PD ISO/TS 21219-15:2016

BSI Standards Publication

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

Part 15: Traffic event compact (TPEG2-TEC)

Documents
Document Sharing Hub

Full document details: PD ISO/TS 21219-15:2016

National foreword

This Published Document is the UK implementation of ISO/TS 21219-15:2016.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Intelligent transport systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 90970 2
ICS 03.220.01; 35.240.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 June 2016.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: PD ISO/TS 21219-15:2016

TECHNICAL SPECIFICATION

ISO/TS 21219-15

First edition
2016-06-01

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

Part 15: Traffic event compact (TPEG2-TEC)

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

Partie 15: Événement trafic compact (TPEG2-TEC)

Reference number
ISO/TS 21219-15:2016(E)

Documents
Document Sharing Hub

© ISO 2016

Full document details: PD ISO/TS 21219-15:2016

COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TS 21219-15:2016

Contents

Page

Foreword ..... **v**
Introduction ..... **vii**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Abbreviated terms **2**
5 Application specific constraints **2**
5.1 Application identification 2
5.2 Version number signalling 2
5.3 Ordered components 3
5.4 Extension 3
5.5 TPEG Service Component Frame 4
6 TEC Structure **4**
7 TEC Message components **5**
7.1 TECMessage 5
7.2 MMCSwitch 5
7.3 MessageManagement 5
7.4 Event 5
7.5 Cause 8
7.6 DirectCause 9
7.7 Causes and sub-causes 10
7.8 LinkedCause 10
7.8.1 Rules 11
7.8.2 Further constraints 11
7.8.3 Coding Examples 11
7.9 Advice 14
7.10 VehicleRestriction 14
7.11 DiversionRoute 15
7.11.1 Description for Creating and Applying Diversions 15
7.11.2 Strategy for Coding a Diversion 15
7.12 TemporarySpeedLimit 17
7.13 ProblemLocation 21
7.14 RestrictionLocation 21
7.15 SegmentLocation 21
8 TEC Datatypes **21**
8.1 RestrictionType 21
8.2 SegmentModifier 21
8.3 TemporarySpeedLimitSection 21
9 TEC Tables **22**
9.1 tec001:EffectCode 22
9.2 tec002:CauseCode 22
9.3 tec003:WarningLevel 24
9.4 tec004:LaneRestriction 25
9.5 tec005:AdviceCode 25
9.6 tec006:Tendency 26
9.7 tec007:RestrictionType 27
9.8 tec008:DiversionRoadType 28
9.9 tec009:VehicleType 28
9.10 tec100:SubCauseType 29
9.11 tec101:TrafficCongestion 30
9.12 tec102:Accident 30

© ISO 2016 – All rights reserved

AVA Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

9.13 tec103:Roadworks 30
9.14 tec104:NarrowLanes 30
9.15 tec105:Impassability 31
9.16 tec106:SlipperyRoad 31
9.17 tec108:Fire 32
9.18 tec109:HazardousDrivingConditions 32
9.19 tec110:ObjectsOnTheRoad 32
9.20 tec111:AnimalsOnRoadway 33
9.21 tec112:PeopleOnRoadway 33
9.22 tec113:BrokenDownVehicles 34
9.23 tec115:RescueAndRecoveryWorkInProgress 34
9.24 tec116:RegulatoryMeasure 34
9.25 tec117:ExtremeWeatherConditions 35
9.26 tec118:VisibilityReduced 35
9.27 tec119:Precipitation 36
9.28 tec120:RecklessPersons 36
9.29 tec123:MajorEvent 36
9.30 tec124:ServiceNotOperating 37
9.31 tec125:ServiceNotUseable 37
9.32 tec126:SlowMovingVehicles 37
9.33 tec127:DangerousEndOfQueue 38
9.34 tec128:RiskOfFire 38
9.35 tec129:TimeDelay 38
9.36 tec130:PoliceCheckpoint 39
9.37 tec131:MalfunctioningRoadsideEquipment 39
9.38 tec200:SubAdviceType 39
9.39 tec202:OvertakingNotAllowed 40
9.40 tec203:DrivingNotAllowed 40
9.41 tec207:GiveWayToVehiclesFromBehind 40
9.42 tec208:FollowDiversion 41
9.43 tec213:DriveCarefully 41
9.44 tec214:DoNotLeaveYourVehicle 41
9.45 tec216:UseTollLanes 41

Annex A (normative) **TPEG TEC, TPEG-Binary Representation** **42**

Annex B (normative) **TPEG application, TPEG-ML Representation** **50**

Bibliography **63**

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

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 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*.

