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From: Secretary-General of the European Commission,
signed by Mr Jordi AYET PUIGARNAU, Director

To: Mr Jeppe TRANHOLM-MIKKELSEN, Secretary-General of the Council of
the European Union

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Subject: ANNEX to the Commission Delegated Regulation supplementing Directive
2010/40/EU of the European Parliament and of the Council with regard to
the deployment and operational use of cooperative intelligent transport
systems

Delegations will find attached document C(2019) 1789 final - Annex 1.

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Brussels, 13.3.2019
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ANNEX 1

ANNEX

to the

Commission Delegated Regulation

**supplementing Directive 2010/40/EU of the European Parliament and of the Council
with regard to the deployment and operational use of cooperative intelligent transport
systems**

{SEC(2019) 100 final} - {SWD(2019) 95 final} - {SWD(2019) 96 final}

ANNEX I

1. INTRODUCTION

This Annex contains the service profiles for the C-ITS priority services. A service profile is a specific configuration of standards, defining the implementation of various options of standards.

1.1. References

The following references are used in this Annex:

- TS 102 894-2 ETSI TS 102 894-2, *Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary*, V1.3.1 (2018-08)
- EN 302 637-2 ETSI EN 302 637-2, *Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service*, V1.4.0 (2018-08); this reference shall be read as the reference to version 1.4.1 from the date of the publication of that version.
- EN 302 637-3 ETSI EN 302 637-3, *Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service*, v1.3.0 (2018-08); this reference shall be read as the reference to version 1.3.1 from the date of the publication of that version.
- ECE 13 Regulation No 13 of the Economic Commission for Europe of the United Nations (UN/ECE), *Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking* [2016/194]
- ECE 13H Regulation No 13H of the Economic Commission for Europe of the United Nations (UN/ECE), *Uniform provisions concerning the approval of passenger cars with regard to braking* [2015/2364]
- ECE 48 Regulation No 48 of the Economic Commission for Europe of the United Nations (UN/ECE), *Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light-signalling devices* [2016/1723]
- ECE 121 Regulation No 121 of the Economic Commission for Europe of the United Nations (UN/ECE), *Uniform provisions concerning the approval of vehicles with regard to the location and identification of hand controls, tell-tales and indicators* [2016/18]

ISO/TS 19321	ISO/TS 19321, <i>Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures</i> (15 April 2015)
ISO 639-1	<i>Codes for the representation of names of languages — Part 1: Alpha-2 code</i>
ISO/TS 14823	ISO/TS 14823:2017. <i>Intelligent transport systems — Graphic data dictionary</i>

1.2. Notations and abbreviations

The following notations and abbreviated terms are used in this Annex:

ABS	Anti-lock Braking System
ASR	Anti-Slip Regulation
AT	Authorization Ticket
CAM	Cooperative Awareness Message
C-ITS	Cooperative Intelligent Transport Systems
DCC	Decentralized Congestion Control
DEN	Decentralized Environmental Notification
DENM	Decentralized Environmental Notification Message
GNSS	Global Navigation Satellite System
I2V	infrastructure-to-vehicle
IRC	Impact Reduction Container
IVI	Infrastructure to Vehicle Information
MAP	Topology information for the intersection
SPAT	Signal Phase and Timing
SREM	Signal Request Extended Message
SSEM	Signal Request Status Extended Message
TC	Traffic Class
TMS	Traffic Management system
TOC	traffic operations centre
TRCO	Triggering condition
TTC	Time to Collision
V2V	vehicle-to-vehicle

1.3. Definitions

The following definitions are used in this Annex:

- (a) ‘stationary vehicle’ means a vehicle with an absolute speed ≤ 8 centimetres per second. This state shall be determined by internal vehicle sensors;
- (b) ‘emergency vehicle’ means a vehicle that is designated and authorised to respond to an emergency. Emergency vehicles are often permitted by law to

break conventional road rules in order to reach their destinations in the fastest possible time, such as (but not limited to) driving through an intersection when the traffic lights are red or exceeding the speed limit.

2. LIST OF PRIORITY SERVICES

Service category	Service	Service profile
Vehicle-to-vehicle services		
Traffic jam	Dangerous end of queue	Section 3
Traffic jam	Traffic jam ahead	Section 4
Stationary vehicle warning	Stopped vehicle	Section 5
Stationary vehicle warning	Broken-down vehicle	Section 6
Stationary vehicle warning	Post-crash	Section 7
Special vehicle warning	Emergency vehicle in operation	Section 8
Special vehicle warning	Stationary safeguarding emergency vehicle	Section 9
Special vehicle warning	Stationary recovery service warning	Section 10
Exchange of IRCs	Request IRC	Section 11
Exchange of IRCs	Response IRC	Section 12
Dangerous situation	Electronic emergency brake light	Section 13
Dangerous situation	Automatic brake intervention	Section 14
Dangerous situation	Reversible occupant restraint system intervention	Section 15
Adverse weather conditions	Fog	Section 16
Adverse weather conditions	Precipitation	Section 17
Adverse weather conditions	Traction loss	Section 18
Infrastructure-to-vehicle services		
In-vehicle signage	Dynamic speed limit information	Section 19
In-vehicle signage	Embedded VMS 'free text'	Section 20
In-vehicle signage	Other signage information	Section 21
Hazardous locations notification	Accident zone	Section 22
Hazardous locations notification	Traffic jam ahead	Section 23
Hazardous locations notification	Stationary vehicle	Section 24
Hazardous locations notification	Weather condition warning	Section 25
Hazardous locations notification	Temporarily slippery road	Section 26

Hazardous locations notification	Animal or person on the road	Section 27
Hazardous locations notification	Obstacle on the road	Section 28
Road works warning	Lane closure (and other restrictions)	Section 29
Road works warning	Road closure	Section 30
Road works warning	Road works — mobile	Section 31
Signalised intersections	Green light optimal speed advisory	Section 32
Signalised intersections	Public transport prioritisation	Section 33

3. TRAFFIC JAM — DANGEROUS END OF QUEUE

3.1. Description of cooperative intelligent transport systems (C-ITS) service

This C-ITS service transmits vehicle-to-vehicle (V2V) information on a situation where an ego vehicle detects the end of a traffic jam ('dangerous end of queue'). Such a situation exists when the traffic lane of the ego vehicle is blocked and the vehicle cannot proceed in its lane. Urban environment is not considered in this service.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- 'dangerous situations — electronic emergency brake light'.

3.2. Triggering conditions

3.2.1. Preconditions

- (1) The following preconditions shall be satisfied every time before this C-ITS service is triggered:
 - (a) the ego vehicle is located in a non-urban environment, as determined in at least one of the following ways:
 - the velocity is greater than 80 km/h for a time block of at least 30 s in the 60 s prior to each detection and the absolute value of the steering wheel angle is less than 90 ° for a time block of at least 30 s in the 60 s prior to each detection ('dangerous end of queue' should not be detected in a non-motorway environment);
 - an on-board camera sensor indicates non-urban environment;
 - an on-board digital map indicates non-urban environment.
 - (2) The vehicle velocity and deceleration shall be determined by the vehicle bus signal, not by a Global Navigation Satellite System (GNSS). The filtered vehicle velocity (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle velocity and deceleration analysis.
 - (3) The velocity and angle values shall be measured continuously. The conditions shall be satisfied throughout the measurement duration. The process shall start over again if the conditions are not satisfied within measurement duration.

3.2.2. Service-specific conditions

- (4) If the preconditions in point (1) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the

generation of a Decentralised Environmental Notification Message (DENM) shall be triggered:

- TRCO_0 AND (TRCO_2 OR TRCO_3 OR TRCO_4 OR TRCO_5 OR TRCO_6)
- TRCO_1 AND TRCO_2.

Table 1: ‘Traffic jam — dangerous end of queue’ service-specific conditions

Count	Triggering condition (TRCO)	Status
TRCO_0	The ego vehicle is driving with an initial velocity exceeding 80 km/h and the initial deceleration is equal to or below 0.1 m/s ² . The driver reacts to the dangerous end of queue by reducing the velocity from initial to target velocity of 30 km/h or less. The duration between initial and target velocity shall be 10 s or less. An instant deceleration between initial and target velocity exceeding 3.5 m/s ² is detected.	driver reaction
TRCO_1	Passengers of the ego vehicle react to the traffic jam by enabling hazard lights for at least 3 s	driver reaction
TRCO_2	At least three other vehicles with a velocity of at least 7 km/h have hazard lights enabled for at least 3 s, as indicated by: <ul style="list-style-type: none"> • an on-board camera sensor; or • CAMs. 	environment or on-board sensors
TRCO_3	At least one DENM corresponding to the ‘ <i>Traffic jam - Dangerous end of queue</i> ’ C-ITS service has been received.	environment
TRCO_4	At least five different DENMs (i.e. with different <i>actionIDs</i>) corresponding to the ‘ <i>traffic jam - traffic jam ahead</i> ’ C-ITS service have been received from the downstream traffic.	environment
TRCO_5	At least one DENM corresponding to the ‘ <i>Special vehicle warning - Static safeguarding emergency vehicle</i> ’ C-ITS service has been received, with <i>linkedCause</i> equal to <i>Traffic Condition</i> or <i>Dangerous End of Queue</i> .	environment
TRCO_6	On-board sensors of the ego vehicle recognise that the vehicle is facing a dangerous end of queue.	on-board sensors

- (5) A new DENM shall not be requested within the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a DENM to that effect has been requested. In this way, a single event is not able to flood the transmission channel. The *Detection Blocking Time* shall be 60 s no matter how the event is detected. The detection period between two detected events shall be at least equal to the *Detection Blocking Time*. The detection algorithm may run during *Detection Blocking Time*.

Note: No period for the braking manoeuvres is presented, because the initial ego vehicle velocity has no upper restriction.

- (6) A condition shall be valid as long as it is active and for an extra period of 5 s (the period increases the determinism of the detection algorithm). The validity shall decrease from the moment the condition is no longer satisfied, thus facilitating the combination of triggering conditions.

- (7) CAMs and DENMs from remote vehicles used for evaluating service-specific conditions as described above shall be relevant for the ego vehicle. The relevance shall be determined in one of these ways:
- (a) a digital map indicates that the event and the ego vehicle are separated by a distance of less than 500 m and share the same driving direction;
 - (b) a path history match indicates that the event and the ego vehicle are separated by a distance of less than 500 m and share the same driving direction;
 - (c) the Euclidean distance between the event and the ego vehicle is less than 500 m and the absolute value of the heading difference is less than 10 °. The traffic jam reference positions according to the DENMs are located in an area spanning from -45 ° to +45 ° starting at the ego vehicle's longitudinal axis.

Note: When counting vehicles or events, Authorization Ticket (AT) change should be considered in such a way that no vehicle or event is counted multiple times.

3.2.3. Information quality

- (8) The value of the data element *informationQuality* in the DENM depends on how the situation is detected. TRCOs (see point (4)) are divided into groups: driver reaction, vehicle dynamics, environment and on-board sensors. The *informationQuality* value shall be set according to the following table. The highest possible value shall be used.

Table 2: Information quality of 'traffic jam — dangerous end of queue'

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
At least one TRCO from the driver reaction AND environment group is fulfilled.	1
At least one TRCO from the driver reaction AND on-board sensors group is fulfilled.	2
At least one TRCO from the driver reaction AND environment AND on-board sensors group is fulfilled.	3

3.3. Termination conditions

- (9) A termination of the C-ITS service shall not be considered.

3.3.1. Cancellation

- (10) A cancellation DENM shall not be used for this C-ITS service.

3.3.2. Negation

- (11) A negation DENM shall not be used for this C-ITS service.

3.4. Update

- (12) An update DENM shall not be used for this C-ITS service.

3.5. Repetition duration and repetition interval

(13) New DENMs shall be repeated for a *repetitionDuration* of 20 s with a *repetitionInterval* of 0.5 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the Decentralised Environmental Notification (DEN) basic service shall be set according to the above values.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

3.6. Traffic class

(14) New DENMs shall be set to *traffic class* 1.

3.7. Message parameters

3.7.1. DENM

(15) The following table specifies the data elements of the DENM that shall be set.

Table 3: DENM data elements of ‘traffic jam — dangerous end of queue’

Data Field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set according to [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -Timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>referenceTime</i>	<i>TimestampIts</i> -Timestamp at which a new DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2].
<i>relevanceDistance</i>	lessThan1000 m(4)
<i>relevanceTrafficDirection</i>	upstreamTraffic(1)
<i>validityDuration</i>	20s (it is expected that vehicles will be facing a different traffic situation 20 s after detection)
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (8)
<i>causeCode</i>	dangerousEndOfQueue(27)
<i>subCauseCode</i>	unavailable(0)

Location container			
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			
<i>lanePosition</i>	If the lanePosition is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.		
	If the lanePosition is unknown, the data element shall be omitted.		

3.7.2. Cooperative Awareness Message (CAM)

(16) CAM adaption shall not be used for this C-ITS service.

3.8. Network and transport layer

- (17) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

3.9. Security layer

- (18) If the triggering conditions are fulfilled as described in point (4), an AT change shall be blocked for new DENMs as long as the *validityDuration* has not expired. Corresponding new DENMs shall be sent with the same AT.

4. TRAFFIC JAM — TRAFFIC JAM AHEAD

4.1. Description of C-ITS service

This C-ITS service transmits V2V information on a situation where an ego vehicle detects a traffic jam. Such a situation exists if the ego vehicle is surrounded by stationary traffic or a heavy volume of traffic. This service does not apply to urban environments.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘stationary vehicle warning — stopped vehicle’;
- ‘stationary vehicle warning — broken-down vehicle’;
- ‘stationary vehicle warning — post-crash’;
- ‘special vehicle warning — stationary recovery service warning’.

4.2. Triggering conditions

4.2.1. Preconditions

- (19) The following preconditions shall be satisfied before this C-ITS service is initialised:
- (a) no ‘stationary vehicle warning’ service (see sections 4 to 6) is detected;
 - (b) no ‘special vehicle warning’ service (see sections 7 to 9) is detected;
 - (c) the ego vehicle is located in a non-urban environment. The location shall be determined in at least one of these ways:
 - (a) the velocity is greater than 80 km/h for a time block of at least 30 s in the 180 s prior to each detection and the absolute value of the steering wheel angle is less than 90° for a time block of at least 30 s in the 60 s prior to each detection (traffic jams should not be detected on motorways);
 - (b) an on-board camera sensor indicates non-urban environment;
 - (c) an on-board digital map indicates non-urban environment.
- (20) The vehicle velocity shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle velocity (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle velocity analysis.

