Safety related message sets – Selection of DATEX II Situations, DENM rel. 2 and TPEG2-TEC Causes and TMC Events for EC high level Categories of Road Safety related Traffic Information - SRTI

Preamble

This Terms and Definitions document describes harmonized Road Safety Related Message sets addressing the EC Delegated Regulation No 886/2013 for a number of widely used ITS standards: DATEX II, TMC, TPEG2 and DENM. It was co-created and is maintained by the corresponding standardization organizations or platforms.

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1 Introduction

In the updated Directive 2023/2661/EU, amending the previous 2010/40/EU (ITS Directive), the European Commission developed for Priority Action C an EU Regulation named *"Data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users"* (EC Delegated Regulation No 886/2013). It defines a single list of categories of safety related traffic information to be provided at no extra cost for the end user at the point of use.

In Paragraph 7 (1) the Delegated Regulation says:

> *"Public and/or private road operators and/or service providers shall share and exchange the data they collect pursuant to Article 6. For that purpose, they shall make these data available in the DATEX II (CEN/TS 16157) format or any fully compatible and interoperable with DATEX II machine-readable format through an access point."*

Therefore, this "Terms and Definitions" provides a set of road safety related concepts, which shall be defined and declared as the message sets to be used for safety related messages. Furthermore, for the selected message sets a correlation in the focused standards DATEX II, DENM v2, TMC, and TPEG2-TEC is defined. This correlation is based on specific versions of these standards as provided in chapter 4 of this document.

The EU delegated regulation DR 886/2013 addresses minimum set of safety relevant events universally applicable in the EU, individual countries may additionally designate other safety relevant events depending on each country's specific needs and legislation in place in that country.

With Version 3 of the document the basis for the events have slightly altered: they are the functional events happening on the road and from there mapped to the respective standards. So, the correlation between standards is always done via the real-world event and not so much a 1-to-1 mapping of standards.

The first version of the following list of messages was collated based on discussions within a joint group of experts incorporating TISA experts (for TMC and TPEG2-TEC Technology) and key experts of the DATEX II specification in 2014. The resulting document was reviewed among a wider audience including all members of TISA, and also the appropriate experts within DATEX II.

In a subsequent update of this document in 2017, corrections to the DATEX II Situations were made. Furthermore, DENM Causes were added in alignment with the TPEG2-TEC Causes. This input was provided under the governance of the informal Amsterdam Group.

In 2019 a survey was made by the DATEX II community to take inventory of the real world events that are categorised as Safety related messages by the road operators on the TEN-T network in

Europe. The outcomes of this survey, in combination with an update of DATEX II version 3 is the basis for Version 3 of this document.

In 2020 the Car2Car Communication Consortium, representing the C-ITS OEM community, in co-operation with C-Roads, the EU wide platform for harmonized Infrastructure based C-ITS Services, and the Data For Road Safety (DFRS) partnership, a high-level initiative including EU Member States and the connected cars OEM community that evolved from the Data Task Force set up by the EU High-Level Meeting on Connected and Automated Driving, joined this workgroup to ensure proper alignment with these organisations and their developments.

Version 4 of this document, published by the group in 2025, now contains a section about how the DFRS initiative supports the growing ecosystem of Safety Related Traffic Information (SRTI) in Annex A together with references related to location referencing in Section 4 and clarifications for some of the event codes.

This document is by no means a prescriptive list of event-types or prescribing data collections or means of distribution of information. According to the delegated regulation it is up to the Member States and the data collecting organisations to determine whether their data has to be processed in compliance with DR 886/2013. The purpose of this document is twofold:

- to provide an insight and understanding of the current state of SRTI event selections and their further communication throughout Europe
- how these events can be expressed in the mainstream standards and profiles in use to inform travellers about traffic events.

The cooperation with the C-Roads platform was extended in order to align the SRTI message sets document with the developments in standards and respective message profiles in harmonized C-ITS service-definitions in C-Roads.

The rapidly increasing ability and availability of vehicles to generated safety related information is an important data source to improve the quality of safety related information services and therefore the safety on European roads. Where up until this version of the document the flow of data was mainly oriented from road operator towards service providers, now a new cooperative data source becomes available in the connected vehicles and mobility domain, which use for good reason the C-ITS or other standards to generate consistent information services for travellers. With this development in the connected vehicle context other relationships between the standard data formats used become more explicitly relevant: This is the transformation from complete messages between the data format standards involved in an unambiguous way and without the loss of information will be more relevant and being processed automatically.

2 Definitions

The following definitions related to Safety Related Traffic Information (SRTI) and Real Time Traffic Information (RTTI) are based on texts in the corresponding EU delegated regulations.

SRTI: road safety-related minimum universal traffic information …	… means an agreed minimum extracted, aggregated and processed road safety related traffic data, offered by public and/or private road operators and/or service providers as information to end users through any delivery channel, relevant throughout the European Union.
RTTI: real-time traffic information …	… means information derived from any static road data, dynamic road status data, traffic data, or the combination thereof, provided by any road authorities, road operators or service providers, for users and end-users, through any communication means
Safety relevant in practice …	… means an agreed minimum real-time road-safety related traffic information that can be collected via any private or public source and can be accessed at minimum effort by a maximum of end users.

3 Basic principles of the Message sets

The events or conditions to be covered by the road safety related minimum universal traffic information service shall consist of at least one of the following categories (according Paragraph 3 of the EU Regulation):

a. **Temporary slippery road**
b. **Animal/people/obstacles/debris on the road**
c. **Unprotected accident area**
d. **Short term road works**
e. **Reduced visibility**
f. **Wrong-way driver**
g. **Unmanaged blockage of a road**
h. **Exceptional weather conditions**

Each of the focused data protocol standards, be it DATEX II, DENM, TMC or TPEG, is a powerful toolbox that allows describing an event in very detail and in almost every variation.

