
Triggering Conditions and Data Quality Stationary Vehicle Warning

CAR 2 CAR Communication Consortium



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COMMUNICATION CONSORTIUM

About the C2C-CC

Enhancing road safety and traffic efficiency by means of Cooperative Intelligent Transport Systems and Services (C-ITS) is the dedicated goal of the CAR 2 CAR Communication Consortium. The industrial driven, non-commercial association was founded in 2002 by vehicle manufacturers affiliated with the idea of cooperative road traffic based on Vehicle-to-Vehicle Communications (V2V) and supported by Vehicle-to-Infrastructure Communications (V2I). The Consortium members represent worldwide major vehicle manufactures, equipment suppliers and research organisations.

Over the years, the CAR 2 CAR Communication Consortium has evolved to be one of the key players in preparing the initial deployment of C-ITS in Europe and the subsequent innovation phases. CAR 2 CAR members focus on wireless V2V communication applications based on ITS-G5 and concentrate all efforts on creating standards to ensure the interoperability of cooperative systems, spanning all vehicle classes across borders and brands. As a key contributor, the CAR 2 CAR Communication Consortium works in close cooperation with the European and international standardisation organisations such as ETSI and CEN.

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Table 2: Changes since last version

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1 Introduction

Other (informational)

RS_tcStVe_183

This document describes the triggering conditions for stationary vehicle warning for the following three vehicle C-ITS service:

- 'stationary vehicle warning — stopped vehicle';
- 'stationary vehicle warning — broken-down vehicle';
- 'stationary vehicle warning — post-crash'.

2 Definitions

Definition

RS_tcStVe_642

'*Vehicle speed*' is the length of the velocity-vector of the reference position point.

3 Requirement specifications

Requirement

RS_tcStVe_208

The Stationary Vehicle Warning vehicle C-ITS services deals with vehicles which are 'stationary'. A stationary vehicle is defined in RS_BSP_511.

Tested by:

3.1 Stationary vehicle warning - stopped vehicle

3.1.1 Description of vehicle C-ITS service

Other (informational)

RS_tcStVe_184

This chapter describes the triggering of V2V messages for stopped vehicles. Various reasons could lead to a situation involving a stopped vehicle, like human problems, accidents, rubbish collection, delivery service or a stopping bus. This chapter focuses on situations without particular information about the reason of the stopping maneuver.

Other (informational)

RS_tcStVe_185

The following vehicle 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'.

Requirement

RS_tcStVe_116

A DENM signal shall be sent to the stack only if the triggering conditions described in this chapter 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.

Tested by:

3.1.2 Triggering conditions

3.1.2.1 Preconditions

Requirement

RS_tcStVe_117

The following preconditions shall be satisfied when this use case is triggered:

1. no breakdown warning message, that prevents the driver from continuing to drive (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 this service is optional when ignition terminal 15 is off.

Tested by:

Requirement

RS_tcStVe_205

Parallel activation with the other related vehicle C-ITS services shall be avoided. Where the 'broken-down vehicle' and/or 'post-crash' vehicle C-ITS services are triggered simultaneously,

the vehicle C-ITS services shall be prioritised as follows:

- 1.) 'post-crash' (highest priority);
- 2.) 'broken-down vehicle';
- 3.) 'stopped vehicle' (lowest priority).

The higher priority service shall generate a new DENM and the overruled lower priority service shall not continue to generate update DENMs. An active repetition of the lower priority service may continue, a termination DENM for lower priority services should not be generated.

Tested by:

3.1.2.2 Service-specific conditions

Requirement

RS_tcStVe_118

If the preconditions in RS_tcStVe_117 and all of the following conditions are satisfied, the triggering conditions for this vehicle C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- the ego vehicle has enabled hazard lights;
- the vehicle is stationary;
- the *Triggering Timer* has expired.

Note: PTWs may not be equipped with hazard lights. PTWs without hazard lights will not trigger this use case.

Tested by:

Requirement

RS_tcStVe_120

If the vehicle 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.