- (21) The velocity and angle values shall be measured continuously. The conditions shall be satisfied throughout the measurement duration. The process shall start over again if the conditions are not satisfied within measurement duration.

4.2.2. Service-specific conditions

- (22) If the preconditions in point (19) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- TRCO_0;
- TRCO_1 AND (TRCO_2 OR TRCO_3 OR TRCO_4 OR TRCO_5)

Table 4: ‘Traffic jam — traffic jam ahead’ service-specific conditions

Count	Triggering condition	Status
TRCO_0	The ego vehicle is moving with an average velocity of 30 km/h or less and more than 0 km/h (this threshold is introduced to avoid overlap and to distinguish TRCO_0 and TRCO_1). The average velocity shall be calculated over a period of 120 s (the duration condition excludes frequently changing traffic states from triggering). Note: This TRCO covers the scenario where the ego vehicle is surrounded by stop-and-go traffic.	vehicle dynamics
TRCO_1	The ego vehicle velocity is equal to 0 km/h for at least 30 s. Note: This TRCO covers a scenario in which the ego vehicle is stationary and surrounded by other road users.	vehicle dynamics
TRCO_2	At least one DENM corresponding to the ‘ <i>traffic jam - traffic jam ahead</i> ’ C-ITS service with the same driving direction has been received.	environment
TRCO_3	At least one traffic jam notification with the same driving direction has been received by means of mobile radio.	environment
TRCO_4	CAMs indicate a velocity of 30 km/h or less of at least five other vehicles within 100 m and with the same driving direction.	environment
TRCO_5	On-board sensors indicate a velocity 30 km/h or less of at least five other vehicles within 100 m and with the same driving direction.	on-board sensor

- (23) A new DENM shall not be requested in the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a DENM to that effect has been requested. In this way, a single event is not able to flood the transmission channel. The *Detection Blocking Time* shall be 180 s no matter how the event is detected. The detection period between two detected events shall be at least equal to the *Detection Blocking Time*. The detection algorithm may run during *Detection Blocking Time*.

- (24) A condition shall be valid as long as it is active and for an extra period of 5 s (the period increases the determinism of the detection algorithm). The validity decreases from the moment the condition is no longer satisfied, thus facilitating the combination of triggering conditions.

- (25) CAMs and DENMs from remote vehicles used to evaluate service-specific conditions as described above shall be relevant for the ego vehicle. The relevance shall be determined in one of these ways:
- (a) a digital map indicates that the event and the ego vehicle are separated by a distance of less than 500 m and share the same driving direction;
 - (b) a path history match indicates that the event and the ego vehicle are separated by a distance of less than 500 m and share the same driving direction;
 - (c) the Euclidean distance between the event and the ego vehicle is less than 500 m and the absolute value of the heading difference is less than 10 °. The traffic jam reference positions according to the DENMs are located in an area spanning from -45 ° to +45 ° starting at the ego vehicle's longitudinal axis.

Note: When counting vehicles or events, AT change should be considered in such a way that no vehicle or event is counted multiple times.

4.2.3. Information quality

- (26) The value of the data element *informationQuality* in the DENM depends on how the situation is detected. TRCOs (see point (22)) are divided into groups: driver reaction, vehicle dynamics, environment and on-board sensors. The *informationQuality* value shall be set in accordance with the following table. The highest possible value shall be used.

Table 5: Information quality of ‘traffic jam — traffic jam ahead’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
At least one condition from the vehicle dynamics group is fulfilled, i.e. condition TRCO_0 is fulfilled.	1
At least one condition from the vehicle dynamics AND environment group is fulfilled.	2
At least one condition from the vehicle dynamics AND on-board sensor group is fulfilled.	3
At least one condition from the vehicle dynamics AND environment group AND on-board sensor group is fulfilled.	4

4.3. Termination conditions

- (27) A termination of the C-ITS service shall not be considered.

4.3.1. Cancellation

- (28) A cancellation DENM shall not be used for this C-ITS service.

4.3.2. Negation

- (29) A negation DENM shall not be used for this C-ITS service.

4.4. Update

(30) An update DENM shall not be used for this C-ITS service.

4.5. Repetition duration and repetition interval

(31) New DENMs shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the values above.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

4.6. Traffic class

(32) New DENMs shall be set to *traffic class* 1.

4.7. Message parameters

4.7.1. DENM

(33) The following table specifies the data elements of the DENM that shall be set.

Table 6: DENM data elements of ‘traffic jam — traffic jam ahead’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2].
<i>relevanceDistance</i>	lessThan1000m(4)
<i>relevanceTrafficDirection</i>	upstreamTraffic(1)
<i>validityDuration</i>	60 s (a traffic jam situation is expected to last at least 60 s)
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (26).
<i>causeCode</i>	trafficCondition(1)

<i>subCauseCode</i>	unavailable(0)		
Location container			
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			
<i>lanePosition</i>	If the lanePosition is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.		
	If the lanePosition is unknown, the data element shall be omitted.		

4.7.2. CAM

(34) CAM adaption shall not be used for this C-ITS service.

4.8. Network and transport layer

(35) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

4.9. Security layer

(36) If the triggering conditions are fulfilled as described in point (22), an AT change shall be blocked for new DENMs as long as the *validityDuration* has not expired. Corresponding new DENMs shall be sent with the same AT.

5. STATIONARY VEHICLE WARNING - STOPPED VEHICLE

5.1. Description of C-ITS service

This C-ITS service transmits V2V information on a situation where a vehicle has stopped, without particular information about the reason.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘special vehicle warning — stationary recovery service warning’;
- ‘stationary vehicle warning — broken-down vehicle’;
- ‘stationary vehicle warning — post-crash’.

(37) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as being met. Such a signal prompts the stack to generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

5.2. Triggering conditions

5.2.1. Preconditions

(38) The following preconditions shall be satisfied before this C-ITS service is triggered:

- (a) no breakdown warning message that prevents the driver from continuing driving (e.g. red warning symbols, in accordance with [ECE 121]) is shown on the instrument cluster.

Note: This service is not required to check ignition terminal 15 status for triggering (can be on or off). Operation of the service is optional when ignition terminal 15 is off.

(39) Parallel activation with the other related C-ITS services shall be avoided. Where the ‘*broken-down vehicle*’ and/or ‘*post-crash*’ C-ITS services are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘post-crash’ (highest priority);
- (b) ‘broken-down vehicle’;
- (c) ‘stopped vehicle’ (lowest priority).

5.2.2. Service-specific conditions

- (40) If the preconditions in point (38) and all of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:
- (a) the ego vehicle has enabled hazard lights;
 - (b) the vehicle is stationary;
 - (c) the *Triggering Timer* has expired.
- (41) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle speed analysis.
- (42) If the vehicle has enabled hazard lights and is stationary, the *Triggering Timer* shall be set to 30 s and started. The *Triggering Timer* shall be reduced if the following situations arise:
- (a) the timer shall be reduced by 10 s if the automatic transmission (AUT) is set to ‘park’ for at least 3 s;
 - (b) the timer shall be reduced by 10 s if the gear box is set to idle for at least 3 s;
 - (c) the timer shall be reduced by 10 s if the parking brake is enabled for at least 3 s;
 - (d) the timer shall be reduced by 10 s if an arbitrary number of seatbelt buckles change from ‘connected’ to ‘disconnected’ for at least 3 s;
 - (e) the timer shall be set to 0 if an arbitrary number of doors are open for at least 3 s;
 - (f) the timer shall be set to 0 if the ignition terminal is switched from on to off for at least 3 s;
 - (g) the timer shall be set to 0 if the boot is open for at least 3 s;
 - (h) the timer shall be set to 0 if the bonnet is open for at least 3 s.
- (43) All above-listed procedures for the timer reduction shall be applied only once during initial detection. If the *Triggering Timer* has been counted down to 0, no further reduction is necessary in the current detection cycle.
- (44) During the runtime of the *Triggering Timer*, the hazard lights shall be enabled and the vehicle shall be stationary. Otherwise, the detection shall be cancelled.

5.2.3. Information quality

- (45) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (42)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 7: Information quality of ‘stationary vehicle — stopped vehicle’

Event detection	Value of InformationQuality
-----------------	-----------------------------

No TRCO-compliant implementation	unknown(0)
None of the conditions a) — h) are fulfilled.	1
At least one condition of a) — d) is fulfilled.	2
At least one condition of e) — h) is fulfilled.	3

(46) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated. In the update phase, only the conditions that would lead to a timer reduction shall be evaluated, but not the timer itself.

5.3. Termination conditions

(47) This C-ITS service is terminated by a cancellation of the originating C-ITS station. At the termination of the C-ITS service, update DENM request shall be terminated.

5.3.1. Cancellation

(48) If at least one of the following conditions is satisfied before the period set in the data element *validityDuration* has expired, the generation of a cancellation DENM shall be triggered:

- (a) the vehicle is no longer stationary for a duration of 5 s;
- (b) the hazard lights are disabled;
- (c) the position of the vehicle has changed more than 500 m (e.g. because the vehicle has been towed away).

Note: The cancellation condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

5.3.2. Negation

(49) A negation DENM shall not be used for this C-ITS service.

5.4. Update

(50) If the previously triggered DENM for a detected *Stopped Vehicle* was not cancelled, the generation of an update DENM shall be triggered every 15 s.

(51) In the update phase, only the triggering conditions shall be checked (further evaluation of timers shall not be executed).

(52) New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*).

Note: The update condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that update condition.

5.5. Repetition duration and repetition interval

(53) DENMs that are new, have been updated or have been cancelled shall be repeated for a *repetitionDuration* of 15 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval*

between the application and the DEN basic service shall be set in accordance with the above values.

Note: The *validityDuration* is set to 30 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

5.6. Traffic class

(54) New, update and cancellation DENMs shall be set to *traffic class 1*.

5.7. Message parameters

5.7.1. DENM

(55) The following table specifies the data elements of the DENM that shall be set.

Table 8: DENM data elements of ‘stationary vehicle warning — stopped vehicle’

Data field	Value										
Management container											
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].										
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].										
<i>termination</i>	Shall not be set in the case of new or update DENM. Shall be set to <i>isCancellation(0)</i> in the case of a cancellation DENM.										
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>relevanceDistance</i>	<i>lessThan1000m(4)</i>										
<i>relevanceTrafficDirection</i>	If the <i>roadType</i> is known, the value shall be set as follows:										
	<table border="1"> <thead> <tr> <th>RoadType</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;"><i>allTrafficDirections(0)</i></td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;"><i>upstreamTraffic(1)</i></td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;"><i>allTrafficDirections(0)</i></td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;"><i>upstreamTraffic(1)</i></td> </tr> </tbody> </table>	RoadType	Direction	0	<i>allTrafficDirections(0)</i>	1	<i>upstreamTraffic(1)</i>	2	<i>allTrafficDirections(0)</i>	3	<i>upstreamTraffic(1)</i>
	RoadType	Direction									
	0	<i>allTrafficDirections(0)</i>									
	1	<i>upstreamTraffic(1)</i>									
	2	<i>allTrafficDirections(0)</i>									
3	<i>upstreamTraffic(1)</i>										
	Otherwise, the value shall be set to <i>allTrafficDirections(0)</i>										
<i>validityDuration</i>	30 s										

<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
Situation container			
<i>informationQuality</i>	See point (45). Shall be refreshed for every update DENM.		
<i>causeCode</i>	stationaryVehicle(94)		
<i>subCauseCode</i>	unavailable(0)		
Location container			
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM. Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			

<i>lanePosition</i>	<p>If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.</p> <p>If the <i>lanePosition</i> is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>
Alacarte container: StationaryVehicleContainer	
<i>stationarySince</i>	<p>Shall be set in accordance with the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>

5.7.2. CAM

(56) CAM adaption shall not be used for this C-ITS service.

5.8. Network and transport layer

(57) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

5.9. Security layer

(58) If the triggering conditions as described in point (40) apply, an AT change shall be blocked for new, update and cancellation DENMs as long as the *validityDuration* has not expired. Corresponding new, update and cancellation DENMs shall be sent with the same AT.

6. STATIONARY VEHICLE WARNING — BROKEN-DOWN VEHICLE

6.1. Description of C-ITS service

This C-ITS service transmits V2V information on a broken-down vehicle. Though various reasons could cause a vehicle breakdown, such as bursting tires, lack of fuel or engine failure, this section focuses on reasons indicated by breakdown warning messages in the instrument cluster.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘special vehicle warning — stationary recovery service warning’;
- ‘stationary vehicle warning — stopped vehicle’;
- ‘stationary vehicle warning — post-crash’.

(59) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

6.2. Triggering conditions

6.2.1. Preconditions

(60) The following precondition shall be satisfied before this C-ITS service is triggered:

- (a) a breakdown warning message that prevents the driver from continuing driving (e.g. red warning symbols, in accordance with [ECE 121]) is shown on the instrument cluster.

Note: This service is not required to check ignition terminal 15 status for triggering (can be on or off). Operation of the service is optional when ignition terminal 15 is off.

(61) Parallel activation with the other related C-ITS services shall be avoided. Where the ‘*stopped vehicle*’ and/or ‘*post-crash*’ C-ITS services are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘post-crash’ (highest priority);
- (b) ‘broken-down vehicle’;
- (c) ‘stopped vehicle’ (lowest priority).

6.2.2. Service-specific conditions

(62) If the precondition in point (60) and all of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (a) the ego vehicle has enabled hazard lights;
- (b) the vehicle is stationary;
- (c) the *Triggering Timer* has expired.

(63) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle speed analysis.

(64) If the vehicle has enabled hazard lights and is stationary, the *Triggering Timer* shall be set to 30 s and started. The *Triggering Timer* shall be reduced if the following situations arise:

- (a) the timer shall be reduced by 10 s if the automatic transmission (AUT) is set to ‘park’ for at least 3 s;
- (b) the timer shall be reduced by 10 s if the gear box is set to idle for at least 3 s;
- (c) the timer shall be reduced by 10 s if the parking brake is enabled for at least 3 s;
- (d) the timer shall be reduced by 10 s if an arbitrary number of the seatbelt buckles change from ‘connected’ to ‘disconnected’ for at least 3 s;
- (e) the timer shall be set to 0 if an arbitrary number of doors are open for at least 3 s;

- (f) the timer shall be set to 0 if the ignition terminal is switched from on to off for at least 3 s;
 - (g) the timer shall be set to 0 if the boot is open for at least 3 s;
 - (h) the timer shall be set to 0 if the bonnet is open for at least 3 s.
- (65) All above-listed procedures for the timer reduction shall be applied only once during initial detection. If the *Triggering Timer* has been counted down to 0, no further reduction is necessary in the current detection cycle.
- (66) During the runtime of the *Triggering Timer*, the hazard lights shall be enabled and the vehicle shall be stationary all the time. Otherwise, the detection shall be cancelled.