The basic principle for the here mentioned selection of events for the safety related categories has been to show those events that are in use by road operators and which are considered relevant throughout Europe. The working group assigned these events to a safety related category and

choose those implementations in the respective standards that represent the intended warning nature of the message best, for the following reasons:

To improve ease of implementation within the whole service chain and future work of harmonisation in presentation of messages to users, the number of safety related messages selected within this document have been minimised.

Having in mind that drivers already receive quite a lot of messages while driving – mostly information only - selecting a huge number of events for the safety related categories might bear a risk that the warning nature of the message will not be entirely implemented in order to avoid an overflow of warning “beeps” to the driver.

The selected events are DANGER warnings, and it has to be guaranteed that the defined events in either DATEX II or DENM or TMC or TPEG if selected by a content provider is really a WARNING message. All following partners of the value chain must interpret that code as a dangerous message with the appropriate presentation. Such a required quality and reliability of the service can be reached best by concentrating on as few events as possible. This is an important issue to be considered by data sources: Very detailed event descriptions might not be expressible 1 to 1 in all standards (you see them as white lines in the tables below). The result will be loss of information and in the worst case: loss of warnings. A strong recommendation to data sources is to express the available information in an event that is supported by all standards in the tables.

A more detailed description of the safety related traffic information, like for example the impact on the traffic, increases the acceptance of the information on the one hand, but has – mostly – no impact for additional safety. In some special cases, for example if the driver isn´t able to notice the danger on first view (e.g. black ice) or if additional care is required (e.g. children on the street), the corresponding event code has also been added to the list presented in this paper.

Of course, it is possible and desired to offer more information than presented in this paper. For example, it can be distributed as an additional “premium” service to traffic relevant safety information.

The aim is to allow service providers to implement a simple but efficient warning service and to avoid misinterpretations of the warning nature of events. The proposed solution is a compromise that tries to reflect the business cases affected as far as possible without losing the principal idea of warning drivers free of charge.

3.1 Warning Level

For an automated processing in devices a classification of safety messages in categories makes sense. According to this classification, the devices identify the warning level of the message and take appropriate actions, such as specific acoustic and visual warnings.

It is important, that a safety related traffic information has the same warning level in every standard.

3.1.1 Warning Level in TPEG2-TEC

The TPEG2-TEC-Standard contains a warning level, which explains the category of danger of the message. The following four levels are possible in TPEG2-TEC:

Code	TISA English "WORD"	Comment	Example
1	informative	This level is of standard informative nature.	-
2	danger level 1	This level is used for acquiring attention by the driver.	Attention, there is a dangerous obstruction due to fog
3	danger level 2	This level is used for local hazard warnings being dangerous.	Attention, there due to deer
4	danger level 3	This level is used for local hazard warnings being highly dangerous.	Attention, highest danger due to ghost driver

Tab. 3-1: Warning Levels in TPEG2-TEC

3.1.2 Warning Level in TMC

In RDS-TMC an urgency level is defined for every TMC event, even if this is not a safety-relevant information. Every TMC event has a default urgency assigned, which can be overridden by adding a (optional) control code during transmission. At the moment, in many end-user devices the message presentation appears independent of the actual transmitted urgency level.

Description	Specification
(blank) normal urgency	make available to end-users on request
urgent	present to end-users having selected this location, immediately
extremely urgent	present to all end-users immediately

Tab. 3-2: Urgency Levels in TMC

3.1.3 Warning Level in DATEX II

The current version of DATEX II (version 3) contains in the Situation Publication an attribute `safetyRelatedMessage` that has been created to clearly mark data elements of type `SituationRecord` (i.e. the type used for elementary content of traffic messages) explicitly as “safety relevant”.

The optional attribute `safetyRelatedMessage` of the class `SituationRecord` – with potential values “true” and ”false” – **shall** be present and **shall** be set to “true” for content in the scope of the Delegated Regulation for safety related messages.

The definition for this new attribute is: Indicates, whether this `SituationRecord` specifies a safety related message according to Commission Delegated Regulation (EU) No 886/2013. It's recommended use is wider: all safety related events should be flagged with this marker, in order to support coherent road network user-experience for this type of services. (be aware that the formalities of the DR apply to the TEN-T network only, except if a MS ordered that the network is wider, this might/will exclude a lot of relevant roads on which road safety is relevant as well)

3.1.4 Warning level in DENM

The current version of DENM has no possibility to mark a message as “safety relevant”. This function could be added in a future version of the DENM specification. For the moment all DENMs are considered to be safety relevant.

Priority levels are handled in vehicular communication not in the DENM, but by the network layer. In ETSI standards these priority levels are called traffic classes. They are similar to urgency levels as used by other communication protocols. Currently, no formal warning level mapping from other data formats to DENM traffic classes is in place.

3.2 Category a) Temporary slippery road

Definition: *EC Delegated Regulation No 886/2013*	“Temporary slippery road” means any unforeseen condition of the road surface which makes it slippery for a certain amount of time, causing low adherence of the vehicle to the road.

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The following messages belong to the category "**Temporary slippery road**":

- Flooding
- Danger of aquaplaning
- Surface water hazard
- Slippery road
- Mud on road
- Loose chippings
- Oil on road
- Petrol on road
- Ice
- Black ice
- Snow drifts
- Icy patches

DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text
EnvironmentalObstruction	flooding		flooding. Danger	908	5	1	3	flooding	9	0	hazardous location - surface condition
WeatherRelatedRoadConditions	surfaceWater		danger of aquaplaning	1002	7		3	aquaplaning	7	0	aquaplaning
WeatherRelatedRoadConditions	surfaceWater		surface water hazard	1041	7		3	aquaplaning	7	0	aquaplaning
WeatherRelatedRoadConditions	slippery		slippery road (above Q hundred metres)	1003	6		3	slippery road	6	0	adverse weather condition -adhesion
NonWeatherRelatedRoad Conditions	mudOnRoad		mud on road. Danger	1055	6	3	3	mud on road	6	3	mud on road
NonWeatherRelatedRoad Conditions	looseChippings		loose chippings. Danger	1056	6	8	3	loose chippings	6	8	loose chippings
NonWeatherRelatedRoad Conditions	oilOnRoad		oil on road. Danger	1057	6	7	3	oil on road	6	7	oil on road
NonWeatherRelatedRoad Conditions	petrolOnRoad		petrol on road. Danger	1058	6	2	3	fuel on road	6	2	fuel on road
WeatherRelatedRoadConditions	ice		ice (above Q hundred metres)	1006	6	5	3	ice on road	6	5	ice on road
WeatherRelatedRoadConditions	blackIce		black ice (above Q hundred metres)	1008	6	6	3	black ice on road	6	6	black ice on road
WeatherRelatedRoadConditions	snowDrifts		snow drifts (above Q hundred metres)	1016	9	5	3	snow drifts	9	5	snow drifts
WeatherRelatedRoadConditions	icyPatches		icy patches (above Q hundred metres)	1047	6	5	3	ice on road	6	5	ice on road