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 (TPEG2-INV) [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 (TPEG2-SFW) [Technical Specification]*

— *Part 6: Message management container (TPEG2-MMC) [Technical Specification]*

— *Part 9: Service and network information (TPEG2-SNI) [Technical Specification]*

— *Part 10: Conditional access information (TPEG2-CAI) [Technical Specification]*

— *Part 14: Parking information application (TPEG2-PKI) [Technical Specification]*

— *Part 15: Traffic event compact [Technical Specification]*

— *Part 18: Traffic flow and prediction application (TPEG2-TFP) [Technical Specification]*

— *Part 19: Weather information (TPEG2-WEA) [Technical Specification]*

The following parts are under preparation:

— *Part 16: Fuel price information and availability application (TPEG2-FPI) [Technical Specification]*

— *Part 23: Road and multi-modal routes application (TPEG2-RMR) [Technical Specification]*

— *Part 24: Light encryption (TPEG2-LTE) [Technical Specification]*

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

— *Part 25: Electromobility charging infrastructure (TPEG2-EMI) [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]*

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

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 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/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 minimize drafting errors, that forms the Annex for each physical format.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

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), TPEG2-LTE (ISO/TS 21219-24);

— 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-EMI (ISO/TS 21219-25).

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 part of ISO/TS 21219 is based on the TISA specification technical/editorial version reference:

SP13001/3.2/002

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

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

Part 15:
Traffic event compact (TPEG2-TEC)

1 Scope

This part of ISO/TS 21219 specifies the TPEG application: Traffic Event Compact (TEC). The TEC application has been specifically designed to support information about traffic events (e.g. road works, traffic jams). A specific form of traffic events are local hazard warnings which, being safety-related messages, are sent with high priority to warn a driver that may encounter dangerous situations (e.g. black-ice, accident beyond curves, obstacles on road, etc.) unexpectedly.

Generally, the Traffic Event Compact application is designed to allow receivers to

— ensure travel safety for the driver,

— enable the calculation of alternative routes,

— avoid delays (e.g. traffic jams),

— warn the driver of obstructions on route, and

— provide the driver with information on infrastructural problems (e.g. closed petrol stations, non-functioning emergency telephones).

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

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

ISO/TS 21219-7[1)], *Intelligent transport systems — Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) — Part 7: Location referencing container (TPEG2-LOC)*

3 Terms and definitions

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

3.1
local hazard warning
specific form of traffic events which, being safety-related messages, are sent with high priority to assist a driver from encountering dangerous situations

1) Planned.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub

Full document details: PD ISO/TS 21219-15:2016

3.2
location referencing container
concept applied to the grouping of all of the location referencing elements of a TPEG-Message

3.3
location referencing
method to provide information which 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 plain-language manner to the end-user (i.e. text, speech or icons) and also to be used for navigational purposes, for example, for map-based systems.

4 Abbreviated terms

ACID	Application and Content Identifier
ADC	Application Data Container
LRC	Location Reference Container
MMC	Message Management Container
RF	Radio Frequency
SFW	TPEG Service Framework: Modelling and Conversion Rules
TEC	Traffic Event Compact
TISA	Traveller Information Services Association
TPEG	Transport Protocol Expert Group
TTI	Traffic and Traveller Information
UML	Unified Modelling Language

5 Application specific constraints

5.1 Application identification

The word “application” is used in this part of ISO/TS 21219 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 IDentification (AID). An AID is defined whenever a new application is developed and these are all listed in the TPEG2-INV specification.

The application identification number is used in the TPEG2-SNI application 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 the TPEG2-INV specification.

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

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 1 — Current version numbers for signalling of TEC

Major version number	3
Minor version number	2

5.3 Ordered components

TPEG-TEC requires a fixed order of TPEG components. The order for the TEC 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 the *one or more Application Data Container component(s) which includes the application-specific information* and this, in turn, is followed by the *Location Referencing Container*.

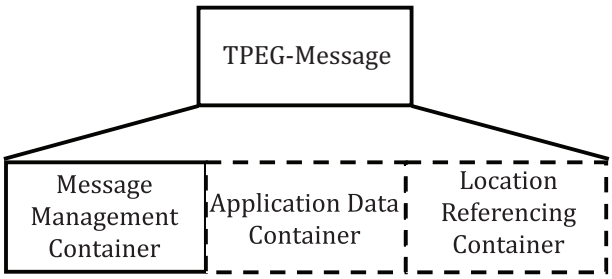

Figure 1 — Composition of TPEG messages

Within the *Event* component, one or more *Cause* components shall come first followed by one or more *Advice* components and so on. Components of the same type shall immediately follow each other.