A corresponding DENM shall be sent out if the *Triggering Timer* is expired and the hazard lights are activated.

Note: For PTWs the side stand is used for at least 3 s is equivalent to point e) (car doors open for more than 3 s).

Tested by:

Requirement

RS_tcStVe_121

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.

Tested by:

Requirement **RS_tcStVe_122**

During the runtime of the *Triggering Timer*, the vehicle shall be stationary. Otherwise, the detection shall be cancelled.

Tested by:

3.1.2.3 Information quality

Requirement **RS_tcStVe_123**

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 3: 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 |

Tested by:

3.1.3 Termination conditions

Requirement **RS_tcStVe_125**

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

Tested by:

3.1.3.1 Cancellation

Requirement **RS_tcStVe_126**

If at least one of the following conditions is satisfied before the time 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 vehicle C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

Tested by:

3.1.3.2 Negation

Requirement

RS_tcStVe_127

A negation DENM shall not be used for this vehicle C-ITS service.

Tested by:

3.1.4 Update

Requirement

RS_tcStVe_128

If the previously detected *Stopped Vehicle* was not cancelled (see RS_tcStVe_126), the generation of an update DENM shall be triggered every 15 s.

Tested by:

Requirement

RS_tcStVe_129

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

Tested by:

Requirement

RS_tcStVe_130

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see RS_tcStVe_133).

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

Tested by:

Requirement

RS_tcStVe_124

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.

Tested by:

3.1.5 Repetition duration and repetition interval

Requirement

RS_tcStVe_131

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 vehicle C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

3.1.6 Traffic class

Requirement

RS_tcStVe_132

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

Tested by:

3.1.7 Message parameters

3.1.7.1 DENM

Requirement

RS_tcStVe_133

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

Table 4: 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>Timestamppts</i> -timestamp at which the event is detected by the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. | | | | | | | | | | |
| <i>referenceTime</i> | <i>Timestamppts</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" style="width: 100%;"> <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> | 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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. | | |
| Situation container | | | |
| <i>informationQuality</i> | See RS_tcStVe_123. 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 vehicle 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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. | | |
| <i>traces</i> | <p><i>PathHistory</i> of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>If the PathDeltaTime is used in the PathPoints, the PathDeltaTime of the first PathPoint (closest point to the ReferencePosition) shall be refreshed for an update DENM. All other PathPoints shall not be refreshed. If the PathDeltaTime of the first PathPoint exceeds the maximum value in accordance with [TS 102 894-2], the PathDeltaTime shall not be further refreshed. If the PathDeltaTime is not used in the PathPoints, the PathHistory shall not be refreshed for an update DENM.</p> | | |
| <i>roadType</i> | <p><i>RoadType</i> of the road on which the detecting vehicle 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 | 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 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 | | | |
| stationarySince | <p>Shall be set in accordance with the duration in minutes of the detecting vehicle 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> | | |

Tested by:

3.1.7.2 CAM

Requirement

RS_tcStVe_134

CAM adaption shall not be used for this vehicle C-ITS service.

Tested by:

3.1.8 Network and transport layer

Requirement

RS_tcStVe_135

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with centre point equal to *eventPosition* and radius equal to *relevanceDistance*.

Tested by:

3.1.9 Security layer

Requirement

RS_tcStVe_137

When the triggering conditions as described in chapter 3.1.2 apply, the application shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:

3.2 Stationary vehicle warning - broken-down vehicle

3.2.1 Description of vehicle C-ITS service

Other (informational)

RS_tcStVe_190

This chapter describes the triggering of V2V messages for broken-down vehicle. Though various reasons could cause a vehicle breakdown, such as bursting tires, lack of fuel or engine failure, this chapter focuses on reasons indicated by breakdown warning messages in the instrument cluster.

Other (informational)

RS_tcStVe_191

The following vehicle 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'.

Requirement

RS_tcStVe_138

A DENM signal shall be sent to the stack only if the triggering conditions described in this chapter 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.