Tab. 3-3: Corresponding Message Subsets for the category "Temporary slippery road"

The selection of the messages is based on the following rules:

- The significant message is "slippery road (above Q hundred metres)", which explains the effect of the category.
- The other messages are also selected, because they give drivers important information for to adjust their driving behaviour. For example, some of them can´t be seen on first view (e.g. oil, petrol or black ice).
- Categories such as heavy snowfall or heavy rain are not relevant in this category, because they are part of category "h) exceptional weather conditions".

Characteristics in the translation to DATEX II:

No conceptual mapping is available for *aquaplaning* in the translation to DATEX II, as this is a consequence of a road condition where water is on the road. Therefore the factual situation of "surface water" is used instead.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

TPEG2-TEC has no specific means to surface water hazards, the cause code 7 for "aquaplaning" was selected instead.

Characteristics in the translation to DENM:

DENM has no specific means to code flooding or surface water hazards.

- For flooding, the general cause code "hazardous location - surface condition" was selected to indicate hazardous driving conditions.
- For surface water hazard, the cause code "aquaplaning" was selected.

3.3 Category b) Animal/people/obstacles/debris on the road

Definition: *EC Delegated Regulation No 886/2013*	"Animal, people, obstacles, debris on the road" means any situation where animals, debris, obstacles or people are positioned on the road where one would not expect to find them so that an emergency manoeuvre might be required to avoid them.

The following messages belong to the category "**Animal/people/obstacles/debris on the road":**

- Objects on the road
- Obstructions on the road
- Shed loads
- Fallen trees
- Avalanches
- Rockfalls
- Landslips
- Animals on the road
- People on roadway
- Children on roadway
- Cyclists on roadway
- Large animals on roadway
- Herds of animals on roadway
- People throwing objects onto the road
- Broken down vehicles
- Vehicle on fire

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The selection of these messages is based on the following rules:

- In this category the reason of the impact is also included, because some of the events can move very quickly other are more static.
- Events, which warn of small things, like for example small animals on the road, are not relevant in this category, because they are not safety relevant for a typical vehicle.

DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)			
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text	linkedCause
GeneralObstruction	objectOnThe Road		(Q) object(s) on the road. Danger	63	10		3	objects on the road	10	0	hazardous location - obstacle on the road	
GeneralObstruction	obstructionOnThe Road		(Q) obstructions on the road. Danger	902	10	4	3	large objects	10	4	large objects	
GeneralObstruction	shedLoad		(Q) shed load(s). Danger	359	10	1	3	shed load	10	1	shed load	
EnvironmentalObstruction	fallenTrees		(Q) fallen trees. Danger	906	10	5	3	fallen trees	10	5	fallen trees	
EnvironmentalObstruction	avalanches		avalanches. Danger	992	5	2	3	danger of avalanches	5	0	impassability	10 – 4 - largeObjects
EnvironmentalObstruction	rockfalls		rockfalls. Danger	998	9	1	3	rockfalls	9	1	rockfalls	
EnvironmentalObstruction	landslips		landslips. Danger	999	5	4	3	landslips	5	0	impassability	10 – 4 - largeObjects
AnimalPresenceObstruction	animalsOnThe Road		animals on the road. Danger	923	11		3	animals on roadway	11	0	hazardous location -animal on the road	
GeneralObstruction	peopleOnRoad way		people on roadway. Danger	1482	12		3	people on roadway	12	0	human presence on the road	
GeneralObstruction	childrenOnRoad way		children on roadway. Danger	1483	12	1	3	children on roadway	12	1	children on roadway	
GeneralObstruction	cyclistsOnRoad way		cyclists on roadway. Danger	1484	12	2	3	cyclists on roadway	12	2	cyclists on roadway	
AnimalPresenceObstruction	largeAnimalsOn TheRoad		large animals on roadway	1067	11	4	3	large animals	11	4	large animals	
AnimalPresenceObstruction	herdOfAnimals OnTheRoad		herds of animals on roadway	1068	11	2	3	herd of animals	11	2	hazardous location - herd of animals	
DisturbanceActivity	peopleThrowingObjectsOnTheRoad		people throwing objects onto the road. Danger	897	20	3	4	stone throwing persons	20	3	stone throwing persons	
VehicleObstruction	brokenDown Vehicle		(Q) broken down vehicle(s). Danger	393	13		3	broken down vehicles	94	2	stationary vehicle – vehicle breakdown	
VehicleObstruction	vehicleOnFire		(Q) vehicle fire(s)	213	13	1	3	broken down vehicle burning	94	0	stationary vehicle	18 – 2 – visibility reduced due to smoke

Tab. 3-4: Corresponding Message Subsets for the category "Animal/people/obstacles/debris on the road"

Characteristics in the translation to DATEX II:

Especially in this category there is a distinction needs to be made between the warning of the risk that these events might (are likely to) occur versus whether they really happened.

In DATEX II the likelihood of occurrence of an event is given by the attribute `probabilityOfOccurence`:

- When this attribute has the value set to riskOf it is a warning.
- When the value has been set to certain, the event really occurred in the specified location.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

No special characteristics in the translation to TPEG2-TEC.