5.4 Extension

Although there is a requirement to maintain a fixed component order, this does not prevent the extension of a TEC message generally. In case of future extensions, new components may be inserted or existing components may be replaced by new ones without losing backward compatibility. This requires that a TEC decoder shall be able to detect and skip unknown components.

Components of the same type shall be included sequentially without the interleaving of other forms of component.

Example (allowed)

The *Advice* component is replaced by *BetterAdvice* having its own component id. A *WeatherSituation* component is inserted after *Advice* component as shown in Figures 2 and 3.

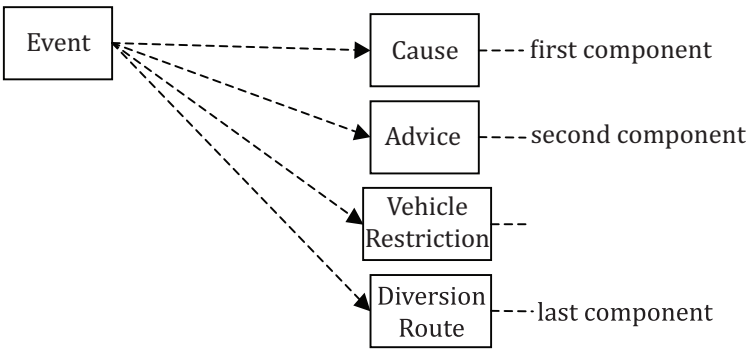

Figure 2 — Example for extension; original component model (before addition of additional components)

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

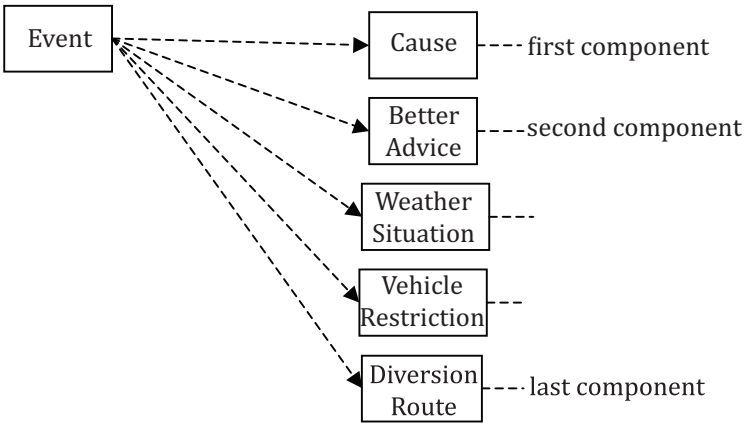

Figure 3 — Example for extension; *Advice* replaced by *BetterAdvice* and *WeatherSituation* added

5.5 TPEG Service Component Frame

TEC makes use of the "Service component frame with dataCRC, groupPriority and messageCount".

6 TEC Structure

The TEC structure is presented in Figure 4.