6.2.3. Information quality

- (67) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (64)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 9: Information quality of ‘stationary vehicle — broken-down vehicle’

Event detection	Value of informationQuality
No TRCO-compliant implementation	unknown(0)
None of conditions a) — h) are fulfilled.	1
At least one condition of a) — d) is fulfilled.	2
At least one condition of e) — h) is fulfilled.	3

- (68) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated. In the update phase, only the conditions that would lead to a timer reduction shall be evaluated, but not the timer itself.

6.3. Termination conditions

- (69) This C-ITS service is terminated by a cancellation of the originating C-ITS station. At the termination of the C-ITS service, update DENM request shall be terminated.

6.3.1. Cancellation

- (70) If at least one of the following conditions is satisfied before the period set in the data element *validityDuration* has expired, the generation of a cancellation DENM shall be triggered:
- (a) the vehicle is no longer stationary for a duration of 5 s;
 - (b) the hazard lights are disabled;
 - (c) the position of the vehicle has changed more than 500 m (e.g. because the vehicle has been towed away).

Note: The cancellation condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

6.3.2. *Negation*

(71) A negation DENM shall not be used for this C-ITS service.

6.4. **Update**

(72) If the previously triggered DENM for a detected *Broken-down Vehicle* was not cancelled, the generation of an update DENM shall be triggered every 15 s.

(73) In the update phase, only the triggering conditions shall be checked (timers shall not be evaluated further).

(74) If the ignition terminal 15 is switched from on to off, an update DENM shall be triggered immediately.

(75) New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*).

Note: The update condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that update condition.

6.5. **Repetition duration and repetition interval**

(76) DENMs that are new, have been updated or have been cancelled shall be repeated for a *repetitionDuration* of 15 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

(77) In the case of an enabled ignition terminal 15, the *validityDuration* shall be set to 30 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: The *validityDuration* is set to a higher value in the case of a disabled ignition terminal 15 than in the case of an enabled ignition terminal 15. This is due to the fact that update DENM cannot be triggered and can no longer be sent. Therefore, the last DENM shall be kept alive longer.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

6.6. **Traffic class**

(78) New, update and cancellation DENMs shall be set to *traffic class* 1.

6.7. **Message parameters**

6.7.1. **DENM**

(79) The following table specifies the data elements of the DENM that shall be set.

Table 10: DENM data elements of ‘stationary vehicle warning — broken-down vehicle’

Data field	Value
Management container	

<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].	
<i>detectionTime</i>	<p><i>TimestampIts</i>-timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	
<i>referenceTime</i>	<p><i>TimestampIts</i>-timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].</p>	
<i>termination</i>	Shall not be set in the case of a new or update DENM. Shall be set to <i>isCancellation(0)</i> in the case of a cancellation DENM.	
<i>eventPosition</i>	<p><i>ReferencePosition</i>. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	
<i>relevanceDistance</i>	lessThan1000m(4)	
<i>relevanceTrafficDirection</i>	If the roadType is known, the value shall be set as follows:	
	RoadType	Direction
	0	allTrafficDirections(0)
	1	upstreamTraffic(1)
	2	allTrafficDirections(0)
	3	upstreamTraffic(1)
Otherwise, the value shall be set to allTrafficDirections(0)		
<i>validityDuration</i>	<ul style="list-style-type: none"> Ignition terminal 15 enabled: 30 s Ignition terminal 15 disabled: 900 s 	
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].	
Situation container		
<i>informationQuality</i>	See point (67). Shall be refreshed for every update DENM.	
<i>causeCode</i>	stationaryVehicle(94)	
<i>subCauseCode</i>	vehicleBreakdown(2)	
Location container		
<i>eventSpeed</i>	<p>Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].	

	Shall be refreshed for an update DENM.																					
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].																					
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM. Shall be set in accordance with [TS 102 894-2] in combination with the following rules:																					
	<table border="1"> <thead> <tr> <th>Urban / non-urban</th> <th>Structural separation</th> <th>Data element</th> </tr> </thead> <tbody> <tr> <td>Urban</td> <td>No</td> <td>urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td>Urban</td> <td>Yes</td> <td>urban-WithStructuralSeparationToOppositeLanes(1)</td> </tr> <tr> <td>Urban</td> <td>Unknown</td> <td>urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td>Non-urban</td> <td>No</td> <td>nonUrban-NoStructuralSeparationToOppositeLanes(2)</td> </tr> <tr> <td>Non-urban</td> <td>Yes</td> <td>nonUrban-WithStructuralSeparationToOppositeLanes(3)</td> </tr> <tr> <td>Non-urban</td> <td>Unknown</td> <td>nonUrban-NoStructuralSeparationToOppositeLanes(2)</td> </tr> </tbody> </table>	Urban / non-urban	Structural separation	Data element	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Urban / non-urban	Structural separation	Data element																			
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)																			
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)																			
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)																			
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)																			
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)																			
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)																			
If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.																						
Alacarte container																						
<i>lanePosition</i>	If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition. If the <i>lanePosition</i> is unknown, the data element shall be omitted. Shall be refreshed for an update DENM.																					
Alacarte container: StationaryVehicleContainer																						
<i>stationarySince</i>	Shall be set according to the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.																					

6.7.2. CAM

(80) CAM adaption shall not be used for this C-ITS service.

6.8. Network and transport layer

(81) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

6.9. Security layer

(82) If the triggering conditions as described in point (62) apply, an AT change shall be blocked for new, update and cancellation DENMs as long as the *validityDuration* has not expired. Corresponding new, update and cancellation DENMs shall be sent with the same AT.

7. STATIONARY VEHICLE WARNING — POST-CRASH

7.1. Description of C-ITS service

This C-ITS service transmits V2V information on a vehicle that is stationary as the result of a traffic accident.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘stationary vehicle warning — stopped vehicle’;
- ‘stationary vehicle warning — broken-down vehicle’.

(83) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

7.2. Triggering conditions

7.2.1. Preconditions

(84) No specific preconditions apply for this C-ITS service.

(85) Parallel activation with the other related C-ITS services shall be avoided. Where the C-ITS services ‘*stopped vehicle*’ and/or ‘*broken-down vehicle*’ are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘post-crash’ (highest priority);
- (b) ‘broken-down vehicle’;
- (c) ‘stopped vehicle’ (lowest priority).

7.2.2. Service-specific conditions

(86) If the preconditions in point (84) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (a) an eCall has been triggered manually by an occupant of the vehicle by the eCall button and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately;
- (b) a low-severity crash is detected without the activation of an irreversible occupant restraint system (e.g. high-voltage battery cut-off, door unlock) and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately;

- (c) a pedestrian collision is detected with the activation of at least one irreversible pedestrian-protection system (e.g. pop-up bonnet, outside airbag) and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately;
 - (d) a high-severity crash is detected with the activation of at least one irreversible occupant-restraint system (e.g. pyrotechnic belt-tightener, airbag).
- (87) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle speed analysis.

Note: The conditions need to be checked only if the necessary power supply is present. This means that crash-secure implementation of the system is not required.

7.2.3. Information Quality

- (88) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (86)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 11: Information quality of ‘stationary vehicle — post-crash’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition (a) is fulfilled.	1
Condition (b) or (c) is fulfilled.	2
Condition (d) is fulfilled.	3

- (89) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

7.3. Termination conditions

- (90) This C-ITS service is terminated by a cancellation of the originating C-ITS station. At the termination of the C-ITS service, update DENM request shall be terminated.

7.3.1. Cancellation

- (91) Once at least one of the following conditions is satisfied before the period set in the data element *validityDuration* has expired, the generation of a cancellation DENM shall be triggered:
- (a) the ego vehicle is not stationary for a duration of 15 s;
 - (b) the position of the vehicle has changed more than 500 m (e.g. because the vehicle has been towed away).

Note: The cancellation condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

7.3.2. *Negation*

(92) A negation DENM shall not be used for this C-ITS service.

7.4. **Update**

(93) An update DENM shall be triggered every 60 s if the C-ITS service has not been cancelled.

(94) If the ignition terminal 15 is switched from on to off, an update DENM shall be triggered immediately.

(95) New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*).

Note: The update condition does not imply that the C-ITS station needs to be permanently operational or extend its operation during that update condition.

7.5. **Repetition duration and repetition interval**

(96) DENMs that are new, have been updated or have been cancelled shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

(97) In the case of an enabled ignition terminal 15, the *validityDuration* shall be set to 180 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: The *validityDuration* is set to a higher value in the case of a disabled ignition terminal 15 than in the case of an enabled ignition terminal 15. This is due to the fact that update DENM cannot be triggered and can no longer be sent. Therefore, the last DENM shall be kept alive longer.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

7.6. **Traffic class**

(98) New, update and cancellation DENMs shall be set to *traffic class* 1.

7.7. **Message parameters**

7.7.1. **DENM**

(99) The following table specifies the data elements of the DENM that shall be set.

Table 12: DENM data elements of ‘Stationary Vehicle Warning — Post-Crash’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].

<i>detectionTime</i>	<p><i>TimestampIts</i>-timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>											
<i>referenceTime</i>	<p><i>TimestampIts</i>-timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].</p>											
<i>termination</i>	<p>Shall not be set in the case of new or update DENM. Shall be set to <i>isCancellation(0)</i> in the case of a cancellation DENM.</p>											
<i>eventPosition</i>	<p><i>ReferencePosition</i>. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>											
<i>relevanceDistance</i>	<p>lessThan5km(5)</p>											
<i>relevanceTrafficDirection</i>	<p>If the <i>roadType</i> is known, the value shall be set as follows:</p> <table border="1"> <thead> <tr> <th>RoadType</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td>1</td> <td>upstreamTraffic(1)</td> </tr> <tr> <td>2</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td>3</td> <td>upstreamTraffic(1)</td> </tr> </tbody> </table>		RoadType	Direction	0	allTrafficDirections(0)	1	upstreamTraffic(1)	2	allTrafficDirections(0)	3	upstreamTraffic(1)
	RoadType	Direction										
	0	allTrafficDirections(0)										
	1	upstreamTraffic(1)										
	2	allTrafficDirections(0)										
	3	upstreamTraffic(1)										
<p>Otherwise, the value shall be set to <i>allTrafficDirections(0)</i></p>												
<i>validityDuration</i>	<ul style="list-style-type: none"> Ignition terminal 15 enabled: 180 s Ignition terminal 15 disabled: 1 800 s 											
<i>stationType</i>	<p>The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p>											
Situation container												
<i>informationQuality</i>	<p>See point (88). Shall be refreshed for every update DENM.</p>											
<i>causeCode</i>	<p>stationaryVehicle(94)</p>											
<i>subCauseCode</i>	<p>postCrash(3)</p>											
Location container												
<i>eventSpeed</i>	<p>Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>											
<i>eventPositionHeading</i>	<p>Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>											

<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM. Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			
<i>lanePosition</i>	If the lanePosition is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition. If the lanePosition is unknown, the data element shall be omitted. Shall be refreshed for an update DENM.		
Alacarte container: StationaryVehicleContainer			
<i>stationarySince</i>	Shall be set according to the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		

7.7.2. CAM

(100) CAM adaption shall not be used for this C-ITS service.

7.8. Network and transport layer

(101) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

7.9. Security layer

(102) If the triggering conditions as described in point (86) apply, an AT change shall be blocked for new, update and cancellation DENMs as long as the *validityDuration* has not expired. Corresponding new, update and cancellation DENMs shall be sent with the same AT.

8. SPECIAL VEHICLE WARNING — EMERGENCY VEHICLE IN OPERATION

8.1. Description of C-ITS service

This C-ITS service transmits V2V information on an emergency vehicle moving to an operation scene, which is signalled by the use of the light bar.

(103) As soon as the C-ITS service is triggered, a DENM shall be transmitted by the emergency vehicle C-ITS station and parts of CAM data fields shall be set in accordance with section 8.7.2.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘special vehicle warning — stationary safeguarding emergency vehicle’;
- ‘special vehicle warning — stationary recovery service warning’.

(104) The default C-ITS service for an emergency vehicle C-ITS station is ‘*emergency vehicle in operation*’. A change to the ‘*stationary safeguarding emergency vehicle*’ C-ITS service shall be triggered only under the conditions set out in section 9.

8.2. Triggering conditions

8.2.1. Preconditions

(105) The following preconditions shall be satisfied before this C-ITS service is triggered:

- (a) the *stationType* is confirmed to be a special vehicle (*stationType* of CAM is set to *specialVehicles*(10)). The C-ITS service is restricted to emergency vehicles;
- (b) the triggering conditions regarding ‘stationary safeguarding emergency vehicle’ shall not be satisfied (see section 9.2).

8.2.2. Service-specific conditions

(106) If the preconditions in point (105) and the following condition are satisfied, the generation of a DENM shall be triggered:

- (a) the light bar is in use.

(107) The level of information quality can be improved by the following conditions:

- (b) the siren is in use;
- (c) the vehicle is not stationary.

(108) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used.

8.2.3. Information quality

(109) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see points (106) and (107)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 13: Information quality of ‘emergency vehicle in operation’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition a) is fulfilled	1
Conditions a) and b) are fulfilled	2
Conditions a) and c) are fulfilled	3
Conditions a), b), and c) are fulfilled	4

(110) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

8.3. Termination conditions

(111) The C-ITS service shall be terminated when the light bar is no longer in use. At the termination of the C-ITS service, updating of DENMs shall be terminated. The *vehicleRole* shall be set to *default(0)* if the light bar is no longer in use.

8.3.1. Cancellation

(112) A cancellation DENM shall not be used for this C-ITS service.

8.3.2. Negation

(113) A negation DENM shall not be used for this C-ITS service.

8.4. Update

(114) The generated DENM shall be updated every 250 ms if the triggering conditions are still satisfied. The data fields that are assigned new values are defined in Table 14 below.

8.5. Repetition duration and repetition interval

(115) A repetition of the DENM shall not be used for this C-ITS service.