Characteristics in the translation to DENM:

- Obstacles and obstructions might be different. This difference is not supported in DENM.
- Vehicle on fire is not supported in DENM, therefore a smoke warning combined with the stationary vehicle is the work-around.
- In a DENM avalanches and landslips are handled as roadblocks caused by large objects on the street.
- There is a difference between a warning in case of a risk of a specific occurrence and a warning in case it already occurred and has impact on the driving conditions. Especially in the situation that the operator wants to warn for the risk of avalanches, rockfalls, landslips, DENM should not be used, as the meaning of this cause sub-cause code combination implies it is a warning for an event that really happened. Per definition DENMs should be sent only when an event occurred. They are no warning messages for something that might happen. For such warning purposes IVI messages should be used.

3.4 Category c) Unprotected accident area

Definition: *EC Delegated Regulation No 886/2013*	"Unprotected accident area" means the area where an accident has occurred and which has not yet been secured by the competent authority;

The following message belongs to the category "**Unprotected accident area":**

- Unprotected accident area(s)
- Accident
- Accident involving bus
- Accident involving lorry

The selection of this message is based on the following rule:

- An accident is protected at the moment, when a competent authority (e.g. the police) arrives at the place of accident. Because of this, all other message types concerning accidents are belonging to protected accident areas and are therefore not part of the category “Unprotected accident area”.
  If the accident area has not been protected and may present a hazard to road users, it may also be signalled as Accident or Accident involving bus or Accident involving lorry.

DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text
GeneralObstruction	Unprotected AccidentArea		(Q) unprotected accident area(s)	857	2	7	3	unsecured accident	2	7	unsecured accident
Accident	accident		(Q) accident(s)	201	2		3	accident	2	0	accident
Accident	accidentInvolvingPublic Transport		accident involving a/(Q) bus(es)	335	2	4	3	accident involving bus	2	4	accident involving bus
Accident	accidentInvolvingHeavyLorries		accident involving a/(Q) heavy lorr(y/ies)	204	2	3	3	accident involving lorry	2	3	accident involving lorry

Tab. 3-5: Corresponding Message Subsets for the category “Unprotected accident area”

Characteristics in the translation to DATEX II:

The scope of the accident type `accidentInvolvingPublicTransport` is wider compared to the other message formats that only support an accident with a bus. For the specific case of an accident involving a bus, the additional element `vehicleInvolved` with `vehicleType` "bus" is used.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

No special characteristics in the translation to TPEG2-TEC.

Characteristics in the translation to DENM:

No special characteristics in the translation to DENM.

3.5 Category d) Short term road works

Definition: *EC Delegated Regulation No 886/2013*	"Short-term road works" means any temporary road works that are carried out on the road or on the side of the road and which are indicated only by minimum signing because of the short-term nature of these works.

The following messages belong to the category "**Short term road works":**

- Clearance work
- Maintenance work
- Slow moving maintenance vehicle(s)
- Road marking work
- Rescue and recovery work
- Snowploughs in action

The selection of these messages is based on the following rules:

- Short term roadworks describe roadworks, which are in the most cases only protected by a (moving) trailer. Construction sites for a longer duration are signalled more in front of the location and are therefore not part of the list.

Traditionally Road operators in C-Roads are driven by legislation, which distinguishes between short- and long-term work zones based on the duration of the work, whereas in a connected vehicle and mobility context with a differentiation according to the complexity and impact of the work zones on the traffic flows and on the single traffic participant the warning level and message send is the key element to be considered.

These different approaches between road infrastructure organisations and vehicle OEM´s and travellers lead to the fact that the harmonisation between sender of the information and the receiver is not fully given, because the details on the work zone are communicated in different ways. Since a uniform solution is the goal, C2C-CC and C-Roads agreed on the following points, which are described in the C-Roads RWW handbook[1].

In this document, the migration path for differently equipped vehicles (currently, vehicles process DENMs in the future vehicles process also C-ITS messages like IVIM, SPATEM and MAPEM) is also reflected. Each DENM message shall contain enough information for the receiver to detect a dangerous situation.

[1] https://releases.c-roads.eu/

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DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text
GeneralObstruction	clearanceWork[2]		clearance work	924	15		3	rescue and recovery work in progress	15	0	rescue and recovery work in progress
MaintenanceWorks	maintenanceWork		(Q sets of) maintenance work	703	3		3	roadworks	3	4	short-term stationary roadworks
MaintenanceVehicles	slowMoving[3]		(Q) slow moving maintenance vehicle(s)	1700	3	3	3	slow moving road maintenance	3	3	slow moving road maintenance
MaintenanceWorks	roadMarkingWork		(Q sets of) road marking work. Danger	824	3	2	3	road marking work	3	2	road marking work
GeneralObstruction	rescueAnd RecoveryWork[4]		rescue and recovery work in progress.	397	15		3	rescue and recovery work in progress	15	0	rescue and recovery work in progress
MaintenanceWorks	snowploughsInUse		(Q) snowploughs	681	26	6	3	snowplough	26	6	slow vehicle snowplough

Tab. 3-6: Corresponding Message Subsets for the category "Short term road works"

Characteristics in the translation to DATEX II:

Slow Moving maintenance vehicles: The class `MaintenanceVehicles` is aggregated to the Roadworks class and not a specialisation of it. Some further specialisation of the abstract Roadworks class is necessary in this case, for example `MaintenanceWork` with literal `maintenanceWork`.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

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2 The term `clearanceWork` is typically associated with an earlier traffic problem (e.g. an accident) and the resulting activities carried out by a road maintenance crew will likely cause traffic disruptions during the time when the clearance work is ongoing.

3 The term `slowMoving` in the category `MaintenanceVehicles` should be clearly separated from DATEX II term `dangerousSlowMovingVehicle` because the latter represents a danger for other road users due to the large speed difference between the `dangerousSlowMovingVehicle` and the other vehicles moving at normal speed and because it is not protected by any signage. The former represents a road maintenance activity with a proper signage (e.g. leading or following protection vehicles).

