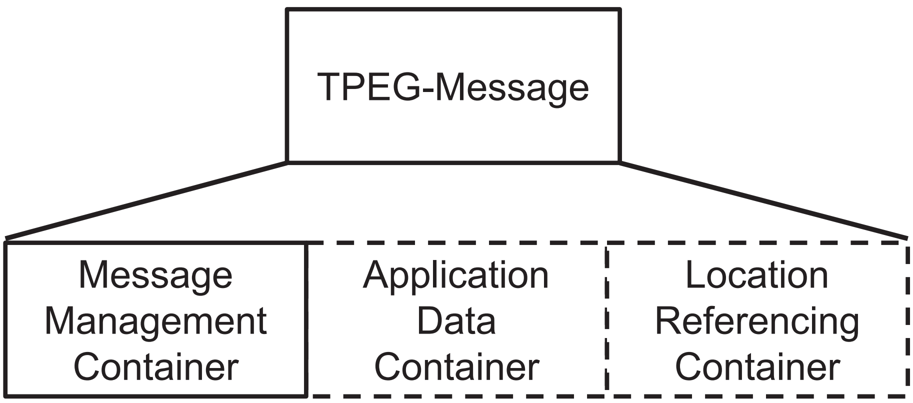

Figure 1 — Composition of TPEG messages

5.4 Extendibility

The requirement of a fixed component order does not affect the extension of TFP. Future application extensions may insert new components or may replace existing components by new ones without

losing backward compatibility. This means that a TFP decoder shall be able to detect and skip unknown components.

5.5 TPEG Service Component Frame

TPEG2 TFP makes use of the "Service Component Frame with dataCRC, groupPriority, and messageCount" according to ISO 21219-5.