8.6. Traffic class

(116) New, update and cancellation DENMs shall be set to *traffic class 1*.

8.7. Message parameters

8.7.1. DENM

(117) The following table specifies the data elements of the DENM that shall be set.

Table 14: DENM data elements of ‘emergency vehicle in operation’

Data field	Value										
Management container											
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].										
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].										
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.										
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>relevanceDistance</i>	lessThan1000m(4)										
<i>relevanceTrafficDirection</i>	If the roadType is known, the value shall be set as follows: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>RoadType</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td>1</td> <td>upstreamTraffic(1)</td> </tr> <tr> <td>2</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td>3</td> <td>upstreamTraffic(1)</td> </tr> </tbody> </table> Otherwise, the value shall be set to allTrafficDirections(0)	RoadType	Direction	0	allTrafficDirections(0)	1	upstreamTraffic(1)	2	allTrafficDirections(0)	3	upstreamTraffic(1)
RoadType	Direction										
0	allTrafficDirections(0)										
1	upstreamTraffic(1)										
2	allTrafficDirections(0)										
3	upstreamTraffic(1)										
<i>validityDuration</i>	2 s										
<i>stationType</i>	specialVehicles(10)										
Situation container											
<i>informationQuality</i>	See point (109). Shall be refreshed for every update DENM.										
<i>causeCode</i>	emergencyVehicleApproaching(95)										
<i>subCauseCode</i>	emergencyVehicleApproaching(1)										
Location container											
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										

<i>eventPositionHeading</i>	<p>Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	
<i>traces</i>	<p><i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	
<i>roadType</i>	<p><i>RoadType</i> of the road on which the detecting C-ITS station is situated.</p> <p>Shall be refreshed for an update DENM.</p> <p>Shall be set in accordance with [TS 102 894-2] in combination with the following rules:</p>	
	Urban / non-urban	Structural separation
	Urban	No
	Urban	Yes
	Urban	Unknown
	Non-urban	No
	Non-urban	Yes
	Non-urban	Unknown
	<p>If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.</p>	
Alacarte container		
<i>lanePosition</i>	<p>If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.</p> <p>If the <i>lanePosition</i> is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>	
Alacarte container: StationaryVehicleContainer		
<i>stationarySince</i>	<p>Shall be set according to the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>	

8.7.2. CAM

(118) The *vehicleRole* shall be initialised at a ‘default’ setting (*vehicleRole* of CAM set to *default(0)*). If at least one of the triggering conditions in point (106) is satisfied, the *vehicleRole* shall be set to *emergency(6)*.

(119) The following table specifies the data elements of the CAM that shall be set if the C-ITS service is triggered.

Table 15: CAM data elements of ‘emergency vehicle in operation’

Data field	Value
CoopAwareness	
<i>generationDeltaTime</i>	Time corresponding to the time of the reference position in the CAM, considered as time of CAM generation. Shall be set in accordance with [EN 302 637-2].
BasicContainer	
<i>stationType</i>	specialVehicles(10)
<i>referencePosition</i>	Position and position accuracy measured at the reference point of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
<i>heading</i>	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
<i>speed</i>	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>driveDirection</i>	Vehicle drive direction (forward or backward) of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>vehicleLength</i>	Length of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>vehicleWidth</i>	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>longitudinalAcceleration</i>	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>curvature</i>	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].

<i>curvatureCalcMode</i>	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set in accordance with [TS 102 894-2].
<i>yawRate</i>	Yaw rate of vehicle at a point in time. Shall be set in accordance with [TS 102 894-2].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
<i>vehicleRole</i>	emergency(6)
<i>exteriorLights</i>	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
<i>pathHistory</i>	Represents the vehicle's movement over a recent period and/or distance. Shall be set in accordance with [TS 102 894-2].
SpecialVehicleContainer shall be set to EmergencyContainer	
<i>lightBarSirenInUse</i>	lightBarActivated bit shall be set to 1(onChange), if the usage of the light bar is detected; otherwise, it shall be set to 0. sirenActivated bit shall be set to 1, if usage of the siren is detected; otherwise, it shall be set to 0.
<i>emergencyPriority</i>	Is not required
<i>causeCode</i>	As specified in point (117)
<i>subCauseCode</i>	As specified in point (117)

8.8. Network and transport layer

(120) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

8.9. Security layer

(121) If the triggering conditions as described in point (106) apply, an AT change shall be blocked for new and update DENMs as long as the *validityDuration* has not expired. Corresponding new and update DENMs shall be sent with the same AT.

9. SPECIAL VEHICLE WARNING — STATIONARY SAFEGUARDING EMERGENCY VEHICLE

9.1. Description of C-ITS service

This C-ITS service transmits V2V information on a stationary emergency vehicle safeguarding a hazard area.

(122) As soon as the C-ITS service is triggered, a DENM shall be transmitted by the emergency vehicle C-ITS station and parts of CAM data fields shall be set in accordance with section 9.7.2.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘special vehicle warning — emergency vehicle in operation’;
- ‘special vehicle warning — stationary recovery service warning’.

9.2. Triggering conditions

9.2.1. Preconditions

(123) The following preconditions shall be satisfied before this C-ITS service is triggered:

- the *stationType* is confirmed to be an emergency vehicle (*stationType* of CAM is set to *specialVehicles(10)*). The C-ITS service is restricted to emergency vehicles;
- the *Standstill Timer* shall be initialised with zero.

(124) The default C-ITS service for an emergency vehicle C-ITS station is ‘*emergency vehicle in operation*’. A change to the C-ITS service ‘*stationary safeguarding emergency vehicle*’ shall be triggered only under the conditions defined in section 9.2.2.

9.2.2. Service-specific conditions

(125) If the vehicle is stationary and the light bar is in use, a *Standstill Timer* shall be initialised with zero and started. If the light bar is no longer in use or the vehicle is no longer stationary, the *Standstill Timer* shall be stopped and reset to zero.

(126) If the preconditions in point (123) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (a) the light bar is in use and engine relay is activated;
- (b) the light bar is in use, the hazard lights are activated and the parking brake is activated or (in the case of automatic transmission) ‘park’ is selected;
- (c) the light bar is in use, the hazard lights are activated and the *Standstill Timer* is 60 s or more.

(127) The level of information quality can be improved by the following conditions:

- (d) the status of at least one door, or the boot, is ‘open’;
- (e) the driver’s seat is detected, by one of the following techniques, as being ‘not occupied’:
 - (1) passenger compartment camera;
 - (2) state-of-the-art technique for seat occupation used in seatbelt reminder.

(128) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle speed analysis.

(129) If the C-ITS service is triggered due to fulfilment of condition (a) or (b) in point (126), the *Standstill Timer* shall be stopped and set to 60 s. In the update phase, only the conditions shall be checked, but no timer shall be started.

9.2.3. Information quality

(130) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see points (126) and (127)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 16: Information quality of ‘stationary safeguarding emergency vehicle’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition (c) fulfilled	1
Condition (b) fulfilled	2
At least one of conditions (b) or (c) fulfilled and condition (d) fulfilled	3
At least one of conditions (b) or (c) fulfilled and condition (e) fulfilled	4
Condition (a) fulfilled	5

(131) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

9.3. Termination conditions

(132) This C-ITS service is terminated by a cancellation of the originating C-ITS station. At the termination of the C-ITS service, update DENM request shall be terminated.

9.3.1. Cancellation

(133) If the following condition is satisfied before the period set in the data element *validityDuration* has expired, the generation of a cancellation DENM shall be triggered:

- (a) all the C-ITS service-specific conditions (a) to (c) in section 9.2.2 are no longer satisfied.

The *vehicleRole* shall be set to default(0) if the light bar is no longer in use.

9.3.2. Negation

(134) A negation DENM shall not be used for this C-ITS service.

9.4. Update

(135) The generated DENM shall be updated every 60 s if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in Table 17 below.

9.5. Repetition duration and repetition interval

(136) DENMs that are new, have been updated or have been cancelled shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

Note: The *validityDuration* is set to 180 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

9.6. Traffic class

(137) New, update and cancellation DENMs shall be set to *traffic class* 1.

9.7. Message parameters

9.7.1. DENM

(138) The following table specifies the data elements of the DENM that shall be set.

Table 17: DENM data elements of ‘stationary safeguarding emergency vehicle’

Data field	Value								
Management container									
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].								
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.								
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].								
<i>termination</i>	Shall not be set in the case of new or update DENM. Shall be set to <i>isCancellation</i> (0) in the case of fulfilment of cancellation conditions; see point (133).								
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.								
<i>relevanceDistance</i>	lessThan5km(5)								
<i>relevanceTrafficDirection</i>	If the <i>roadType</i> is known, the value shall be set as follows: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>RoadType</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td><i>allTrafficDirections</i>(0)</td> </tr> <tr> <td>1</td> <td><i>upstreamTraffic</i>(1)</td> </tr> <tr> <td>2</td> <td><i>allTrafficDirections</i>(0)</td> </tr> </tbody> </table>	RoadType	Direction	0	<i>allTrafficDirections</i> (0)	1	<i>upstreamTraffic</i> (1)	2	<i>allTrafficDirections</i> (0)
RoadType	Direction								
0	<i>allTrafficDirections</i> (0)								
1	<i>upstreamTraffic</i> (1)								
2	<i>allTrafficDirections</i> (0)								

	3	upstreamTraffic(1)									
	Otherwise, the value shall be set to allTrafficDirections(0)										
<i>validityDuration</i>	180 s										
<i>stationType</i>	specialVehicles(10)										
Situation container											
<i>informationQuality</i>	See point (130). Shall be refreshed for every update DENM.										
<i>causeCode</i>	rescueAndRecoveryWorkInProgress(15)										
<i>subCauseCode</i>	emergencyVehicles(1)										
Location container											
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>roadType</i>	<p><i>RoadType</i> of the road on which the detecting C-ITS station is situated.</p> <p>Shall be refreshed for an update DENM.</p> <p>Shall be set in accordance with [TS 102 894-2] in combination with the following rules:</p> <table border="1"> <thead> <tr> <th>Urban / non-urban</th> <th>Structural separation</th> <th>Data element</th> </tr> </thead> <tbody> <tr> <td>Urban</td> <td>No</td> <td>urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td>Urban</td> <td>Yes</td> <td>urban-WithStructuralSeparationToOppositeLanes(1)</td> </tr> </tbody> </table>		Urban / non-urban	Structural separation	Data element	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
Urban / non-urban	Structural separation	Data element									
Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)									
Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)									

	Urban	Unknown	urban-NoStructuralSeparation ToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparation ToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparation ToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparation ToOppositeLanes(2)
If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.			
Alacarte container			
<i>lanePosition</i>	<p>If the lanePosition is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.</p> <p>If the lanePosition is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>		
Alacarte container: StationaryVehicleContainer			
<i>stationarySince</i>	<p>Shall be set according to the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>		

9.7.2. CAM

(139) The *vehicleRole* shall be initialised at a ‘default’ setting (*vehicleRole* of CAM set to *default(0)*). If at least one of the triggering conditions defined in point (126) is satisfied, the *vehicleRole* shall be set to *emergency(6)*.

(140) The following table specifies the data elements of the CAM that shall be set if the C-ITS service is triggered.

Table 18: CAM data elements of ‘stationary safeguarding emergency vehicle’

Data field	Value
CoopAwareness	
<i>generationDeltaTime</i>	<p>Time corresponding to the time of the reference position in the CAM, considered as time of CAM generation.</p> <p>Shall be set in accordance with [EN 302 637-2].</p>
BasicContainer	
<i>stationType</i>	specialVehicles(10)

<i>referencePosition</i>	Position and position accuracy measured at the reference point of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
<i>heading</i>	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
<i>speed</i>	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>driveDirection</i>	Vehicle drive direction (forward or backward) of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>vehicleLength</i>	Length of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>vehicleWidth</i>	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>longitudinalAcceleration</i>	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>curvature</i>	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].
<i>curvatureCalcMode</i>	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set in accordance with [TS 102 894-2].
<i>yawRate</i>	Yaw rate of vehicle at a point in time. Shall be set in accordance with [TS 102 894-2].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
<i>vehicleRole</i>	emergency(6)
<i>exteriorLights</i>	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
<i>pathHistory</i>	Represents the vehicle's movement over a recent period and/or distance. Shall be set in accordance with [TS 102 894-2].
SpecialVehicleContainer shall be set to EmergencyContainer	

<i>lightBarSirenInUse</i>	lightBarActivated bit shall be set to 1(onChange), if the usage of the light bar is detected, otherwise, it shall be set to 0. sirenActivated bit shall be set to 1, if usage of the siren is detected, otherwise, it shall be set to 0.
<i>emergencyPriority</i>	Is not required
<i>causeCode</i>	As specified in point (138)
<i>subCauseCode</i>	As specified in point (138)

9.8. Network and transport layer

(141) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

9.9. Security layer

(142) If the triggering conditions as described in point (126) apply, an AT change shall be blocked for new, update and cancellation DENMs as long as the *validityDuration* has not expired. Corresponding new, update and cancellation DENMs shall be sent with the same AT.

10. SPECIAL VEHICLE WARNING — STATIONARY RECOVERY SERVICE WARNING

10.1. Description of C-ITS service

This C-ITS service transmits V2V information on a recovery service vehicle supporting a broken-down vehicle. The C-ITS service of the moving recovery service, e.g. carrying a broken-down vehicle, is covered by the common CAM.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘special vehicle warning — emergency vehicle in operation’;
- ‘special vehicle warning — stationary safeguarding emergency vehicle’.

10.2. Triggering conditions

10.2.1. Preconditions

(143) The following preconditions shall be satisfied before this C-ITS service is triggered:

- the *stationType* is confirmed as an emergency vehicle (*stationType* of CAM is set to *specialVehicles(10)*). The C-ITS service is restricted to recovery service vehicles;
- the *Standstill Timer* shall be initialised with zero.

10.2.2. Service-specific conditions

(144) If the vehicle is stationary and the light bar is in use, a *Standstill Timer* shall be initialised with zero and started. If the light bar is no longer in use or the vehicle is no longer stationary, the *Standstill Timer* shall be stopped and reset to zero.

(145) If the preconditions in point (143) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (a) the light bar is in use, the hazard lights are activated and the parking brake is activated or (in the case of automatic transmission) ‘park’ is selected;
- (b) the light bar is in use, the hazard lights are activated and the *Standstill Timer* is 60 s or more.