4 The term `rescueAndRecoveryWork` indicates rescue activities undertaken by emergency services or first-responders (e.g. police, fire trucks, ambulances) and these may present a hazard to road users because signage may be sparse or improvised (e.g. due to first-responders having just arrived at the scene and being in the process of setting up signage) and because the situation may change over time (e.g. additional lanes being closed to protect first-responders or opened after first-responders leave the scene).

Characteristics in the translation to TPEG2-TEC:

TPEG2-TEC does not distinct between “clearance work” and “rescue and recovery work in progress”. Both are mapped to rescue and recovery work in progress.

Characteristics in the translation to DENM:

The DENM does not distinct between “clearance work” and “rescue and recovery work in progress”. Both are mapped to rescue and recovery work in progress.

3.6 Category e) Reduced visibility

Definition: *EC Delegated Regulation No 886/2013*	“Reduced visibility” means visibility affected by any condition that reduces the sight range of drivers and which might affect safe driving.

The following messages belong to the category “**Reduced visibility”:**

- Visibility reduced
- Smoke hazard
- Dense fog
- Patchy fog
- Blowing snow
- Serious fire
- Fog

The selection of these messages is based on the following rules:

- The main message in this category is “visibility reduced”, explaining the category generally.
- The other selected messages are also relevant, because they need different adapted reactions of the driver.
- Fog is recommended as safety relevant if it presents a hazard to road user when the visibility could fall below e.g. 100 meters, exact value may be country specific.
- Slightly reduced visibility because of fog, snow or rain is not a safety relevant message, because in many Member States this is a normal weather situation.
- Serious fire is considered as safety relevant if this is the first signalisation of the fire, when it could lead to a smoke hazard or other dangerous impact. Although these other kinds of danger do not comply with the category definition of the Delegated Regulation, operational practise shows that fire should (and actually is) flagged as SRTI, with or without smoke hazard.

DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)			
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text	Linked Cause
PoorEnvironmentConditions	visibilityReduced		visibility reduced (to Q)	1318	18		3	visibility reduced	18	0	adverse weather condition - visibility	
PoorEnvironmentConditions	smokeHazard		smoke hazard (visibility reduced to Q)	1309	18	2	3	visibility reduced due to smoke	18	2	visibility reduced due to smoke	
PoorEnvironmentConditions	denseFog		dense fog (visibility reduced to Q)	1301	18	1	3	visibility reduced due to fog	18	1	visibility reduced due to fog	
PoorEnvironmentConditions	patchyFog		patchy fog (visibility reduced to Q)	1307	18	1	3	visibility reduced due to fog	18	1	visibility reduced due to fog	
PoorEnvironmentConditions	blowingSnow		blowing snow (visibility reduced to Q)	1323	18	3	3	visibility reduced due to heavy snowfall	18	3	visibility reduced due to heavy snowfall	17 – 1 – strong winds
EnvironmentalObstruction	seriousFire		serious fire	921	8	1	3	major fire	5	0	impassibility	18 – 2 – visibility reduced due to smoke
PoorEnvironmentConditions	fog		dense fog (visibility reduced to Q)	1301	18	1	3	visibility reduced due to fog	18	1	visibility reduced due to fog	

Tab. 3-7: Corresponding Message Subsets for the category "Reduced visibility"

Characteristics in the translation to DATEX II:

No special characteristics in the translation to DATEX II.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

TPEG2-TEC doesn´t distinguish between dense and patchy fog, there is one fog message for all types of fog.

Characteristics in the translation to DENM:

DENM doesn´t distinguish between dense and patchy fog, there is one message for all types of fog.

There is no DENM for blowing snow. This event is translated to heavy snow fall with strong winds as linked cause code.

There is currently no DENM for fire, a serious fire is indicated as closure of at least a lane and reduced visibility due to smoke.

3.7 Category f) Wrong-way driver

Definition: *EC Delegated Regulation No 886/2013*	"Wrong-way driver" means a vehicle travelling on the wrong side of a divided carriageway against the oncoming traffic;

The following message belongs to the category **"Wrong-way driver":**

- Vehicle(s) on wrong carriageway

DATEX II (EN 16157-3)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text
VehicleObstruction	vehicleOnWrong Carriageway		(Q) vehicle(s) on wrong carriageway	1701	14		4	vehicle on wrong carriageway	14	2	wrong way driving

Tab. 3-8: Corresponding Message Subsets for the category "Wrong-way driver"

Characteristics in the translation to DATEX II:

No special characteristics in the translation to DATEX II.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

No special characteristics in the translation to TPEG2-TEC.

Characteristics in the translation to DENM:

No special characteristics in the translation to DENM.

3.8 Category g) Unmanaged blockage of a road

Definition: *EC Delegated Regulation No 886/2013*	"Unmanaged blockage of a road" means any blockage of a road, partial or total, which has not been adequately secured and signposted.

The following messages belong to the category "**Unmanaged blockage of a road**":

- blocked
- bridge blocked
- tunnel blocked
- exit blocked
- connecting carriageway blocked
- entry blocked

The selection of these messages is based on the following rule:

- This category only contains events, which describe an unmanaged blockage of a road. If a blockage is secured by competent authority (e.g. the police) or if the road is closed for roadworks, the authority has enough time to plan a safeguard. Once the blockage is managed, the affected (part of the) road is closed. Lane and road closures are not defined as SRTI rel-

evant traffic situations.

DATEX II (EN 16157-3)			TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type	Supplementary Position Description		Text (CEN-English)	Code	Cause Code	Cause Sub Code	Warning Level	Text	Cause Code	Cause Sub Code	Text
TrafficElement	roadBlocked			blocked	402	5		3	impassability	5	0	impassibility
TrafficElement	roadBlocked	onBridge		bridge blocked	26	5		3	impassability	5	0	impassibility
TrafficElement	roadBlocked	inTunnel		tunnel blocked	27	5		3	impassability	5	0	impassibility
TrafficElement	roadBlocked	exitSlipRoad		exit blocked	476	5		3	impassability	5	0	impassibility
TrafficElement	carriagewayBlocked	connectingCar-riageway		connecting carriageway blocked	485	5		3	impassability	5	0	impassibility
TrafficElement	roadBlocked	entrySlipRoad		entry blocked	473	5		3	impassability	5	0	impassibility

Tab. 3-9: Corresponding Message Subsets for the category "Unmanaged blockage of a road"

Characteristics in the translation to DATEX II:

No special characteristics in the translation to DATEX II.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

In TPEG2-TEC the cause code impassability was selected. The Location Reference shall refer to the proper location (the entry or exit location itself in case the entry or exit was blocked). Any further description can be added additional.