6 TFP structure

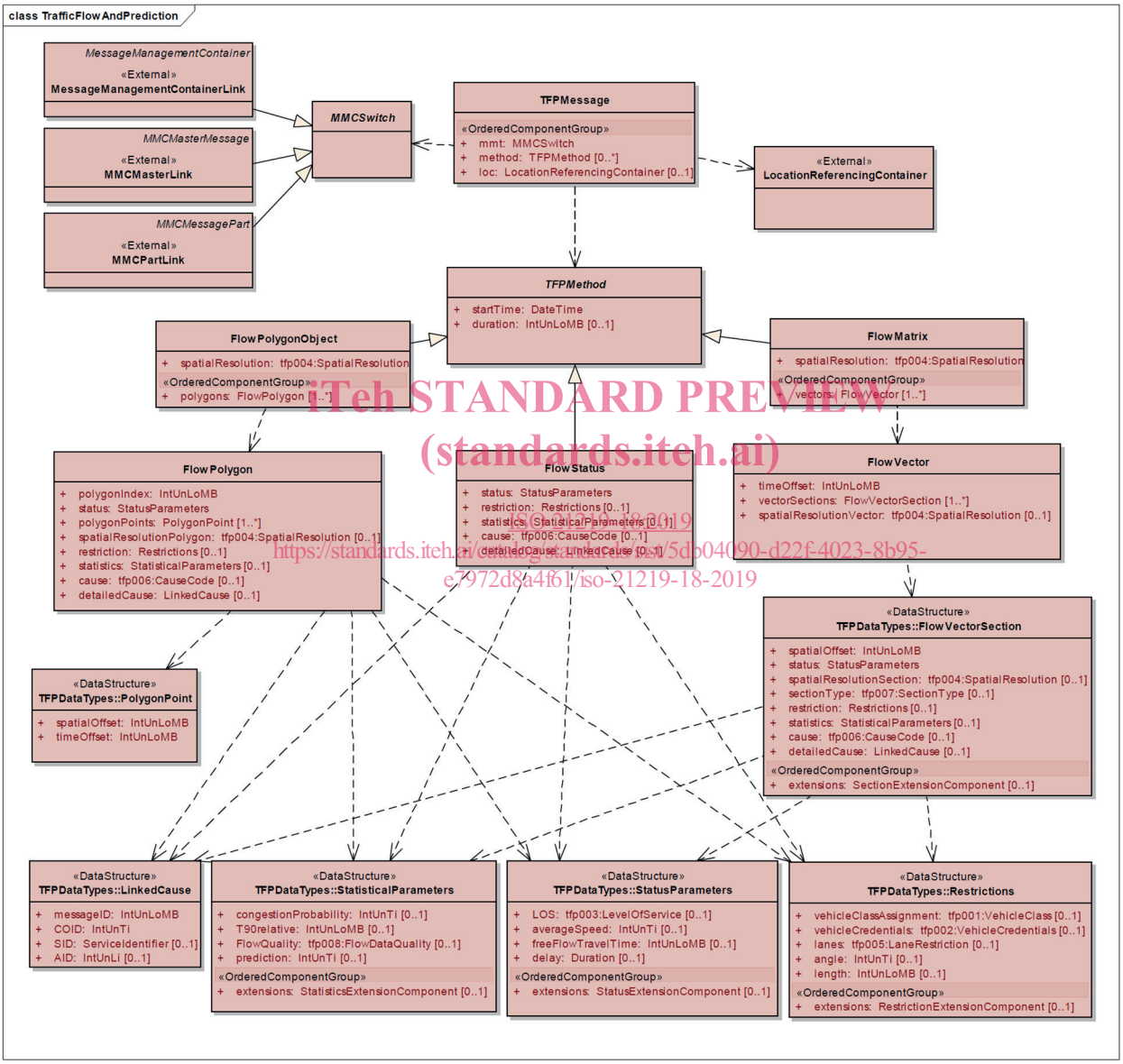

Figure 2 — TFP message structure

7 TFP Message components

7.1 TFPMessage

A 'TFPMessage' component is the top container of a TFP message. It contains all information about a particular part of the network, e.g. the traffic state for a road segment.

The traffic flow content of a TFPMessage is typically highly dynamic while the affected road stretch defined by the Location Referencing Container (LRC) shall remain static during the life cycle of a message. Thus, partial message management (ISO 21219-6) may be applied to update the traffic flow states of a message frequently whereas the LRC may be repeated with a longer repetition interval. Accordingly, a TFP message can include alternatively:

— One MMC only in case of a cancellation message (ISO 21219-6);

— One MMC, one or several ADCs and one LRC in case of monolithic message management (ISO/TS 21219-6);

— Partial message management (ISO/TS 21219-6):

  — One MMC only, including the multipart message directory,

  — One MMC and one or several ADCs,

  — One MMC and one LRC.

TFP provides three methods for the representation of current and predicted traffic flow states which may be used alternatively, i.e. just one method shall be applied within one TFP message:

— Flow-Polygon-Method: The traffic flow is modelled by a number of spatial/temporal 'FlowPolygonObjects' (see description of component 'FlowPolygonObject', 7.8).

— FlowStatus-Method: A flow status applied to the overall road stretch defined by the LRC of the message (see description of component 'FlowStatus', 7.10). A TFP message using this method and which is not a cancellation message shall contain exactly one 'FlowStatus' container.

— Flow-Matrix-Method: The road stretch is divided into sections each with a homogenous flow state, thus building a 'FlowVector'. A 'FlowMatrix' consists of one or several FlowVectors for dedicated temporal intervals, e.g. with one FlowVector for the current flow status and another one for prognosis in 15 min (see description of components 'FlowMatrix', 7.11). A TFP message using this method and which is not a cancellation message shall contain exactly one 'FlowMatrix' container.

To minimize the length of TFP messages the spatial positions of the Flow-Matrix and Flow-Polygon methods are coded by spatial offsets to the location reference in the LRC. These offsets shall be calculated in upstream direction to the end of the road stretch as defined by the location reference of the message (see also 8.3). The location reference in the LRC shall cover the entire road stretch required for this TFP message. The Flow-Matrix method allows also the usage of relative offsets (see 7.11).

The attributes of the 'TFPMessage' component are listed hereunder:

Table 2 — TFPMessage

Name	Type	Multiplicity	Description
Ordered Components			
mmc	MessageManagementContainer (external)	1	Message Management Container
method	Component TFPMethod	0..*	Traffic flow data
loc	LocationReferencingContainer (external)	0..1	Location Referencing Container

7.2 TFPMethod

Traffic conditions are modelled as traffic flow objects. TFP provides three different methods to define such an object, for details see descriptions of components 'FlowPolygonObject', FlowStatus' and FlowMatrix'.

The template 'TFPMethod' is the generalization of these three methods.

Name	Type	Multiplicity	Description
startTime	DateTime	1	The start of the time period for which the provided content is valid.
duration	IntUnLoMB	0..1	The duration [min] of the time period for which the provided content is valid. The period starts at 'startTime' and ends at 'startTime'+'duration'. This attribute shall be used by the 'PolygonFlowObject' component and may be used if required otherwise.