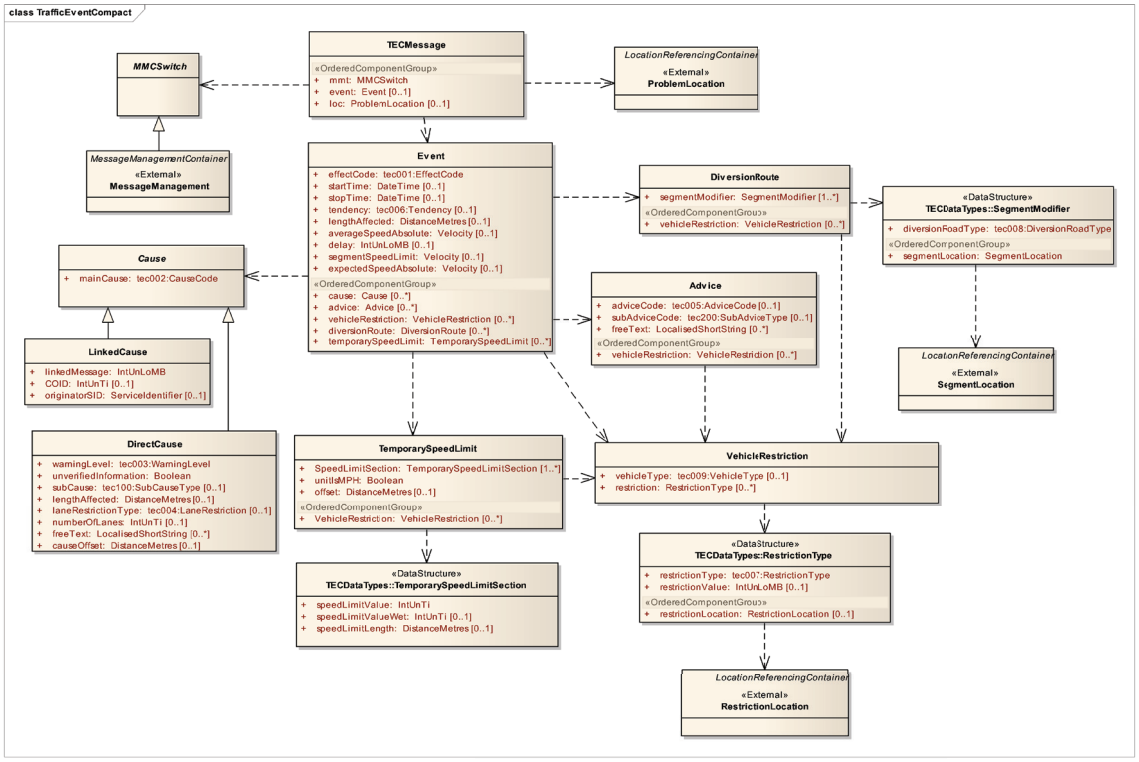

Figure 4 — TEC message structure

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

7 TEC Message components

7.1 TECMessage

A TECMessage (see Table 2) is either a normal message or a cancellation message. A normal message (i.e. other than cancellation messages) shall include the following:

— one message management container with management information related to the overall message (ID and version, expiry time);

— one event container with one traffic flow effect and, optionally, one or more causes with additional information;

— one location referencing container with the location reference for the overall traffic message.

Cancellation messages (cancelFlag = true) shall not include an event nor a location referencing container, only the message management container.

Table 2 — TECMessage

Name	Type	Multiplicity	Description
Ordered Components			
Mmt	MMCSwitch	1	Message Management Container
Event	Event	0..1	Describes the impact on the traffic flow and the related cause (always included except for cancellation of a message)
Loc	ProblemLocation	0..1	Location Referencing Container (always included except for cancellation of a message)

7.2 MMCSwitch

The MMCSwitch is an abstract container included for formal reasons, to allow future extension of the MMC.

7.3 MessageManagement

The MessageManagement component is a placeholder for the MessageManagementContainer as specified in ISO/TS 21219-6. It assigns the traffic event compact (TEC) application specific local component ID for the MMC container. All component IDs within the MMC container are local to the MMC toolkit. The MMC contains all and only information related to message management.

Message generation systems shall ensure that the information given in the MMC promotes unambiguous interpretation over the whole time a message is valid. It is particularly important to recognize that client devices are likely to suffer from non-continuous reception as typically encountered in broadcast systems suffering intermittent Radio Frequency (RF) performance.

TEC shall only use the monolithic message management as specified in ISO/TS 21219-6. Multipart messages management shall not be used.

7.4 Event

The Event component (see Table 3) supports definition, in general, of the impact on the traffic flow and the related cause.

NOTE For example, Stationary Traffic (due to) Narrow Lanes.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 3 — Event component

Name	Type	Multiplicity	Description
effectCode	tec001:EffectCode	1	Describes the impairment of the trafficflow.
startTime	DateTime	0..1	Date and time at which an event began or is scheduled to begin (intended to be used for presentation to the end-user).
stopTime	DateTime	0..1	Date and time at which an event, or status information, ended or is scheduled to end (intended to be used for presentation to the end-user).
tendency	tec006:Tendency	0..1	Tendency is related to the averageSpeedAbsolute indicating if this has been increasing, decreasing or has remained constant. Timescale of this trend should be typically in the range of 30 min or less, but is defined by the service provider. It is not a forecast of a future trend, nor does it relate to the length of the traffic queue.
lengthAffected	DistanceMetres	0..1	Length of the event in metres.
averageSpeedAbsolute	Velocity	0..1	The actual average speed in m/s at the given location. It is recommended to use this value for calculation of the route and estimated arrival time.
delay	IntUnLoMB	0..1	Delay in minutes added to journey due to event at the location. Only applicable to point locations, i.e. at border crossings.
segmentSpeedLimit	Velocity	0..1	Averaged speed limit (in m/s) within the problem location. Within the problem location, multiple speed limits may exist (e.g. multiple reducing speed limits on entering a roadworks zone). Average speed limit is calculated as: the total length (in m) of the problem location divided by the sum of the individual travel times travel times (seconds) when travelling at the defined speed limit. Shall be used as speed limit for re-routing, but not to display or warn the driver.
expectedSpeedAbsolute	Velocity	0..1	The expected (normal) speed in m/s for this time of the day based on, e.g. historical data. This speed may vary as function of the time of day and can be markedly different from the free-flow speed (especially in rush hour conditions).
Ordered Components			
cause	Cause	0..*	Defines the reason for the traffic problem (direct or linked cause).
advice	Advice	0..*	Recommendations or prohibitions for the driver.
vehicleRestriction	VehicleRestriction	0..*	Vehicle types (restrictions) that are relevant for the message.
diversionRoute	DiversionRoute	0..*	Diversion information relating to the event.
temporarySpeedLimit	TemporarySpeedLimit	0..*	This is the temporary speed limit displayed on road signs associated with the Event. This data is intended for display to drivers.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Effect and Cause