Characteristics in the translation to DENM:

DENM uses the code for impassibility. It could be accompanied by an IVI message providing additional detailed information.

3.9 Category h) Exceptional weather conditions

Definition: *EC Delegated Regulation No 886/2013*	"Exceptional weather conditions" means unusual, severe or unseasonal weather conditions which might affect safe driving.

The category "**Exceptional weather conditions**" contains all the weather-related events, which are not part of the categories "Temporary slippery road" and "Reduced visibility". The following messag-

es belong to the category “Exceptional weather conditions”:

- Heavy snowfall
- Heavy rain
- Hurricane force winds
- Storm force winds
- Strong winds
- Crosswinds
- Strong winds affecting high-sided vehicles
- Hail
- Thunderstorm

The selection of these messages is based on the following rules:

- Common weather conditions, like snow, rain or wind are not relevant for a safety relevant message, because in many Member States they are a normal weather situation.
- For drivers the exact definition of the wind is not important. Drivers only need to know that they have to anticipate strong wind.

DATEX II (EN 16157)		TMC Events (EN ISO 14819-2)			TPEG2-TEC (ISO/TS 21219-15)				DENM (ETSI EN 302 637-3)		
DATEX Class	Type		Text (CEN-English)	Code	Cause Code	Sub Cause Code	Warning Level	Text	Cause Code	Sub Cause Code	Text
PoorEnvironmentConditions	heavySnowfall		heavy snowfall (Q)	1101	19	2	3	heavy snowfall	19	2	heavy snowfall
PoorEnvironmentConditions	heavyRain		heavy rain (Q)	1109	19	1	3	heavy rain	19	1	heavy rain
PoorEnvironmentConditions	hurricaneForceWinds[5]		storm force winds (Q)[5]	1204	17	1	3	strong winds[5]	17	3	hurricane[5]
PoorEnvironmentConditions	stormForceWinds[5]		storm force winds (Q)[5]	1204	17	1	3	strong winds[5]	17	1	strong winds[5]
PoorEnvironmentConditions	strongWinds[5]		strong winds (Q)[5]	1205	17	1	3	strong winds[5]	17	1	strong winds[5]
PoorEnvironmentConditions	crosswinds[6]		crosswinds (Q)[6]	1210	17	1	3	strong winds[5]	17	1	strong winds[5]
PoorEnvironmentConditions	strongWinds[5]		strong winds (Q)[5] affecting high-sided vehicles	1211	17	1	3	strong winds[5]	17	1	strong winds[5]
PoorEnvironmentConditions	hail[7]		hail (visibility reduced to Q)	1106	17	2	3	damaging hail	17	2	damaging hail
PoorEnvironmentConditions	thunderstorms		thunderstorms (visibility reduced to Q)	1108	17	4	3	thunderstorm	17	4	thunderstorm

Tab. 3-10: Corresponding Message Subsets for the category “Exceptional weather conditions”

5 EN with 1991-1-4:2005 Euro Code for Wind Load Calculation

6 `Crosswinds` is mapped in DENM to `strong winds` at a certain local position (small area). Crosswinds are typically indicated be road signs of type A18 according to the Vienna Convention.

7 Road operators, having a focus on road safety (e.g. closing roads in bad weather conditions), or road maintenance/clearance works (e.g. dispatching snowploughs) do generally not differentiate between ‘hail’ or ‘damaging hail’ as the effect of hail on road safety or road maintenance is the same. Hence, `PoorEnvironmentConditions/hail` is considered sufficient, no further differentiation required. For indicating hail to drivers, the difference between ‘hail’ and ‘damaging hail’ may have consequences on driving style, route planning or pausing a journey for seeking shelter.

Characteristics in the translation to DATEX II:

No special characteristics in the translation to DATEX II.

Characteristics in the translation to TMC:

No special characteristics in the translation to TMC.

Characteristics in the translation to TPEG2-TEC:

TPEG2-TEC doesn´t distinguish between different types of strong wind.

Characteristics in the translation to DENM:

DENM doesn´t distinguish between different types of strong wind.

4 Location referencing

Location referencing is a critical component for SRTI services as the intrinsic value of the information increases the more accurate the warning can be displayed to the driver in time and space. While accuracy the time dimension can easily be guaranteed by fine-granular time stamps and synchronized clocks, spatial accuracy requires exact geolocations when encoding the event (e.g. at the point where an obstacle for category b is detected on the road) and decoding the event in the vehicle. The main challenge is that both encoding and decoding may use different maps and/or different methods for describing points, lines, areas or road segments relative to a map.

Each of the standards referenced in this document uses potentially different, albeit often similar, methods for describing geolocations. While the tables in sections 3.2 to 3.9 provide guidance on which event codes to use for different SRTI data categories, location referencing relies on the preferred location referencing methods used for each standard.

As this document focuses on the *Safety Related Messages Sets*, it is beyond its scope to provide detailed explanations on the different location referencing methods. The following Tab. 5-1 should merely provide a general overview of which location referencing methods are available for the different standards together with references to the corresponding standards documents.