Tested by:

3.2.2 Triggering conditions

3.2.2.1 Preconditions

Requirement

RS_tcStVe_139

The following preconditions shall be satisfied when this use case is triggered:

- 1.) 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 this service is optional when ignition terminal 15 is off.

Tested by:

Requirement

RS_tcStVe_206

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

- 1.) 'post-crash' (highest priority);
- 2.) 'broken-down vehicle';
- 3.) 'stopped vehicle' (lowest priority).

The higher priority service shall generate a new DENM and the overruled lower priority service shall not continue to generate update DENMs. An active repetition of the lower priority service may continue, a termination DENM for lower priority services should not be generated.

Tested by:

3.2.2.2 Service-specific conditions

Requirement

RS_tcStVe_140

If the precondition in RS_tcStVe_139 and all of the following conditions are satisfied, the triggering conditions for this vehicle C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- the ego vehicle has enabled hazard lights;
- the vehicle is stationary;
- the *Triggering Timer* has expired.

Note: PTWs may not be equipped with hazard lights. PTW without hazard lights will not trigger this use case.

Tested by:

Requirement

RS_tcStVe_142

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.

Note: For PTWs the side stand is used for at least 3 s is equivalent to point e) (car doors open for more than 3 s).

Tested by:

Requirement

RS_tcStVe_143

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.

Tested by:

Requirement

RS_tcStVe_144

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.

Tested by:

3.2.2.3 Information quality

Requirement

RS_tcStVe_145

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 5: 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 |

Tested by:

3.2.3 Termination conditions

Requirement

RS_tcStVe_147

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

Tested by:

3.2.3.1 Cancellation

Requirement

RS_tcStVe_148

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 vehicle C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

Tested by:

3.2.3.2 Negation

Requirement

RS_tcStVe_149

A negation DENM shall not be used for this vehicle C-ITS service.

Tested by:

3.2.4 Update

Requirement

RS_tcStVe_150

If the previously triggered DENM for a detected *Broken-down Vehicle* was not cancelled (see RS_tcStVe_148), the generation of an update DENM shall be triggered every 15 s.

Tested by:

Requirement

RS_tcStVe_151

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

Tested by:

Requirement

RS_tcStVe_152

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

Tested by:

Requirement

RS_tcStVe_153

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see RS_tcStVe_157).

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

Tested by:

Requirement

RS_tcStVe_146

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.

Tested by:

3.2.5 Repetition duration and repetition interval

Requirement

RS_tcStVe_154

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.

Tested by:

Requirement

RS_tcStVe_155

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 vehicle C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

3.2.6 Traffic class

Requirement

RS_tcStVe_156

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

Tested by:

3.2.7 Message parameters

3.2.7.1 DENM

Requirement

RS_tcStVe_157

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

Table 6: 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> | <i>Timestamp</i> ts-timestamp at which the event is detected by the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. |
| <i>referenceTime</i> | <i>Timestamp</i> ts-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 a new or update DENM. Shall be set to <i>isCancellation</i> (0) 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> | lessThan1000m(4) |
| <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>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> <p>Otherwise, the value shall be set to allTrafficDirections(0)</p> | 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> | <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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. | | | | | | | | | | |
| Situation container | | | | | | | | | | | |
| <i>informationQuality</i> | See RS_tcStVe_145. Shall be refreshed for every update DENM. | | | | | | | | | | |
| <i>causeCode</i> | stationaryVehicle(94) | | | | | | | | | | |
| <i>subCauseCode</i> | vehicleBreakdown(2) | | | | | | | | | | |
| Location container | | | | | | | | | | | |
| <i>eventSpeed</i> | Speed of the originating vehicle 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 vehicle 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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. If the PathDeltaTime is used in the PathPoints, the PathDeltaTime of the first PathPoint (closest point to the ReferencePosition) shall be refreshed for an update DENM. All other PathPoints shall not be refreshed. If the PathDeltaTime of the first PathPoint exceeds the maximum value in accordance with [TS 102 894-2], the PathDeltaTime shall not be further refreshed. If the PathDeltaTime is not used in the PathPoints, the PathHistory shall not be refreshed for an update DENM. | | | | | | | | | | |
| <i>roadType</i> | <i>RoadType</i> of the road on which the detecting vehicle 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- NoStructuralSeparation ToOppositeLanes(0) | | | | | | | | |

| | | | |
|--|--|---------|---|
| | Urban | Yes | urban- WithStructuralSeparation ToOppositeLanes(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 vehicle 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> | | |

Tested by:

3.2.7.2 CAM

Requirement

RS_tcStVe_158

CAM adaption shall not be used for this vehicle C-ITS service.