For a single event, it should be possible to distinguish between the effect that describes an impairment of the traffic flow (e.g. stationary traffic) and the cause (e.g. roadworks). The latter can be seen as the reason for the traffic flow effect described by the attribute effectCode. A "Cause" can be used to provide further information to inform or warn the driver of a special situation (e.g. oil on the road).

LengthAffected

If LengthAffected is included within the Event component, it describes the length of the overall problem; otherwise, the length is defined by the location given in the Location Reference Container.

LengthAffected shall not be greater than the length defined by the Location Reference Container.

startTime and stopTime

These describe the beginning and end time of a traffic event. The startTime is the time at which an event started or is scheduled to start. The stopTime is the time at which the event is scheduled to end. These times may be presented directly to the user by the receiver for information.

Speed Attributes

Speed related attributes are all defined in metres per second (m/s). Client devices may need to convert to other units.

Average Speed Absolute

The averageSpeedAbsolute is used to signal the real speed of traffic through the problem location.

Delay

Delay associated with a specific location like a border crossing.

Segment Speed limit

The segmentSpeedLimit is used to signal the averaged potential speed (due to applied legal limits along the Problem Location) for re-routing and ETA calculations, but not to display or warn the driver. This attribute is not guaranteed to match signed speed limits on a road.

Expected Speed Absolute

The expectedSpeedAbsolute is used to signal the expected (normal) speed of traffic through the problem location.

Rounding of speed information

Speed information is always given in metres per seconds (m/s) as the TPEG data type "Velocity" is used. For calculations of journey and arrival times, receivers should use this information directly. However, for presentation to the driver, the receiver should convert and round these values as suggested in Table 4.

Table 4 — Rounding of speed information

m/s	km/h (exact)	km/h (rounded, steps of 5)	mph (exact to 2 decimal places)	mph (rounded, steps of 5)
0	0,0	0	0,0	0
1	3,6	5	2,24	0
2	7,2	5	4,49	5
3	10,8	10	6,73	5
4	14,4	15	8,98	10

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 4 *(continued)*

m/s	km/h (exact)	km/h (rounded, steps of 5)	mph (exact to 2 decimal places)	mph (rounded, steps of 5)
5	18,0	20	11,22	10
6	21,6	20	13,47	15
7	25,2	25	15,71	15
8	28,8	30	17,96	20
9	32,4	30	20,20	20
10	36,0	35	22,44	20
11	39,6	40	24,69	25
12	43,2	45	26,93	25
13	46,8	45	29,18	30
14	50,4	50	31,42	30

The following formulae are used to calculate the values listed in Table 4. Additional higher values than those listed may be used.

For steps of 5 km/h (0, 5, 10, 15, 20, ...)

Rounded Speed (km/h) = 5 × [(36 × v + 25)/50]

For steps of 5 mph (0, 5, 10, 15, 20, ...)

Rounded Speed (km/h) = 5 × [(360 × v + 401)/802]

Where v is the velocity signalled (in m/s)

In these formulae, the division is an **integer division** which means that the fractional part (remainder) is discarded.

7.5 Cause

The cause component (see Table 5) specifies the additional interface including a mandatory CauseCode for all instances.

Table 5 — Cause

Name	Type	Multiplicity	Description
mainCause	tec002:CauseCode	1	Main categorization of the cause according to table tec002

There are two ways to encode “events” where an effect and one or more causes belong together.