(146) The level of information quality can be improved by the following conditions:

- (c) the status of driver door is ‘open’;
- (d) the driver’s seat is detected, by one of the following techniques, as being ‘not occupied’:
 - (1) passenger compartment camera;
 - (2) state-of-the-art technique for seat occupation used in seatbelt reminder.

(147) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used. This requirement shall be applied for all subsequent occurrences of vehicle speed analysis.

(148) If the C-ITS service is triggered due to fulfilment of condition (a) in point (145), the *Standstill Timer* shall be stopped and set to 60 s. In the update phase, only the conditions shall be checked, but no timer shall be started.

10.2.3. Information quality

(149) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (145) and (146)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 19: Information quality of ‘stationary recovery service warning’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition (b) fulfilled	1
Condition (a) fulfilled	2
At least one of conditions (a) or (b) fulfilled and condition (c) fulfilled	3
At least one of conditions (a) or (b) fulfilled and condition (d) fulfilled	4

(150) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

10.3. Termination conditions

(151) This C-ITS service is terminated by a cancellation of the originating C-ITS station. At the termination of the C-ITS service, update DENM request shall be terminated.

10.3.1. Cancellation

(152) If the following condition is satisfied before the period set in the data element *validityDuration* has expired, the generation of a cancellation DENM shall be triggered and the *vehicleRole* shall be set to *default(0)*:

- (a) C-ITS service-specific conditions (a) and (b) in point (145) are not satisfied.

10.3.2. Negation

(153) A negation DENM shall not be used for this C-ITS service.

10.4. Update

(154) The generated DENM shall be updated every 60 s if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in Table 20 below.

10.5. Repetition duration and repetition interval

(155) DENMs that are new, have been updated or have been cancelled shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

Note: The *validityDuration* is set to 180 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

10.6. Traffic class

(156) New, update and cancellation DENMs shall be set to *traffic class 1*.

10.7. Message parameters

10.7.1. DENM

(157) The following table specifies the data elements of the DENM that shall be set.

Table 20: DENM data elements of ‘stationary recovery service warning’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].

	Shall be refreshed for an update DENM.										
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].										
<i>termination</i>	Shall not be set in the case of new or update DENM. Shall be set to <i>isCancellation(0)</i> in the case of fulfilment of cancellation conditions, see point (152).										
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>relevanceDistance</i>	<i>lessThan5km(5)</i>										
<i>relevanceTrafficDirection</i>	If the <i>roadType</i> is known the value shall be set as follows: <table border="1"> <thead> <tr> <th>RoadType</th> <th>Direction</th> </tr> </thead> <tbody> <tr> <td>0</td> <td><i>allTrafficDirections(0)</i></td> </tr> <tr> <td>1</td> <td><i>upstreamTraffic(1)</i></td> </tr> <tr> <td>2</td> <td><i>allTrafficDirections(0)</i></td> </tr> <tr> <td>3</td> <td><i>upstreamTraffic(1)</i></td> </tr> </tbody> </table> Otherwise, the value shall be set to <i>allTrafficDirections(0)</i>	RoadType	Direction	0	<i>allTrafficDirections(0)</i>	1	<i>upstreamTraffic(1)</i>	2	<i>allTrafficDirections(0)</i>	3	<i>upstreamTraffic(1)</i>
RoadType	Direction										
0	<i>allTrafficDirections(0)</i>										
1	<i>upstreamTraffic(1)</i>										
2	<i>allTrafficDirections(0)</i>										
3	<i>upstreamTraffic(1)</i>										
<i>validityDuration</i>	180 s										
<i>stationType</i>	<i>specialVehicles(10)</i>										
Situation container											
<i>informationQuality</i>	See point (149). Shall be refreshed for every update DENM.										
<i>causeCode</i>	<i>rescueAndRecoveryWorkInProgress(15)</i>										
<i>subCauseCode</i>	<i>unavailable(0)</i>										
Location container											
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.										

<i>roadType</i>	<p><i>RoadType</i> of the road on which the detecting C-ITS station is situated.</p> <p>Shall be refreshed for an update DENM.</p> <p>Shall be set in accordance with [TS 102 894-2] in combination with the following rules:</p> <table border="1"> <thead> <tr> <th>Urban / Non-urban</th> <th>Structural separation</th> <th>Data element</th> </tr> </thead> <tbody> <tr> <td>Urban</td> <td>No</td> <td>urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td>Urban</td> <td>Yes</td> <td>urban-WithStructuralSeparationToOppositeLanes(1)</td> </tr> <tr> <td>Urban</td> <td>Unknown</td> <td>urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td>Non-urban</td> <td>No</td> <td>nonUrban-NoStructuralSeparationToOppositeLanes(2)</td> </tr> <tr> <td>Non-urban</td> <td>Yes</td> <td>nonUrban-WithStructuralSeparationToOppositeLanes(3)</td> </tr> <tr> <td>Non-urban</td> <td>Unknown</td> <td>nonUrban-NoStructuralSeparationToOppositeLanes(2)</td> </tr> </tbody> </table> <p>If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.</p>	Urban / Non-urban	Structural separation	Data element	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
Urban / Non-urban	Structural separation	Data element																				
Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)																				
Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)																				
Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)																				
Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)																				
Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)																				
Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)																				
Alacarte container																						
<i>lanePosition</i>	<p>If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.</p> <p>If the <i>lanePosition</i> is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>																					
Alacarte Container: StationaryVehicleContainer																						
<i>stationarySince</i>	<p>Shall be set according to the duration in minutes of the detecting C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2].</p> <p>Shall be refreshed for an update DENM.</p>																					

10.7.2. CAM

(158) The *vehicleRole* shall be initialised at a ‘default’ setting (*vehicleRole* of CAM set to *default(0)*). If at least one of the triggering conditions defined in point (145) is satisfied the *vehicleRole* shall be set to *rescue(5)*.

(159) The following table specifies the data elements of the CAM that shall be set if the C-ITS service is triggered.

Table 21: CAM data elements of ‘stationary recovery service warning’

Data field	Value
CoopAwareness	
<i>generationDeltaTime</i>	Time corresponding to the time of the reference position in the CAM, considered as time of the CAM generation. Shall be set in accordance with [EN 302 637-2].
BasicContainer	
<i>stationType</i>	specialVehicles(10)
<i>referencePosition</i>	Position and position accuracy measured at the reference point of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
<i>heading</i>	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
<i>speed</i>	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>driveDirection</i>	Vehicle drive direction (forward or backward) of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>vehicleLength</i>	Length of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>vehicleWidth</i>	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>longitudinalAcceleration</i>	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>curvature</i>	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].

<i>curvatureCalcMode</i>	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set in accordance with [TS 102 894-2].
<i>yawRate</i>	Yaw rate of vehicle at a point in time. Shall be set in accordance with [TS 102 894-2].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
<i>vehicleRole</i>	rescue(5)
<i>exteriorLights</i>	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
<i>pathHistory</i>	Represents the vehicle's movement over a recent period and/or distance. Shall be set in accordance with [TS 102 894-2].
SpecialVehicleContainer shall be set to SafetyCarContainer	
<i>lightBarSirenInUse</i>	lightBarActivated bit shall be set to 1(onChange) if the usage of the light bar is detected; otherwise, it shall be set to 0. sirenActivated bit shall be set to 1 if usage of the siren is detected; otherwise, it shall be set to 0.
<i>causeCode</i>	As specified in point (157)
<i>subCauseCode</i>	As specified in point (157)

10.8. Network and transport layer

(160) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

10.9. Security layer

(161) If the triggering conditions as described in point (145) apply, an AT change shall be blocked for new, update and cancellation DENMs as long as the *validityDuration* has not expired. Corresponding new, update and cancellation DENMs shall be sent with the same AT.

11. EXCHANGE OF IRCs — REQUEST IRC

11.1. Description of C-ITS service

This C-ITS service transmits V2V information on a critical driving situation where a crash between two vehicles is highly likely or unavoidable. The ego vehicle recognises a potential collision and sends its own IRC to get the IRC of the collision opponent in response.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘exchange of IRCs — response IRC’;
- (162) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new DENM. If the triggering conditions are not met, a DENM signal shall not be generated.

11.2. Triggering conditions

11.2.1. Preconditions

(163) No specific preconditions apply to this C-ITS service.

11.2.2. Service-specific conditions

(164) If both the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- the ‘time to collision’ (TTC) calculated by an on-board measurement device algorithm is < 1.5 s. The acceptable tolerance for the calculated TTC value is 10 %;
- the relative speed between two potential collision opponents exceeds 20 km/h.

Note: Calculating the TTC on the basis of the GNSS position only, as delivered from state-of-the-art GNSS-receivers, is not reliable enough for this service.

11.2.3. Information quality

(165) The value of the data element *informationQuality* in the DENM depends on how the event is detected. The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 22: Information quality of ‘exchange of IRCs — request IRC’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Otherwise	1

11.3. Termination conditions

(166) A termination of the C-ITS service shall not be considered.

11.3.1. Cancellation

(167) A cancellation DENM shall not be used for this C-ITS service.

11.3.2. Negation

(168) A negation DENM shall not be used for this C-ITS service.

11.4. Update

(169) An update DENM shall not be used for this C-ITS service.

11.5. Repetition duration and repetition interval

(170) New DENMs shall be repeated for a *repetitionDuration* of 300 ms (100 ms three times in a row) with a *repetitionInterval* of 100 ms. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the

application and the DEN basic service shall be set in accordance with the above values.

Note: As it is not guaranteed that a sent IRC will reach the receiver (e.g. because of channel load, temporarily out of range, etc.), the sender sends the IRC three times in a row. This is equivalent to a *repetitionDuration* of 300 ms.

Note: The estimated duration for transmitting (application to application) an IRC (repetition not included) over automotive WLAN is 200-300 ms. If only the third attempt is received (worst case), in both cases (request and response), the information will be available for both vehicles after 1 second (2 * (300 ms + 100 ms (@10 Hz) + 100 ms (@10 Hz))). Therefore, the trigger parameter $TTC < 1.5 \text{ s}$ is sufficient. Sending the IRC three times in a row is considered a good compromise between channel load and ensuring successful transmission.

Note: Only the first DENM will be sent without Decentralized Congestion Control (DCC) constraints. The second and third DENMs may be affected by DCC (based on current channel load).

Note: Where two DENMs with the same causeCode originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

11.6. Traffic class

(171) New DENMs shall be set to *traffic class* 0.

11.7. Message parameters

11.7.1. DENM

(172) The following table specifies the data elements of the DENM that shall be set.

Table 23: DENM data elements of ‘exchange of IRCs — request IRC’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2].
<i>relevanceDistance</i>	lessThan100m(1) Note: This shall also cover the worst-case scenario of driving at nearly 250 km/h towards a dangerous end of queue ($s = v \cdot t = 69.4 \text{ m/s} \cdot 1.5 \text{ s} = 104.2 \text{ m}$).
<i>relevanceTrafficDirection</i>	allTrafficDirections(0)

<i>validityDuration</i>	2 s Note: Shall be larger than TTC.
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (165)
<i>causeCode</i>	collisionRisk(97)
<i>subCauseCode</i>	unavailable(0)
Location container	
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>roadType</i>	Shall be set in accordance with [TS 102 894-2]. If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.
Alacarte container: ImpactReductionContainer	
<i>heightLonCarrLeft</i>	Height of left longitudinal carrier of the vehicle from base to top. Shall be set in accordance with [TS 102 894-2].
<i>heightLonCarrRight</i>	Height of right longitudinal carrier of the vehicle from base to top. Shall be set in accordance with [TS 102 894-2].
<i>posLonCarrLeft</i>	Longitudinal distance from the centre of vehicle front bumper to the front of the left longitudinal carrier of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>posLonCarrRight</i>	Longitudinal distance from the centre of vehicle front bumper to the front of the right longitudinal carrier of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>positionOfPillars</i>	Vehicle pillars refer to the vertical or near-vertical support of vehicle, designated respectively as A, B, C or D. Shall be set in accordance with [TS 102 894-2].
<i>posCentMass</i>	Perpendicular distance from the centre of mass of an empty load vehicle to the front line of the vehicle bounding box. Shall be set in accordance with [TS 102 894-2].
<i>wheelBaseVehicle</i>	Perpendicular distance between front and rear axle of the wheel base of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>turningRadius</i>	The smallest circular turn (i.e. U-turn) that the vehicle is capable of making. Shall be set in accordance with [TS 102 894-2].

<i>posFrontAx</i>	Perpendicular distance between the vehicle front line of the bounding box and the front wheel axle. Shall be set in accordance with [TS 102 894-2].
<i>positionOfOccupants</i>	BitString that indicates whether a passenger seat is occupied or whether the occupation status is detectable. Shall be set in accordance with [TS 102 894-2].
<i>vehicleMass</i>	Mass of an empty load vehicle. Shall be set in accordance with [TS 102 894-2].
<i>requestResponseIndication</i>	request(0)

11.7.2. CAM

(173) CAM adaption shall not be used for this C-ITS service.

11.8. Network and transport layer

(174) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

11.9. Security layer

(175) If the triggering conditions as described in point (164) apply, an AT change shall be blocked as long as the *validityDuration* has not expired.

12. EXCHANGE OF IRCs — RESPONSE IRC

12.1. Description of C-ITS service

This C-ITS service transmits V2V information on a critical driving situation where a crash between two vehicles is highly likely or unavoidable. The ego vehicle has received an IRC from another vehicle and sends its own IRC in response.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘exchange of IRCs — request IRC’.

(176) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new DENM. If the triggering conditions are not met, a DENM signal shall not be generated.

12.2. Triggering conditions

12.2.1. Preconditions

(177) An IRC as described in Table 23 has been received.

12.2.2. Service-specific conditions

(178) If the precondition in point (177) and both the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- requestResponseIndication* in the received IRC is set to request(0);

- (b) the perpendicular distance between the requesting vehicle (event position in the IRC) and the ego vehicle (reference position as defined in CAM) is less than 100 m.

Note: When an IRC is received, the receiver has to check that it was actually requested before responding with its own IRC. This can be done on the basis of the requestResponseIndication. To avoid unnecessary load on the transmission channel from multiple transmitted IRCs, only vehicles in the immediate vicinity (within 100 m) respond to the request.

12.2.3. Information quality

- (179) The value of the data element *informationQuality* in the DENM depends on how the event is detected. The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 24: Information quality of ‘exchange of IRCs — response IRC’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Otherwise	1

12.3. Termination conditions

- (180) A termination of the C-ITS service shall not be considered.