Location feature	Location referencing type	DATEX	TMC	TPEG	DENM
Point	geographic (only coordinate-based)	Point-by-Coordinates (GPS)		DLR1 [3] OLR [4] GLR [5] ULR [6]	Location referencing for Point, Linear and Area are described in ETSI TS102894-2 [8]
	map-related pre-coded (table-lookup)	TMC [1]	TMC [1]	TMC [1]	
	map-related on-the-fly plus geographic (map-matching)	OpenLR TpegLoc PointAlongLinearElement [1]		DLR1 [3] OLR [4] ULR [6]	
Linear	geographic (only coordinate-based)	GML		DLR1 [3] OLR [4] GLR [5]	
	map-related pre-coded (table-lookup)	TMC [1]	TMC [1]	TMC [1]	
	map-related on-the-fly plus geographic (map-matching)	OpenLR TpegLoc PointAlongLinearElement [1]		DLR1 [3] OLR [4] ULR [6]	
Area	geographic (co-ordinate-based)	GML		DLR1 [3] OLR [4] GLR [5] ULR [6]	
	map-related pre-coded (table-lookup)	TMC [1]	TMC [1]	TMC [1]	
	map-related on-the-fly plus geographic (map-matching)	OpenLR TpegArea		DLR1 [3] (road network within area) OLR [4] (area within bounding roads)	

Tab. 4-1: Location referencing methods that can be used with the different message sets

Note that TPEG uses a Location Referencing Container (LRC) concept [2], where different location referencing methods can be flexibly embedded for the various TPEG applications.

Note that DENM uses as concept with *Awareness area*, *Relevance zone* and *Detection zone* as described in section 6.1.3 Geographic location information in [7]. This document links the use cases to Awareness area or Relevance zone.

Awareness area: Geographic area in which information concerning the event is potentially applicable for use or for further distribution.

Detection Zone: Part of the road network that is passed by a vehicle in approach of the relevance zone. This is covered by traces.

Relevance Zone: Area where the information is applicable For geographical precise use cases like accident, roadworks warning, stationary vehicle, etc.

In the C-ITS area all traffic events, and especially SRTI related ones, need to be encoded at lane level precision, in order to be received and processed correctly by the receiving vehicles and different message types (IVIM, SPATEM, MAPEM and others) can be used to do so, but these are out of scope of this paper and therefore please see details at https://releases.c-roads.eu/.

References for Tab. 5-1:

[1] ISO 14819-3:2021 Intelligent transport systems – Traffic and travel information messages via traffic message encoding, Part 3: Location referencing for Radio Data System – Traffic Message Channel (RDS-TMC) using ALERT-C

[2] ISO TS 21219-7 Intelligent transport systems (ITS) - Traffic and travel information (TTI) via transport protocol experts group, generation 2 (TPEG2) – Part 7: Location referencing container (TPEG2-LRC_3.0/001)

[3] ISO 17572-3:2015 Location referencing for geographic databases, Part 3: Dynamic location references

[4] ISO TS 21219-22 TPEG2 – Part 22: OpenLR location reference (TPEG2-OLR)

[5] ISO TS 21219-21 TPEG2 – Part 21: Geographic location referencing (TPEG2-GLR)

[6] SP13008_TPEG2-ULR_1_0_001 TPEG2 – Part 11: Universal Location Referencing (TPEG2-ULR_1.0/001) (no ISO version)

[7] ETSI TS 103 831 V2.1.1 (2022-11): Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Decentralized Environmental Notification Service; Release 2

[8] ETSI TS 102 894-2 V2.1.1 (2022-11): Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary; Release 2

5 References

ITS Directive (2010):

Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport (Text with EEA relevance).

EC Delegated Regulation No 886/2013 (2013):

Commission Delegated Regulation (EU) No 886/2013 of 15 May 2013 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users (Text with EEA relevance).

DATEX II (2018):

EN 16157-3:2018 Intelligent transport systems - DATEX II data exchange specifications for traffic management and information - Part 3: Situation Publication.

DENM (2019):

ETSI EN 302 637-3 V1.3.1 (2019-04), Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service

NOTE: The update of the Common Data Dictionary ETSI TS 102 894-2 from V1.3.1 to V2.3.1 does not affect the Message Set correlation in this document. Release 2 (V2.3.1) only adds Codes, but does not change or delete them, and is therefore backward compatible in terms of Message Set correlation.TMC (2013):

EN ISO 14819-2:2013, Traffic and Traveller Information (TTI). TTI messages via traffic message coding Event and information codes for Radio Data System. Traffic Message Channel (RDS-TMC).

TPEG2-TEC (2016):

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)

6 Contact

For questions related to this document, please contact the TISA Executive Office via eo@tisa.org

Annex A – The role of DFRS within the SRTI eco-system

Data For Road Safety (DFRS) is the European-wide organisation representing industry partners, public bodies and governments with the goal of contributing to the collaborative Safety Related Traffic Information (SRTI) ecosystem. It currently represents the collaboration between Vehicle Manufacturers (OEMs), Data Service Providers, National Road Authorities and National Governments.

Nr.	High-level data category		
1	Static travel data		
2	Dynamic travel data		
3	Infrastructure data		
4	Regulations and restrictions: static and dynamic traffic regulations, traffic circulation plans, other regulations and restrictions		
5	State of network: closures, works, traffic management measures, accidents, weather conditions		
6	Real-time use of the network: volumes, speeds, queues, travel times, availabilities of POIs		
7	**Safety related data**	**Slippery road** **Obstacle** **Unprotected accidents** **Short-term roadworks** **Reduced visibility** **Wrong-way driving** **Unmanaged blockage** **Exceptional weather**	**Scope of this document**
8	Safe and secure truck parking: static data, safety and equipment, dynamic data in priority zones		

Tab. 0-1: SRTI message categories within the high-level data categories defined by ITS Directive 2010/40/EU

DFRS provides input to the *safety related data* category of the ITS Directive 2010/40/EU, describing the 8 high-level data categories shown in the above Tab. 4-1. The high-level category *'safety related data'* is further subdivided into 8 subcategories, which are the primary subject of this document.

The DFRS data is generated way of collecting road- or traffic-related situations from individual vehicles and integrating them into reports that fall within these 8 *safety-related data* subcategories. the general data flow from the vehicles over the OEM backends toward the National Access Points (NAPs) and the Service Providers is shown in the following Fig. 4-1.