Direct Cause

Direct Cause is where both the effect and the cause are defined together in the same message In this case, both the cause and effect are deemed to occur within the same location as defined by the LRC.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Linked Cause

The other method is called a “LinkedCause” where the effect is defined in one message, but the detailed cause is defined in a separate message.

In this case, the complete description of the traffic situation will be spread over two or more separate messages.

7.6 DirectCause

The DirectCause (see Table 6) is used to describe the reason for traffic problem in general.

The main reason for the separation of causes and the effect is so that the traffic situation can be described in the most meaningful way to the driver.

For example, Road closed (effectCode = 7), (due to) objects on the road (causeCode = 10).

Table 6 — DirectCause

Name	Type	Multiplicity	Description
mainCause	tec002:CauseCode	1	Main categorization of the cause according to table tec002.
warningLevel	tec003:WarningLevel	1	The level “informative” should be used for all traffic events, which may influence the driver’s route in any way requiring normal level of attention from the driver. The “danger levels” 1 to 3 should only be used for dangerous situations. Levels 1 to 3 are used in ascending levels of danger (Level 1 - Danger; Level 3 - Highly Dangerous). Danger levels 1 to 3 in combination with unverifiedInformation = True should be used in case of an unverified danger. For example, a traffic management centre receives a call from a private “jam buster” reporting that there is a “vehicle travelling on the wrong side of the road”, but this has not been confirmed by the police.
unverifiedInformation	Boolean	1	If element is set to 1, the given information has not been verified.
subCause	tec100:SubCauseType	0..1	Carries the value in the sub-cause table defined by the mainCauseCode.
lengthAffected	DistanceMetres	0..1	Length of the cause in metres.
laneRestrictionType	tec004:LaneRestriction	0..1	Specifies whether lanes are closed or open.

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 6 *(continued)*

Name	Type	Multiplicity	Description
numberOfLanes	IntUnTi	0..1	Specifies how many lanes are closed or open. If this element is not given, but laneRestrictionType indicates there are lane closures, it means an unspecified number of lanes are closed, i.e. “one or more lanes closed”. Or if laneRestrictionType indicates lanes open: “one or more lanes open”.
freeText	LocalizedShortString	0..*	Additional description.
causeOffset	DistanceMetres	0..1	Offset (metres) from the start of the Cause to the end of the Problem Location. When used together with lengthAffected, the cause can be positioned within the event more accurately. Without Cause Offset, but with lengthAffected efined, the cause position is not defined. If neither Affected Length nor Cause Offset are defined, the Cause spans the entire Problem Location.

7.7 Causes and sub-causes

When using a Direct Cause, then this Direct Cause component may optionally include a single subCause attribute of type SubCauseType.

The subCause attribute is used to further elaborate on the type of incident causing the problem.

Applicable SubCauseType values are defined in tables particular to each (mainCause) CauseCode.

Simple receivers shall support at least all Causes.

Receivers with more memory may additionally support subCauses. In this case, subCauses should replace the (main) cause completely. It is not necessary to combine causes and sub-causes in a manner to produce a grammatically correct complete sentence.

7.8 LinkedCause

LinkedCause (see Table 7) specifies a link to a message that provides more details about the cause. A link to another message is uniquely specified by the combination of originatorServiceID, contentID, applicationID and messageID. The linked message can be found in the service component where those attributes are equal to the values given in that component: linkedMessage, contentID (COID), originatorServiceID. In this case, the applicationID points to the TEC Application and is therefore not explicitly given in this component.

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 7 — LinkedCause

Name	Type	Multiplicity	Description
mainCause	tec002:CauseCode	1	Main categorization of the cause according to table tec002.
linkedMessage	IntUnLoMB	1	Contains a messageID as pointer to a message. If contentID and originatorSID is not given, the linked messages is contained in the actual component stream of the actual service.
COID	IntUnTi	0..1	If COID is not included, the linked message can be found in the component stream that has the same contentID as the linking message.
originatorSID	ServiceIdentifier	0..1	If originatorID is not included, the linked message can be found in the same service as the linking message.

7.8.1 Rules

Effect and cause(s) shall be split into two or more messages (linked cause) if

— they are from different providers, e.g. effect is provided by the police and cause by a private service provider,

— different update rates shall be used,

— the effect does not share the same position with the cause(s); splitting the messages permits a different Problem Location definition for the cause(s) and the effect, and

— the same situation requires two traffic flow-effects, e.g. different speed limits for cars and lorries.