7.3 MMCSwitch

The MMCSwitch component is an abstract component, allowing the flexible use of monolithic or multi-part message management.

7.4 MessageManagementContainerLink

The MessageManagementContainerLink is a placeholder for the MessageManagementContainer as defined in the MMC-toolkit specification (see ISO 21219-6). It assigns the Traffic Flow and Prediction application specific local component ID for the MMC container (see Annex A).

This component contains all and only information related to message management. The TPEG server side, especially the instance generating the transmission data, has to ensure that the message management information allows unambiguous interpretation over time and in appropriate scenarios with disturbed reception specific to the transmission channel.

TFP implementations may use both monolithic and partial message management (see ISO 21219-6). A TPEG service may contain messages with both MMC methods but it shall be used alternatively for a particular message, i.e. a dedicated message shall not be transmitted with an alternating partial/monolithic MMC.

7.5 MMCMasterLink

The MMCMasterLink is a placeholder for the Master-Message MMC for Multi-part message management, as defined in the MMC-toolkit specification (see ISO 21219-6). It assigns the Traffic Flow and Prediction application specific local component ID for the MMC container (see Annex A).

The TPEG server side, especially the instance generating the transmission data, has to ensure that the message management information allows unambiguous interpretation over time and in appropriate scenarios with disturbed reception specific to the transmission channel.

TFP implementations may use both monolithic and partial message management (see ISO 21219-6). A TPEG service may contain messages with both MMC methods but it shall be used alternatively for a particular message, i.e. a dedicated message shall not be transmitted with an alternating partial/monolithic MMC.

7.6 MMCPartLink

The MMCPartLink is a placeholder for the external Partial-Message MMC (MMCMessagePart) for multi-part message management, as defined in the MMC-toolkit specification (see ISO 21219-6). It assigns the Traffic Flow and Prediction application specific local component ID for the MMC container (see Annex A).

The TPEG server side, especially the instance generating the transmission data, has to ensure that the message management information allows unambiguous interpretation over time and in appropriate scenarios with disturbed reception specific to the transmission channel.

TFP implementations may use both monolithic and partial message management (see ISO 21219-6). A TPEG service may contain messages with both MMC methods but it shall be used alternatively for a particular message, i.e. a dedicated message shall not be transmitted with an alternating partial/monolithic MMC.

7.7 LocationReferencingContainer

The LocationReferencingContainer component is a placeholder for the LocationReferencingContainer (LRC) as described in the LRC toolkit specification defined in ISO/TS 21219-7. It assigns the Traffic Flow and Prediction (TFP) application specific local component ID for the LRC container (see also Annex A). All component IDs within the LRC container are local to the LRC toolkit.

The location of a TFP message (e.g. a road stretch) may be quite stable where the related traffic flow values may change dynamically. Thus, the LRC may not be required in each version of the message. The MMC Partial Update mechanism shall be used if the LRC is not present in a TFP message. Accordingly, the sender side shall use a new message ID if the location respectively the LRC is changed.

The LRC component contains all information describing the location where the situation described in TFP is taking place. TFP shall use only linear locations to define the road stretch affected, but no area or point locations.

The **end of the LRC location** (in driving direction) defines the **Spatial Reference Point**. Based on this Reference Point offsets are used to dedicated points on the road stretch, e.g. Polygon Points (see description of the Flow-Polygon-Method, see 7.8) or delimiters of road sections (see description of the Flow-Matrix-Method, see 7.11).

If TMC location referencing (ISO 17572-3) is used in the LRC, the Spatial Reference Point shall be always the Primary Location. As the TMC Primary Location defines only an intersection and is thus not very accurate the following convention shall be applied in TFP for TMC locations (see also Figure 3).

It is strongly recommended that TFP services use only one-directional but no bi-directional location references.

As TFP uses linear locations only the TMC extent defining the secondary location shall be greater than 0, whenever it is feasible to construct an “TMC extent > 0” location reference for the TMC primary location, i.e. when this primary location has a predecessor TMC location against driving direction in the TMC location table.

Only in the exceptional case, when for a linear (road segment) location only a “TMC extent 0” location reference is possible (e.g. typically for P4.0 type link roads), then a TMC extent 0 location reference is permitted under the following condition. Any first spatial offset in an TMC extent 0 location reference shall always be assigned a spatial resolution of type ‘tfp004:start-of-location’ (for backward compatibility reasons).

The Spatial Reference Point for TMC locations is the position on the road stretch where the last entry or exit in driving direction is entering or leaving the road stretch (see Figure 3 below).