12.3.1. Cancellation

- (181) A cancellation DENM shall not be used for this C-ITS service.

12.3.2. Negation

- (182) A negation DENM shall not be used for this C-ITS service.

12.4. Update

- (183) An update DENM shall not be used for this C-ITS service.

12.5. Repetition duration and repetition interval

- (184) New DENMs shall be repeated for a *repetitionDuration* of 300 ms (100 ms three times in a row) with a *repetitionInterval* of 100 ms. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

Note: As it is not guaranteed that a sent IRC will reach the receiver (e.g. because of channel load, temporarily out of range, etc.), the sender sends the IRC three times in a row. This is equivalent to a *repetitionDuration* of 300 ms.

Note: The estimated duration for transmitting (application to application) an IRC (repetition not included) over automotive WLAN is 200-300 ms. If only the third attempt is received (worst case), in both cases (request and response), the information will be available for both vehicles after 1 second (2 * (300 ms + 100 ms (@10 Hz) + 100 ms (@10 Hz))). Therefore, the trigger parameter $TTC < 1.5 \text{ s}$ is sufficient. Sending the IRC three times in a row is considered a good compromise between channel load and ensuring successful transmission.

Note: Only the first DENM will be sent without DCC constraints. The second and third DENMs may be affected by DCC (based on current channel load).

Note: Where two DENMs with the same causeCode originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

12.6. Traffic class

(185) New DENMs shall be set to *traffic class 0*.

12.7. Message parameters

12.7.1. DENM

(186) The following table specifies the data elements of the DENM that shall be set.

Table 25: DENM data elements of ‘exchange of IRCs — response IRC’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2].
<i>relevanceDistance</i>	lessThan100m(1)
<i>relevanceTrafficDirection</i>	allTrafficDirections(0)
<i>validityDuration</i>	2 s
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (179).
<i>causeCode</i>	collisionRisk(97)
<i>subCauseCode</i>	unavailable(0)
Location container	
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].

<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
<i>roadType</i>	Shall be set in accordance with [TS 102 894-2]. If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.
Alacarte container: ImpactReductionContainer	
<i>heightLonCarrLeft</i>	Height of left longitudinal carrier of the vehicle from base to top. Shall be set in accordance with [TS 102 894-2].
<i>heightLonCarrRight</i>	Height of right longitudinal carrier of the vehicle from base to top. Shall be set in accordance with [TS 102 894-2].
<i>posLonCarrLeft</i>	Longitudinal distance from the centre of vehicle front bumper to the front of the left longitudinal carrier of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>posLonCarrRight</i>	Longitudinal distance from the centre of vehicle front bumper to the front of the right longitudinal carrier of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>positionOfPillars</i>	Vehicle pillars refer to the vertical or near vertical support of vehicle, designated respectively as A, B, C or D. Shall be set in accordance with [TS 102 894-2].
<i>posCentMass</i>	Perpendicular distance from the centre of mass of an empty load vehicle to the front line of the vehicle bounding box. Shall be set in accordance with [TS 102 894-2].
<i>wheelBaseVehicle</i>	Perpendicular distance between front and rear axle of the wheel base of vehicle. Shall be set in accordance with [TS 102 894-2].
<i>turningRadius</i>	The smallest circular turn (i.e. U-turn) that the vehicle is capable of making. Shall be set in accordance with [TS 102 894-2].
<i>posFrontAx</i>	Perpendicular distance between the vehicle front line of the bounding box and the front wheel axle. Shall be set in accordance with [TS 102 894-2].
<i>positionOfOccupants</i>	BitString that indicates whether a passenger seat is occupied or whether the occupation status is detectable. Shall be set in accordance with [TS 102 894-2].
<i>vehicleMass</i>	Mass of an empty load vehicle. Shall be set in accordance with [TS 102 894-2].
<i>requestResponseIndication</i>	response(1)

12.7.2. CAM

(187) CAM adaption shall not be used for this C-ITS service.

12.8. Network and transport layer

(188) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

12.9. Security layer

(189) If the triggering conditions as described in point (178) apply, an AT change shall be blocked as long as the *validityDuration* has not expired. Corresponding new DENMs shall be sent with the same AT.

13. DANGEROUS SITUATION — ELECTRONIC EMERGENCY BRAKE LIGHT

13.1. Description of C-ITS service

This C-ITS service transmits V2V information on an emergency brake by the driver, e.g. as a reaction to a stationary or slower vehicle in front. The ego vehicle itself becomes a possible local danger zone.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘dangerous situations — automatic brake intervention’;
- ‘dangerous situations — reversible occupant restraint system intervention’.

13.2. Triggering conditions

13.2.1. Preconditions

(190) No specific preconditions apply for this C-ITS service.

(191) Parallel activation with the other related C-ITS services shall be avoided. Where the ‘*automatic brake intervention*’ and/or ‘*reversible occupant restraint system intervention*’ C-ITS services are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘electronic emergency brake light’ (highest priority);
- (b) ‘automatic brake intervention’;
- (c) ‘reversible occupant restraint system intervention’ (lowest priority).

(192) If a higher-priority C-ITS service is triggered, any related lower-priority C-ITS service transmission that has already been triggered and is still active regarding update, shall be aborted. In addition, the generation of a new DENM for the higher-priority C-ITS service shall be requested.

13.2.2. Service-specific conditions

(193) If the following condition is satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered.

- (a) a signal representing the request for the electronic emergency brake light is detected. The conditions for such a request are set out in [ECE 48], [ECE 13] and [ECE 13H].

Vehicles may also use the following alternative triggering condition:

- (b) the current vehicle speed is above 20 km/h and the current acceleration is below -7 m/s^2 for a minimum of 500 ms.

(194) The acceleration of the vehicle shall be determined by the vehicle bus signal, not by GNSS. The filtered acceleration with respect to sensor noise shall be used.

13.2.3. Information quality

(195) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (193)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 26: Information quality of ‘electronic emergency brake light’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	0
Condition (a) fulfilled	1
Condition (a) fulfilled and current filtered longitudinal acceleration of the vehicle < -4 m/s ²	2
Condition (b) fulfilled	3

(196) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

13.3. Termination conditions

(197) The C-ITS service shall be terminated when condition (a) or (b) is no longer valid. At the termination of the C-ITS service, update DENM request shall be terminated.

13.3.1. Cancellation

(198) A cancellation DENM shall not be used for this C-ITS service.

13.3.2. Negation

(199) A negation DENM shall not be used for this C-ITS service.

13.4. Update

(200) The generated DENM shall be updated every 100 ms if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in Table 27 below.

13.5. Repetition duration and repetition interval

(201) A repetition of the DENM shall not be used for this C-ITS service.

13.6. Traffic class

(202) New and update DENMs shall be set to *traffic class 0*.

13.7. Message parameters

13.7.1. DENM

(203) The following table specifies the data elements of the DENM that shall be set.

Table 27: DENM data elements of ‘electronic emergency brake light’

Data field	Value	
Management container		
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].	
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.	
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].	
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.	
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for every update DENM.	
<i>relevanceDistance</i>	lessThan500m(3)	
<i>relevanceTrafficDirection</i>	If the roadType is known, the value shall be set as follows:	
	RoadType	Direction
	0	allTrafficDirections(0)
	1	upstreamTraffic(1)
	2	allTrafficDirections(0)
	3	upstreamTraffic(1)
	Otherwise, the value shall be set to allTrafficDirections(0)	
<i>validityDuration</i>	2 s	
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].	
Situation container		
<i>informationQuality</i>	See point (195).	
<i>causeCode</i>	dangerousSituation(99)	
<i>subCauseCode</i>	emergencyElectronicBrakeEngaged(1)	
Location container		

<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / Non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			
<i>lanePosition</i>	If the lanePosition is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition. If the lanePosition is unknown, the data element shall be omitted. Shall be refreshed for an update DENM.		

13.7.2. **CAM**

(204) CAM adaption shall not be used for this C-ITS service.

13.8. **Network and transport layer**

(205) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

13.9. **Security layer**

(206) If the triggering conditions as described in point (193) apply, an AT change shall be blocked for new and update DENMs as long as the *validityDuration* has not expired. Corresponding new and update DENMs shall be sent with the same AT.

14. **DANGEROUS SITUATION — AUTOMATIC BRAKE INTERVENTION**

14.1. **Description of C-ITS service**

This C-ITS service transmits V2V information on an autonomous emergency braking intervention by the vehicle. The ego vehicle itself becomes a possible local danger zone.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘dangerous situations — emergency electronic brake light’;
- ‘dangerous situations — reversible occupant restraint system intervention’.

14.2. **Triggering conditions**

14.2.1. *Preconditions*

(207) No specific preconditions apply for this C-ITS service.

(208) Parallel activation with the other related C-ITS services shall be avoided. Where the ‘*electronic emergency brake light*’ and/or ‘*reversible occupant restraint system intervention*’ C-ITS services are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘*electronic emergency brake light*’ (highest priority);
- (b) ‘*automatic brake intervention*’;
- (c) ‘*reversible occupant restraint system intervention*’ (lowest priority).

(209) If a higher-priority C-ITS service is triggered, any related lower-priority C-ITS service transmission that has already been triggered and is still active regarding update, shall be aborted. In addition, the generation of a new DENM for the higher priority C-ITS service shall be requested.

14.2.2. *Service-specific conditions*

(210) If the following condition is satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (a) a signal representing a request for the intervention of an autonomous emergency braking system is detected.

(211) The acceleration of the vehicle shall be determined by the vehicle bus signal, not by GNSS. The filtered acceleration with respect to sensor noise shall be used.

14.2.3. Information quality

(212) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (210)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 28: Information quality of ‘automatic brake intervention’

Event detection	Value of <i>InformationQuality</i>
No TRCO-compliant implementation	0
Condition (a) fulfilled	1
Condition (a) fulfilled and current filtered longitudinal acceleration of the vehicle < -4 m/s ²	2

(213) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

14.3. Termination conditions

(214) The C-ITS service shall be terminated when condition (a) is no longer valid. At the termination of the C-ITS service, update DENM request shall be terminated.

14.3.1. Cancellation

(215) A cancellation DENM shall not be used for this C-ITS service.

14.3.2. Negation

(216) A negation DENM shall not be used for this C-ITS service.

14.4. Update

(217) The generated DENM shall be updated every 100 ms if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in Table 29.

14.5. Repetition duration and repetition interval

(218) A repetition of the DENM shall not be used for this C-ITS service.

14.6. Traffic class

(219) New and update DENMs shall be set to *traffic class 0*.

14.7. Message parameters

14.7.1. DENM

(220) The following table specifies the data elements of the DENM that shall be set.

Table 29: DENM data elements of ‘automatic brake intervention’

Data field	Value	
Management container		
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].	
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.	
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].	
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.	
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2].	
	Shall be refreshed for every update DENM.	
<i>relevanceDistance</i>	lessThan500m(3)	
<i>relevanceTrafficDirection</i>	If the roadType is known, the value shall be set as follows:	
	RoadType	Direction
	0	allTrafficDirections(0)
	1	upstreamTraffic(1)
	2	allTrafficDirections(0)
	3	upstreamTraffic(1)
	Otherwise, the value shall be set to allTrafficDirections(0)	
<i>validityDuration</i>	2 s	
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].	
Situation container		
<i>informationQuality</i>	See point (212)	
<i>causeCode</i>	dangerousSituation(99)	
<i>subCauseCode</i>	aebEngaged(5)	
Location container		

<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / Non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			

<i>lanePosition</i>	<p>If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate of the lane number is not legitimate for this version of the triggering condition.</p> <p>If the <i>lanePosition</i> is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>
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14.7.2. CAM

(221) CAM adaption shall not be used for this C-ITS service.

14.8. Network and transport layer

(222) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

14.9. Security layer

(223) If the triggering conditions as described in point (210) apply, an AT change shall be blocked for new and update DENMs as long as the *validityDuration* has not expired. Corresponding new and update DENMs shall be sent with the same AT.

15. DANGEROUS SITUATION — REVERSIBLE OCCUPANT RESTRAINT SYSTEM INTERVENTION

15.1. Description of C-ITS service

This C-ITS service transmits V2V information on an active intervention of a reversible occupant-restraint system (e.g. reversible belt-tightener) in the ego vehicle due to a critical driving situation.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘dangerous situations — electronic emergency brake light’;
- ‘dangerous situations — automatic brake intervention’.

15.2. Triggering conditions

15.2.1. Preconditions

(224) No specific preconditions apply for this C-ITS service.

(225) Parallel activation with the other related C-ITS services shall be avoided. Where the ‘*electronic emergency brake light*’ and/or ‘*automatic brake intervention*’ C-ITS services are triggered simultaneously, the C-ITS services shall be prioritised as follows:

- (a) ‘electronic emergency brake light’ (highest priority);
- (b) ‘automatic brake intervention’;
- (c) ‘reversible occupant restraint system intervention’ (lowest priority).

(226) If a higher-priority C-ITS service is triggered, any related lower-priority C-ITS service transmission that has already been triggered and is still active regarding

update, shall be aborted. In addition, the generation of a new DENM for the higher priority C-ITS service shall be requested.

15.2.2. Service-specific conditions

(227) If the following condition is satisfied, the generation of a DENM shall be triggered:

- (a) a signal representing a request for the active intervention of a reversible occupant-restraint system (e.g. reversible belt-tightener) is detected due to a critical driving situation.

15.2.3. Information quality

(228) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (227)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 30: Information quality of ‘reversible occupant restraint system intervention’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	0
Condition (a) fulfilled	1
Condition (a) fulfilled and current filtered longitudinal acceleration of the vehicle < -4 m/s ²	2

(229) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

15.3. Termination conditions

(230) The C-ITS service shall be terminated when condition (a) is no longer valid. At the termination of the C-ITS service, update DENM request shall be terminated.

15.3.1. Cancellation

(231) A cancellation DENM shall not be used for this C-ITS service.

15.3.2. Negation

(232) A negation DENM shall not be used for this C-ITS service.

15.4. Update

(233) The generated DENM shall be updated every 100 ms if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in Table 31 below.

15.5. Repetition duration and repetition interval

(234) A repetition of the DENM shall not be used for this C-ITS service.

15.6. Traffic class

(235) New and update DENMs shall be set to *traffic class 0*.

15.7. Message parameters

15.7.1. DENM

(236) The following table specifies the data elements of the DENM that shall be set.