7.8.2 Further constraints

One real cause may be represented either as a linked cause or as a direct cause. It is not allowed to describe one situation using both a direct cause and a linked cause at the same time. But it is allowed to use a direct cause and, in addition, a linked cause if two different causes apply to one situation (see Example 2 below).

7.8.3 Coding Examples

Example 1

In this case (see Figure 5 and Table 8), roadworks are causing a traffic jam, the position of the individual elements cannot be defined in detail, but as an overall event "Roadworks + Queue", the location is defined by the LRC. If the location of the queue and roadworks need to be explicitly detailed, they shall be split into separate messages.

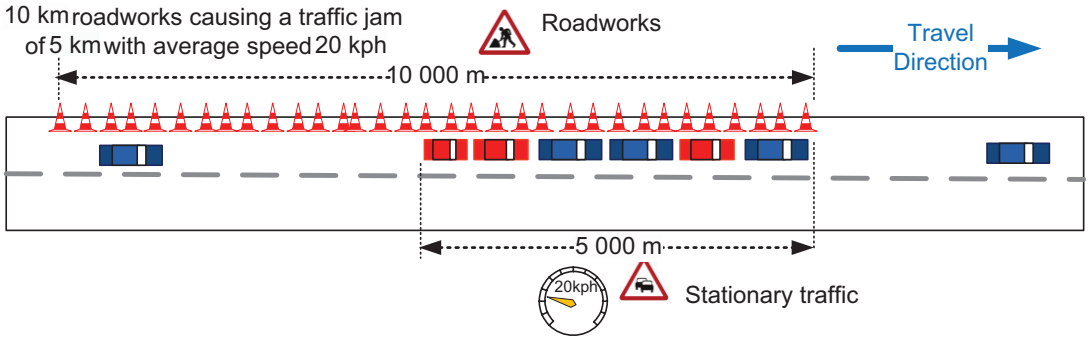

Figure 5 — Example 1 for a traffic situation which can be coded by use of a DirectCause

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 8 — Example 1

	Attribute	Value	Meaning
trafficflow_effect	effectCode	6	"stationary traffic"
	lengthAffected	5 000	5 000 m
	averageSpeedAbsolute	5 m/s	20 kph
directCause	causeCode	3	"roadworks"
	lengthAffected	10 000	10 000 m

Example 2

In this example (see Figure 6, Table 9 and Table 10), there is an accident causing a traffic queue within a section of roadworks. Since the accident is causing the tailback rather than the roadworks, the accident is the "direct cause" and the stationary traffic is the effect, the later can be reported in a single TEC message, with the Roadworks detailed in a separate message, linked by using the linked cause. For this situation, the two separate messages allow better definition of the location of the various elements of the problem. The first defining the position of the accident and its resulting traffic queue, and a second message reporting the position of the roadworks.

The segment_speed is a way to define the overall effect on permitted speed through the roadworks using a single value for routing calculations. The combination of the 80 kph and 60 kph sections combine to give an overall (mean) maximum permitted speed of 64 kph through a 10 km length of the problem.

For details on providing Temporary Speed Limits for display to the driver, see 7.12.

It should be noted that in this example, two messages may have to be transmitted with accident as the cause, one for each direction, as the accident may affect both sides of the road with different "effect".

An accident causing a 5 km traffic jam with average speed 20 kph within a 10 km Roadworks zone with multiple speed limit sections.

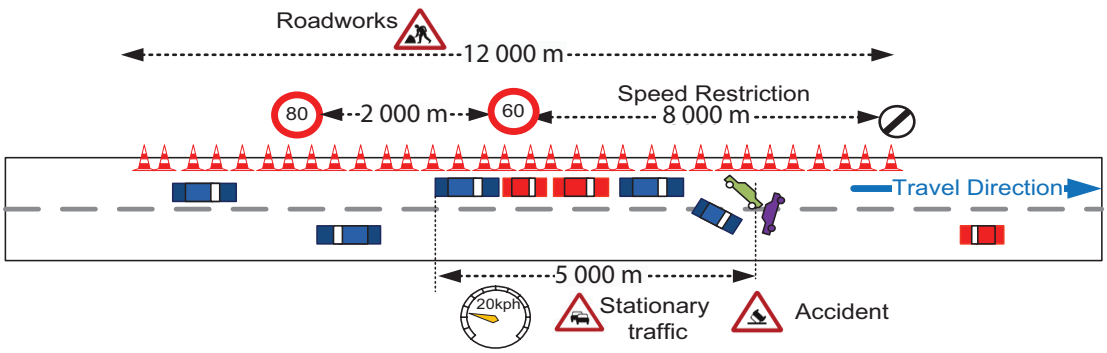

Figure 6 — Example 2 for a traffic situation, where a LinkedCause is necessary

Table 9 — Example 2: First message

	Attribute	Value	Meaning
effect	effectCode	5	"Queuing Traffic"
	lengthAffected	5 000	5 000 m
	averageSpeedAbsolute	5 m/s	20 kph
directCause	causeCode	2	"accident"
linkedCause	causeCode	3	"roadworks"
	linkedMessage	(ID of second message)	