Safety related message sets –
Selection of DATEX II Situations, DENM rel. 2 and TPEG2-TEC Causes and TMC Events for EC high level Categories of Road Safety related Traffic Information - SRTI

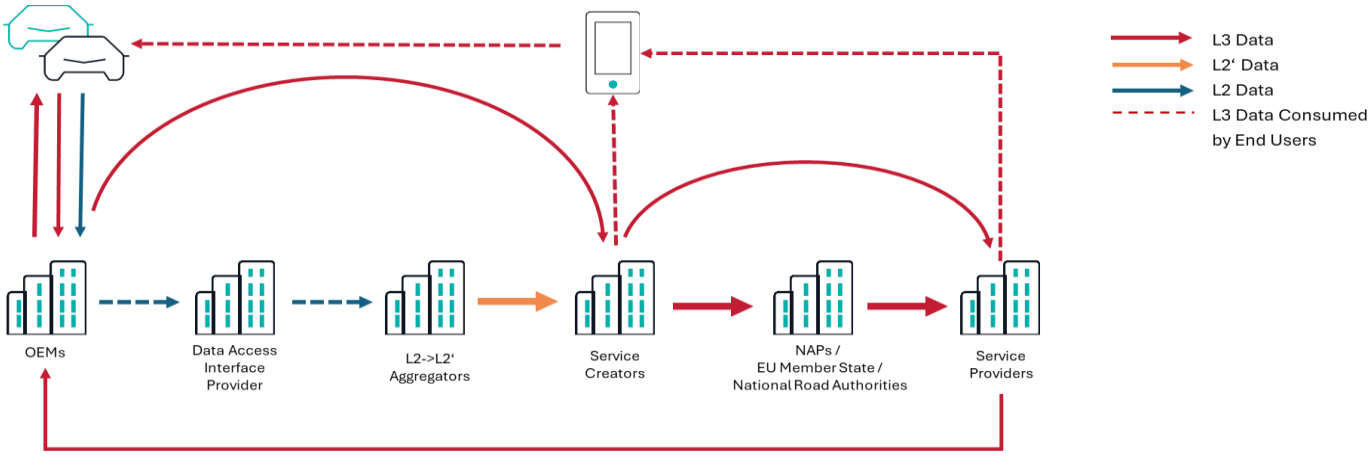

Fig. 0-1: DFRS message generation process

DFRS defines 3 aggregation levels for the vehicle-generated data as shown in Tab. 4-2 below.

DFRS Defined Data Levels	Description	Produced by	Access provided by
Level 2 (L2)	Fleet wide SRTI and non-SRTI data collated from an individual vehicle fleet by the vehicle cloud and made available by a service cloud	Data Source Members	Data Access Interface Providers
Level 2 Prime (L2')	Enriched L2 data by aggregating multiple feeds, cleansing data and harmonisation of data set syntax	Aggregator Members	Data Access Interface Providers
Level 3 (L3)	L3 data created by aggregating data of matching type and spatial proximity. Additional non-vehicle L2 observed data made be added to corroborate. Encoded and published as DATEX II	Creators	Data Access Interface Providers, or Service Provers if direct to End Users

Tab. 0-2: DFRS data categories definitions

This document refers to the Level 3 *"SRTI Information Situation categories"* (L3) that DFRS Service Provider members will render and distribute to end users free of charge. The DFRS members will produce and disseminate L3 SRTI as DATEX2 situations which can be mapped to the other safety related message sets defined within this document.

Various member roles are defined within the SRTI ecosystem and detailed explanations can be found within the DFRS Technical Documentation[8]. However, *'Data Source'* members contribute original data to the SRTI ecosystem by providing their Level 2 (L2) raw data using the SENSORIS standard. *'Aggregator'* members process and aggregate multiple sources of Level 2 (L2) data to

[8] www.dataforroadsafety.eu/relevant-documents

create Level 2 Prime (L2') either as SENSORIS or DATEX II. *'Creator'* members generate L3 data by combining and aggregating L2, L2', other L3 data from external sources such incident management information as shown in Fig. 4-1.

DFRS is a decentralised system, meaning that the various members can act independently of each other whilst still contributing to the benefit of the wider SRTI ecosystem. For example, multiple OEM vehicle fleets can operate independently of each other within their own vehicle fleets and vehicle clouds using communication methods and open data standards of their choice. Decentralisation allows diverse datasets and encourages innovation within an inclusive ecosystem.

Using open standards and by exposing the technical documentation created by the individual member services, other members of the SRTI ecosystem can leverage the L2 data generated and to provide value add activities such as aggregation of multiple L2 data sources into L2'. DFRS as a collective works to harmonise the lower-level data by creating a common vocabulary of what attributes SRTI data requires, whilst still allowing extensibility and innovation within the consortium.

Creators, such as Road Authorities, may create L3 data by combining multiple different L2 or L2' sources alongside their own L2 and L3 data. They may group events spatially and by time of occurrence. Events of the same type that occur near each other and at similar times are likely to represent the same event, the reporting by multiple different sources, merely increases the reliability of that information by allowing corroboration. Different grouping thresholds may be explored for different SRTI event types, for example unprotected accidents areas will not have a large geographical spread, and multiple reports may be split into multiple different L3 event, whereas extreme weather events could extend for large distances and may be grouped into a single event. The number of events that a grouped in a L3 event may determine the priority, a creator such as a road authority, gives to responding to that event.

Different DFRS Creators may assign different grouping and prioritisation rules depending on their own business priorities and use cases, meaning that L3 SRTI output may differ between Creators in both output and latency. However, the DATEX II standard and consistent meaning of the SRTI message sets ensures that output is of a consistent structure and meaning between all Creators and Service Providers. This allows End Users to consume the L3 data with consistent processing and understanding of the messages they receive.

Annex B – Excel spreadsheet

For user convenience the tables in this document are also available as excel sheet. The filename of this excel sheet is `ITSTF20001 – SafetyRelatedMessageSets 1.0.xlsx`. In case of conflicts between the excel sheet and this document, the content of this document is prevailing.