Table 31: DENM data elements of ‘reversible occupant restraint system intervention’

Data field	Value	
Management container		
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].	
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.	
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].	
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.	
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for every update DENM.	
<i>relevanceDistance</i>	lessThan500m(3)	
<i>relevanceTrafficDirection</i>	If the roadType is known, the value shall be set as follows:	
	RoadType	Direction
	0	allTrafficDirections(0)
	1	upstreamTraffic(1)
	2	allTrafficDirections(0)
	3	upstreamTraffic(1)
	Otherwise, the value shall be set to allTrafficDirections(0)	
<i>validityDuration</i>	2 s	
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].	
Situation container		
<i>informationQuality</i>	See point (228).	

<i>causeCode</i>	dangerousSituation(99)		
<i>subCauseCode</i>	preCrashSystemEngaged(2)		
Location container			
<i>eventSpeed</i>	Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>eventPositionHeading</i>	Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / Non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte container			

<i>lanePosition</i>	<p>If the <i>lanePosition</i> is provided by an on-board sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map to estimate the lane number is not legitimate for this version of the triggering condition.</p> <p>If the <i>lanePosition</i> is unknown, the data element shall be omitted.</p> <p>Shall be refreshed for an update DENM.</p>
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15.7.2. CAM

(237) CAM adaption shall not be used for this C-ITS service.

15.8. Network and transport layer

(238) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

15.9. Security layer

(239) If the triggering conditions as described in point (227) apply, an AT change shall be blocked for new and update DENMs as long as the *validityDuration* has not expired. Corresponding new and update DENMs shall be sent with the same AT.

16. ADVERSE WEATHER CONDITIONS — FOG

16.1. Description of C-ITS service

This C-ITS service transmits V2V information on fog that may impede the driver's vision.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘adverse weather conditions — precipitation’.

(240) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

16.2. Triggering conditions

16.2.1. Preconditions

(241) The following preconditions shall be satisfied before this C-ITS service is triggered:

- the vehicle speed is greater than 7 km/h;
- the vehicle speed is less than 80 km/h.

(242) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used.

16.2.2. Service-specific conditions

(243) If the preconditions in point (241) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (1) driver reaction and light status:
 - (a) the driver enables the rear fog-light and the low-beam light is enabled. All these conditions must be valid for more than 20 s (to minimise risk of misuse by driver, conditions have to be valid for a longer period);
 - (b) the driver enables the rear fog-light, the low-beam light is enabled and the vehicle velocity is less than 60 km/h. All these conditions must be valid for a duration greater than 20 s;
- (2) visibility range measurement device:
 - (a) the visibility due to fog is less than 80 m +/- 40 m tolerance for more than 5 s (the obscured view has to be detected for a reasonable period. The period is shorter than for conditions (a) and (b) due to more reliable information);
 - (b) the visibility due to fog is less than 80 m +/- 40 m tolerance and the vehicle velocity is less than 60 km/h (if the vehicle is in a non-urban area, this speed could be an indication of reduced visibility) for more than 5 s.

(244) A new or update DENM shall not be generated in the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a DENM to that effect has been triggered. In this way, a single event cannot trigger a series of DENMs. For the visibility range measurement device (conditions (c) and (d)), the *Detection Blocking Time* shall be 15 s. For the other conditions there shall be no *Detection Blocking Time*.

(245) In order to ensure consistent functional behaviour for the different triggering conditions and the *Detection Blocking Time*, the *Minimum Detection Interval* between two detected events shall be 20 s.

16.2.3. Information quality

(246) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (243)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 32: Information quality of ‘adverse weather condition — fog’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition (a) is fulfilled	1
Condition (b) is fulfilled	2
Condition (c) is fulfilled	3
Condition (d) is fulfilled	4

(247) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed

conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

16.3. Termination conditions

(248) A termination of the C-ITS service shall not be considered.

16.3.1. Cancellation

(249) A cancellation DENM shall not be used for this C-ITS service.

16.3.2. Negation

(250) A negation DENM shall not be used for this C-ITS service.

16.4. Update

(251) The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

- (a) at least one of the conditions in point (243) is fulfilled after the *Minimum Detection Interval* specified in section 16.2.2;
- (b) the *validityDuration* of the former DENM has not expired;
- (c) neither the value of the data element *DeltaLatitude* nor that of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude*.

(252) If conditions (a), (b) and (c) as specified in point (251) are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (*eventPosition*, *eventDeltaTime*, *informationQuality*) shall be stored in the *eventHistory* as an additional *eventPoint*.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent *eventPoint* in first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* shall be deleted from the *eventHistory* for the update DENM. If the distance covered by the *eventHistory* exceeds the threshold allowed by the security, the oldest event points shall be deleted from the *eventHistory*.

The information of the current detected event shall be assigned to the DENM data fields of the updated DENM.

Note: It is up to the receiver to handle event points with lifetimes that exceed the *validityDuration* after the update DENM has been generated.

(253) If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event shall be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the *repetitionDuration* of the former DENM does not expire.

(254) If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

(255) If condition (a) is not fulfilled, the generation of an update DENM is not necessary.

16.5. Repetition duration and repetition interval

(256) DENMs that are new or have been updated shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

Note: The *validityDuration* is set to 300 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

16.6. Traffic class

(257) New and update DENMs shall be set to *traffic class* 1.

16.7. Message parameters

16.7.1. DENM

(258) The following table specifies the data elements of the DENM that shall be set.

Table 33: DENM data elements of ‘adverse weather condition — fog’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event.
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
<i>relevanceDistance</i>	<ul style="list-style-type: none"> • New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the eventHistory becomes longer. To address all relevant ITS stations, the relevanceDistance is longer in this case.)
<i>relevanceTrafficDirection</i>	allTrafficDirections(0)

<i>validityDuration</i>	300 s		
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].		
Situation container			
<i>informationQuality</i>	See point (246). Shall be refreshed for every update DENM and set to the informationQuality of the current event point.		
<i>causeCode</i>	adverseWeatherCondition-Visibility(18)		
<i>subCauseCode</i>	unavailable(0) or fog(1)		
<i>eventHistory</i>	This element shall be used for update DENMs only (see section 16.4).		
Location container			
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station with reference to the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM. Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / Non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		

16.7.2. CAM

(259) CAM adaption shall not be used for this C-ITS service.

16.8. Network and transport layer

(260) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

16.9. Security layer

(261) If the triggering conditions as described in point (243) apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was generated). Corresponding new and update DENMs shall be sent with the same AT.

(262) If the AT changes and there is an active DENM transmission (new or update DENM), the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* shall be deleted. The regular DENM generation process shall then continue.

17. ADVERSE WEATHER CONDITIONS — PRECIPITATION

17.1. Description of C-ITS service

This C-ITS service transmits V2V information on precipitation that may impede the driver's vision.

The following C-ITS services are related to this service, because they share similar triggering conditions:

- 'adverse weather conditions — fog'.

(263) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

17.2. Triggering conditions

17.2.1. Preconditions

(264) The following preconditions shall be satisfied before this C-ITS service is triggered:

- (a) the vehicle velocity is greater than 7 km/h;
- (b) the vehicle velocity is less than 80 km/h;
- (c) the windshield washer function is not active.

(265) The vehicle speed shall be determined by the vehicle bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise) shall be used.

17.2.2. Service-specific conditions

(266) If the preconditions in point (264) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered.

- (1) wiper level and light status:
 - (a) the wiper operates at its maximum speed level. The low-beam light is enabled. All these conditions must be valid for more than 20 s;

- (b) the wiper operates at its maximum speed level and the vehicle velocity is less than 60 km/h. The low-beam light is enabled. All these conditions must be valid for more than 20 s;
- (2) rain measurement device, wiper level and light status:
 - (a) the quantity of rainfall is at least 90 % of the maximum output of the measurement device and the wiper operates at its maximum speed level. The low-beam light is enabled. All these conditions must be valid for more than 20 s;
 - (b) the quantity of rainfall is at least 90 % of the maximum output of the measurement device and the wiper operates at its maximum speed level. The low-beam light is enabled and the vehicle velocity is less than 60 km/h. All these conditions must be valid for more than 20 s.

(267) The *Minimum Detection Interval* between two detected events shall be 20 s.

17.2.3. Information quality

(268) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (266)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 34: Information quality of ‘adverse weather condition — precipitation’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition (a) is fulfilled	1
Condition (b) is fulfilled	2
Condition (c) is fulfilled	3
Condition (d) is fulfilled	4

(269) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

17.3. Termination conditions

(270) A termination of the C-ITS service shall not be considered.

17.3.1. Cancellation

(271) A cancellation DENM shall not be used for this C-ITS service.

17.3.2. Negation

(272) A negation DENM shall not be used for this C-ITS service.

17.4. Update

(273) The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

- (a) at least one of the conditions in point (266) is fulfilled after the *Minimum Detection Interval* specified in section 17.2.2;
 - (b) the *validityDuration* of the former DENM has not expired;
 - (c) neither the value of the data element *DeltaLatitude* nor that of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude*.
- (274) If conditions (a), (b) and (c) as specified in point (273) are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (*eventPosition*, *eventDeltaTime*, *informationQuality*) must be stored in the *eventHistory* as an additional *eventPoint*.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent *eventPoint* in first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* shall be deleted from the *eventHistory* for the update DENM. If the distance covered by the *eventHistory* exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the *eventHistory*.

The information of the current detected event must be assigned to the DENM data fields of the updated DENM.

Note: It is up to the receiver to handle event points with lifetimes that exceed the *validityDuration* after the update DENM has been generated.

- (275) If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event must be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the *repetitionDuration* of the former DENM does not expire.

- (276) If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

- (277) If condition (a) is not fulfilled, the generation of an update DENM is not necessary.

17.5. Repetition duration and repetition interval

- (278) DENMs that are new or have been updated shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 s. Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set according to the above values.

Note: The *validityDuration* is set to 300 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same *causeCode* originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

17.6. Traffic class

(279) New and update DENMs shall be set to *traffic class* 1.

17.7. Message parameters

17.7.1. DENM

(280) The following table specifies the data elements of the DENM that shall be set.

Table 35: DENM data elements of ‘adverse weather condition — precipitation’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event point.
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the position of the current event point.
<i>relevanceDistance</i>	<ul style="list-style-type: none"> • New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the <i>eventHistory</i> becomes longer. To address all relevant ITS stations, the <i>relevanceDistance</i> is longer in this case.)
<i>relevanceTrafficDirection</i>	allTrafficDirections(0)
<i>validityDuration</i>	300 s
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (268). Shall be refreshed for every update DENM and set to the <i>informationQuality</i> of the current event point.
<i>causeCode</i>	adverseWeatherCondition-Precipitation(19)
<i>subCauseCode</i>	unavailable(0), heavyRain(1) or heavySnowfall(2)

<i>eventHistory</i>	This element shall be used for update DENMs only (see section 17.4).		
Location container			
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station with reference to the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM and set to the roadType of the current event point. Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / Non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		

17.7.2. CAM

(281) CAM adaption shall not be used for this C-ITS service.

17.8. Network and transport layer

(282) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

17.9. Security layer

(283) If the triggering conditions as described in point (266) apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was generated). Corresponding new and update DENMs shall be sent with the same AT.

(284) If the AT changes and there is active transmission of a new or update DENM, the transmission shall be stopped. In addition, the *EventHistory* and the

PathHistory shall be deleted. The regular DENM generation process shall then continue.

18. ADVERSE WEATHER CONDITIONS — TRACTION LOSS

18.1. Description of C-ITS service

This C-ITS service transmits V2V information on slipperiness that may impact driving behaviour.

(285) A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

18.2. Triggering conditions

18.2.1. Preconditions

(286) The following preconditions shall be satisfied before this C-ITS service is triggered:

- (a) reverse gear is not enabled;
- (b) no errors concerning engine, drive train and braking system are reported.

18.2.2. Service-specific conditions

(287) If the precondition in point (286) and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- (1) on the basis of positive acceleration:
 - (a) on the basis of Anti-Slip Regulation (ASR), acceleration pedal, vehicle acceleration and vehicle velocity. An ASR request must be active for at least 200 ms (as for other safety functions depending on ASR). The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered vehicle bus signal) is less than 40 % of the vehicle acceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre. (In order to cover different drive configurations, e.g. two-wheel vs. four-wheel drive, no detailed values have been put here);
 - (b) on the basis of ASR, acceleration pedal, vehicle acceleration and vehicle velocity. An ASR request must be active for at least 200 ms. The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered vehicle bus signal) is less than 20 % of the vehicle acceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre;
 - (c) on the basis of ASR, acceleration pedal, vehicle acceleration and vehicle velocity. An ASR request must be active for at least 200 ms. The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered vehicle bus signal) is less than 10 % of the vehicle

acceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre;

(d) on the basis of ASR and acceleration pedal. An ASR request must be active for at least 200 ms. The acceleration pedal is pressed on average less than 30 % (so as not to cause an ASR intervention on ground with high friction value) while ASR intervention is active;

(2) on the basis of negative acceleration (deceleration):

(a) on the basis of Anti-lock Braking System (ABS), braking pressure and deceleration. ABS intervention is active for more than 200 ms (according to other safety functions depending on ABS). Braking pressure is more than 20 % of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered vehicle bus signal) is less than 50 % of the vehicle deceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre;

(b) on the basis of ABS, braking pressure and deceleration. ABS intervention is active for more than 200 ms. Braking pressure is more than 20 % of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered vehicle bus signal) is less than 25 % of the vehicle deceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre;

(c) on the basis of ABS, braking pressure and deceleration. ABS intervention is active for more than 200 ms. Braking pressure is more than 20 % (so as not to cause an ABS intervention on ground with high friction value) of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered vehicle bus signal) is less than 10 % of the vehicle deceleration on a surface with high friction coefficient (such as dry asphalt (typical $\mu = 0.85$)) at the same start speed and driving manoeuvre;

(d) on the basis of ABS and braking pressure. ABS intervention is active for more than 200 ms. Braking pressure is less than 20 % of maximum capable braking pressure;

(3) on the basis of friction coefficient estimation:

(a) the friction coefficient is less than 0.3 for at least 5 s (the friction coefficient of ice is < 0.2 ; for snow and loose chippings, it is approx. 0.4. The friction coefficient needs to be detected for a certain period);

(b) the friction coefficient is less than 0.2 for at least 5 s.

(288) If conditions 1a-c or 2a-c are evaluated as valid, the vehicle acceleration/deceleration shall be determined by the vehicle bus signal, not by GNSS analysis.