© ISO 2016 – All rights reserved
Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016

Table 10 — Example 2: Second message

	Attribute	Value	Meaning
effect	effectCode	1	"unknown"
	lengthAffected	10 000	10 km
	segmentSpeedLimit	18 m/s	64 kph
	TemporarySpeedLimit	80 kph (2 km) + 60 kph, offset 10 km	(See 7.12)
directCause	causeCode	3	"roadworks"

Example 3

The causeOffset allows the positioning of DirectCauses within a single event to be defined more precisely.

Figure 7 (see also Table 11) shows an example of an event with 3 Causes: Roadworks and Narrow Lanes and LaneClosed. The Narrow Lanes and LaneClosed causes only cover part of the overall Problem Location.

The causeOffset, for the NarrowLanes and LaneClosed causes in this example, defines the position of the starting point of the cause upstream of the end of the Problem location. When used in addition to the lengthAffected, it allows relative positioning of each Cause within the Problem Location.

If lengthAffected is not defined for a cause, then the cause is deemed to extend fully to the downstream end of the Problem Location.

A message with LengthAffected, but without a causeOffset shall be interpreted as the Cause extending to the downstream end of the Problem Location.

If neither lengthAffected nor causeOffset is defined, then the cause spans the entire Problem Location.

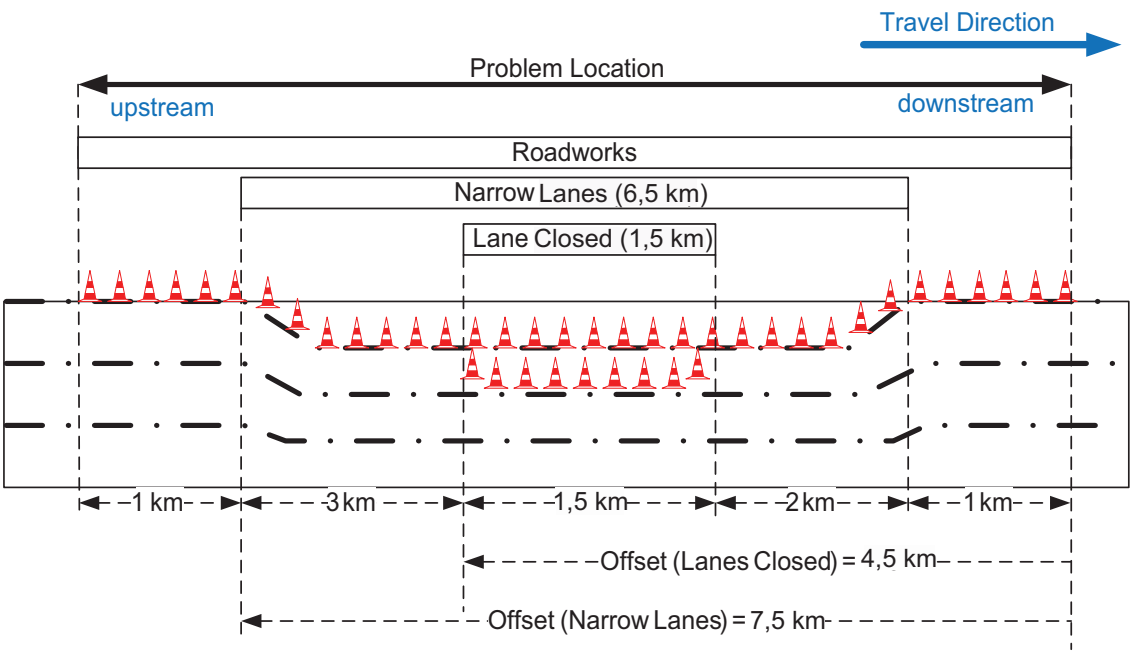

Figure 7 — Cause Offsets

© ISO 2016 – All rights reserved

Documents
Document Sharing Hub
Full document details: PD ISO/TS 21219-15:2016