(289) A new or update DENM shall not be generated in the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a DENM to that effect has been triggered. This way, a single event is not able to trigger a series of DENMs. For friction coefficient estimation (conditions 3a

and 3b), the *Detection Blocking Time* shall be 15 s. For the other conditions the *Detection Blocking Time* shall be 20 s.

(290) In order to ensure consistent functional behaviour for triggering conditions (a)-(d) and the *Detection Blocking Time*, the *Minimum Detection Interval* between two detected events shall be 20 s.

18.2.3. Information quality

(291) The value of the data element *informationQuality* in the DENM depends on how the event is detected (see point (287)). The *informationQuality* value shall be set in accordance with the following table (highest possible value shall be used):

Table 36: Information quality of ‘adverse weather condition — traction loss’

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition 1a or 2a is fulfilled	1
Condition 1b fulfilled	2
Condition 1c or 2b is fulfilled	3
Condition 2c fulfilled	4
Condition 1d or 2d fulfilled	5
Condition 3a is fulfilled	6
Condition 3b is fulfilled	7

(292) If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

18.3. Termination conditions

(293) A termination of the C-ITS service shall not be considered.

18.3.1. Cancellation

(294) A cancellation DENM shall not be used for this C-ITS service.

18.3.2. Negation

(295) A negation DENM shall not be used for this C-ITS service.

18.4. Update

(296) The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

- (a) at least one of the conditions in point (287) is fulfilled after the *Minimum Detection Interval* specified in section 18.2.2;
- (b) the *validityDuration* of the former DENM has not expired;

- (c) neither the value of the data element *DeltaLatitude* nor that of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude*.

(297) If conditions (a), (b) and (c) as specified in point (296) are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (*eventPosition*, *eventDeltaTime*, *informationQuality*) must be stored in the *eventHistory* as an additional *eventPoint*.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent *eventPoint* in first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* (see point (303)) shall be deleted from the *eventHistory* for the update DENM. If the distance covered by the *eventHistory* exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the *eventHistory*.

The information of the current detected event must be assigned to the DENM data fields of the updated DENM.

Note: It is up to the receiver to handle event points with lifetimes that exceed the *validityDuration* after the update DENM has been generated.

(298) If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event shall be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the *repetitionDuration* of the former DENM does not expire.

(299) If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

(300) If condition (a) is not fulfilled, the generation of an update DENM is not necessary.

18.5. Repetition duration and repetition interval

(301) By default, DENMs that are new or have been updated shall be repeated for a *repetitionDuration* of 300 s with a *repetitionInterval* of 1 s.

However, if the DENM is triggered in an urban area, as determined by a digital map or an on-board sensor algorithm, it shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 s.

Therefore, the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set in accordance with the above values.

Note: The *validityDuration* is set to 600 s or 300 s respectively. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same causeCode originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

18.6. Traffic class

(302) New and update DENMs shall be set to *traffic class* 1.

18.7. Message parameters

18.7.1. DENM

(303) The following table specifies the data elements of the DENM that shall be set.

Table 37: DENM data elements of ‘adverse weather condition — traction loss’

Data field	Value
Management container	
<i>actionID</i>	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
<i>detectionTime</i>	<i>TimestampIts</i> -timestamp at which the event is detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event point.
<i>referenceTime</i>	<i>TimestampIts</i> -timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
<i>termination</i>	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
<i>eventPosition</i>	<i>ReferencePosition</i> . Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the position of the current event point.
<i>relevanceDistance</i>	<ul style="list-style-type: none"> • New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the <i>eventHistory</i> becomes longer. To address all relevant ITS stations, the <i>relevanceDistance</i> is longer in this case.)
<i>relevanceTrafficDirection</i>	allTrafficDirections(0)
<i>validityDuration</i>	Default: 600 s In urban areas, as determined by digital map or on-board sensor algorithm: 300 s (If the vehicle has no information about the urban/non-urban status, the default value shall be used.)
<i>stationType</i>	The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
<i>informationQuality</i>	See point (291). Shall be refreshed for every update DENM and set to the <i>informationQuality</i> of the current event point.
<i>causeCode</i>	adverseWeatherCondition-Adhesion(6)

<i>subCauseCode</i>	unavailable(0)		
<i>eventHistory</i>	This element shall be used for update DENMs only (see section 18.4).		
Location container			
<i>traces</i>	<i>PathHistory</i> of the originating C-ITS station with reference to the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.		
<i>roadType</i>	<i>RoadType</i> of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM and set to the <i>roadType</i> of the current event point.		
	Shall be set in accordance with [TS 102 894-2] in combination with the following rules:		
	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		

18.7.2. CAM

(304) CAM adaption shall not be used for this C-ITS service.

18.8. Network and transport layer

(305) The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

18.9. Security layer

(306) If the triggering conditions as described in point (287) apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was generated). Corresponding new and update DENMs shall be sent with the same AT.

(307) If the AT changes and there is active transmission of a new or update DENM, the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* shall be deleted. The regular DENM generation process shall then continue.

19. IN-VEHICLE SIGNAGE — DYNAMIC SPEED LIMIT INFORMATION

This C-ITS service transmits I2V information (using IVI) on the currently valid speed limit, by segment, lane or vehicle category, continuously, as set and distributed by the road operator.

(308) The information shall be consistent with the currently valid dynamic traffic signs.

(309) [ISO/TS 14823] Data Field shall be set with serviceCategoryCode = regulatory, nature = 5, serialnumber = 57, attributes/spe/spm = the value of the speed limit in km/h and unit = 0 (i.e. kmperh) or the equivalent for other countries (e.g. 1 for milesperh).

(310) With regard to the end of the speed limit, the following may be used: [ISO/TS 14823] Data Field with serviceCategoryCode = regulatory (12), nature = 6, serialnumber = 14 (notice of end of speed limit) or serviceCategoryCode = informative (13), nature = 6, serial number = 63 (notice of end of all restrictions by electronic signs) if this sign is shown on the road. Ending messages might be redundant, as the end point of the relevance zone of the initial IVI message already terminates the speed limit.

20. IN-VEHICLE SIGNAGE — EMBEDDED VMS ‘FREE TEXT’

This C-ITS service transmits infrastructure-to-vehicle (I2V) information (using Infrastructure to Vehicle Information (IVI)) in ‘free text’, as set and distributed by the road operator. The priority of the IVS messages sent is defined by the road operator.

(311) The information shall be consistent with the currently valid dynamic traffic signs.

21. IN-VEHICLE SIGNAGE — OTHER SIGNAGE INFORMATION

This C-ITS service transmits I2V signage information (using IVI) other than dynamic speed limit and free text information, e.g. bans on overtaking or lane advice, as set and distributed by the road operator.

(312) The information shall be consistent with the currently valid dynamic traffic signs.

(313) [ISO/TS 14 823] Data Field is set with serviceCategoryCode = informative; nature = 6; serialnumber = 59 (for lane closed), 60 (for lane free), 61 (for clear lane to left) or 62 (for clear lane to right).

(314) As regards ‘end of the restriction’: serviceCategoryCode = informative (13), nature = 6, serial number = 63 for ‘end of all restrictions by electronic signs’ may be used if this electronic sign is shown. Ending messages might be redundant, as the end point of the relevance zone of the initial IVI message already terminates the signage information.

22. HAZARDOUS LOCATIONS NOTIFICATION — ACCIDENT ZONE

This C-ITS service transmits I2V information (using DEN) about an accident zone using a single warning message ID, as set and distributed by the road operator.

(315) CauseCode shall be set to 2 (accident) and subCauseCode shall be set between 0 and 7 (except 6).

23. HAZARDOUS LOCATIONS NOTIFICATION — TRAFFIC JAM AHEAD

This C-ITS service transmits I2V information (using DEN) about a traffic jam ahead, by segment or lane, using a single warning message ID, as set and distributed by the road operator (mentioning the positions, the length of the traffic jam and the section/lanes concerned, if this information is available).

(316) CauseCode shall be set to 27 (dangerous end of queue) and subCauseCode shall be set to 0 (unavailable) to signal a dangerous end of queue. To convey information about the whole length of the queue, causeCode shall be set to 1 (traffic congestion) and subCauseCode shall be set to 0.

24. HAZARDOUS LOCATIONS NOTIFICATION — STATIONARY VEHICLE

This C-ITS service transmits I2V information (using DEN) about a stationary vehicle using a single warning message ID, as set and distributed by the road operator.

(317) CauseCode shall be set to 94 (stationary vehicle) and subCauseCode shall be set to 0 (unavailable) or 2 (breakdown vehicle).

25. HAZARDOUS LOCATIONS NOTIFICATION — WEATHER CONDITION WARNING

This C-ITS service transmits I2V information (using DEN) about current and/or expected precipitation or extreme weather conditions (scenario 1) or low visibility ranges (scenario 3), using a single warning message ID, as set and distributed by the road operator.

(318) CauseCode shall be set to 17 (extreme weather condition) or 19 (precipitation).

26. HAZARDOUS LOCATIONS NOTIFICATION — TEMPORARY SLIPPERY ROAD

This C-ITS service transmits I2V information (using DEN) on slippery sections of road using a single warning message ID, as set and distributed by the road operator.

(319) CauseCode shall be set to 6 (adhesion) and subCauseCode shall be set between 0 and 9.

27. HAZARDOUS LOCATIONS NOTIFICATION — ANIMAL OR PERSON ON THE ROAD

This C-ITS service transmits I2V information (using DEN) on animals or persons on the road, using a single warning message ID, as set and distributed by the road operator.

(320) CauseCode shall be set to 11 (animal on the road) or 12 (human presence on the road).

28. HAZARDOUS LOCATIONS NOTIFICATION — OBSTACLE ON THE ROAD

This C-ITS service transmits I2V information (using DEN) on one or more obstacles in one or more lanes. However, traffic can still go through (not a blockage). It uses a single warning message ID, as set and distributed by the road operator.

(321) CauseCode shall be set to 10 (obstacle on the road) and subCauseCode shall be set between 0 and 5 (6 and 7 are not used).

29. ROAD WORKS WARNING — LANE CLOSURE (AND OTHER RESTRICTIONS)

This C-ITS service transmits I2V information (using DEN) on the closure of part of a lane, a whole lane or several lanes (including hard shoulder), but without full road closure. It uses a single warning message ID, as set and distributed by the road operator.

It can be provided in one the following ways:

- static planned roadworks (Traffic Operation Centre (TOC) triggered) – the road operator programmes static and planned (or *ad hoc*) road works in its Traffic Management System (TMS);
- stand-alone mode – a trailer is used for a short-term or long-term roadwork, but without a connection to the TOC (no connection available);
- augmented (stand-alone followed by TOC triggered) – the message is first sent from a trailer and can be updated later, including with additional details from the TOC.

(322) CauseCode shall be set to 3 (roadworks) and subCauseCode shall be set to 0 or 4.

30. ROAD WORKS WARNING — ROAD CLOSURE

This C-ITS service transmits I2V information (using DEN) on a road closure due to a set of static roadworks. The closure is temporary. It uses a single warning message ID, as set and distributed by the road operator.

(323) CauseCode shall be set to 3 (roadworks) and subCauseCode shall be set to 1.

31. ROAD WORKS WARNING — ROAD WORKS (MOBILE)

This C-ITS service transmits I2V information (using DEN) on a zone on the road in which, at some point, a lane is narrowed or closed (but without road closure), due to a planned mobile work site. It uses a single warning message ID, as set and distributed by the road operator.

This C-ITS service can be provided in one the following ways:

- TOC triggered – the road operator programmes mobile and planned (or *ad hoc*) road works in its TMS. The information contains all elements that can be used to identify the work zone (start/end position, duration). The operating agents will not use the entire zone, but mark the actual work site within it. More information can be added, such as the speed limit in each narrowed portion;
- stand-alone mode – a trailer is used for a short-term or long-term roadworks, but without a connection to the TOC (no connection available).

(324) CauseCode shall be set to 3 (roadworks) and subCauseCode shall be set to 3.

32. SIGNALISED INTERSECTIONS — GREEN LIGHT OPTIMAL SPEED ADVISORY

This C-ITS service transmits I2V information, using Signal Phase and Timing (SPAT) and Topology Information for the Intersection (MAP), on speed advice to road users approaching and passing traffic-light-controlled intersections, based on the current phase state and predicted timing of the traffic lights, and road topology for the intersection(s) ahead.

It can be provided in one of the following ways:

- vehicle calculates speed advice – the signalised intersection transmits periodically and in real time the current phase state of the traffic lights and the timing of upcoming phase changes. The approaching vehicle, aware of its own location and velocity, receives the messages and calculates the optimal speed for approaching the intersection;
- infrastructure calculates speed advice – the signalised intersection calculates and transmits periodically and in real time advisory speed information for multiple road segments of the approach to the intersection. The approaching vehicle, aware of its own location and velocity, receives the messages and extracts the optimal speed for approaching the intersection;
- green-wave speed advice – a sequence of traffic-light-controlled, synchronised intersections transmit pre-defined/planned green-wave speed advice. The approaching vehicle, aware of its own location and velocity, receives the messages and extracts the green-wave speed for passing the intersections.

(325) Information on the current phase state and timing of upcoming phase changes from the signalised intersection shall be sufficiently accurate and reliable to ensure high-quality speed advice.

(326) The information shall be consistent with the physical signal heads of the intersection.

(327) Traffic conditions, such as queues or traffic jams, affect the validity of speed advice and shall therefore be taken into account.

(328) Advised speeds shall never exceed the legal speed limit.

33. SIGNALISED INTERSECTIONS — PUBLIC TRANSPORT PRIORITISATION

This C-ITS service gives priority to public transport vehicles over private vehicles at signalised intersections using Signal Request Extended Message (SREM) and Signal Request Status Extended Message (SSEM). The public transport vehicle transmits a prioritisation request using V2I. The public transport prioritisation system processes the request, accepts or rejects it, and sends feedback to the public transport vehicle using I2V. If the request is accepted, e.g. ‘red phases’ may be shortened and ‘green phases’ extended, the public transport vehicle gets a ‘green light’ with minimum delay at the stop line. After it has successfully driven through the intersection, the traffic-light controller switches back to normal operation.

(329) The stationID of the vehicle shall not change during processing of a prioritisation request.

(330) Authentication and authorisation of public transport vehicles shall be ensured.

(331) The priority request shall be provided in time to allow the public transport prioritisation system to react.