Tested by:

3.2.8 Network and transport layer

Requirement

RS_tcStVe_159

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with centre point equal to *eventPosition* and radius equal to *relevanceDistance*.

Tested by:

3.2.9 Security layer

Requirement

RS_tcStVe_161

When the triggering conditions as described in chapter 3.2.2 apply, the application shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:

3.3 Stationary vehicle warning - post-crash

3.3.1 Description of vehicle C-ITS service

Other (informational)

RS_tcStVe_195

This chapter describes the triggering conditions for a V2V DENM transmission caused by a traffic accident.

Other (informational)

RS_tcStVe_196

The following vehicle 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'.

Requirement

RS_tcStVe_162

A DENM signal shall be sent to the stack only if the triggering conditions described in this chapter 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.

Tested by:

3.3.2 Triggering conditions

3.3.2.1 Preconditions

Requirement

RS_tcStVe_163

No specific preconditions apply for this vehicle C-ITS service.

Tested by:

Requirement

RS_tcStVe_207

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

- 1.) 'post-crash' (highest priority);
- 2.) 'broken-down vehicle';
- 3.) 'stopped vehicle' (lowest priority).

The higher priority service shall generate a new DENM and the overruled lower priority service shall not continue to generate update DENMs. An active repetition of the lower priority service may continue, a termination DENM for lower priority services should not be generated.

Tested by:

3.3.2.2 Service-specific conditions

Requirement

RS_tcStVe_164

If the preconditions in RS_tcStVe_163 and at least one of the following conditions are satisfied, the triggering conditions for this vehicle 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).

Note: The condition ‘vehicle becomes/is stationary’ is defined in RS_tcStVe_208.

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.

Tested by:

3.3.2.3 Information quality

Requirement

RS_tcStVe_166

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 7: 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 |

Tested by:

3.3.3 Termination conditions

Requirement

RS_tcStVe_168

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

Tested by:

3.3.3.1 Cancellation

Requirement

RS_tcStVe_169

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 vehicle C-ITS station needs to be permanently operational or extend its operation during that cancellation condition.

Tested by:

3.3.3.2 Negation

Requirement

RS_tcStVe_170

A negation DENM shall not be used for this vehicle C-ITS service.

Tested by:

3.3.4 Update

Requirement

RS_tcStVe_171

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

Tested by:

Requirement

RS_tcStVe_172

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

Tested by:

Requirement

RS_tcStVe_173

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see RS_tcStVe_177).

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

Tested by:

Requirement

RS_tcStVe_167

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.

Tested by:

3.3.5 Repetition duration and repetition interval

Requirement

RS_tcStVe_174

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.

Tested by:

Requirement

RS_tcStVe_175

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 vehicle C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

3.3.6 Traffic class

Requirement

RS_tcStVe_176

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

Tested by:

3.3.7 Message parameters

3.3.7.1 DENM

Requirement

RS_tcStVe_177

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

Table 8: 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> | <i>Timestamp</i> ts-timestamp at which the event is detected by the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. | | | | | | | | | | |
| <i>referenceTime</i> | <i>Timestamp</i> ts-timestamp at which a new DENM, an update DENM or a cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2]. | | | | | | | | | | |
| <i>termination</i> | Shall not be set in case of new or update DENM. Shall be set to <i>isCancellation</i> (0) in 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> | lessThan5km(5) | | | | | | | | | | |
| <i>relevanceTrafficDirection</i> | If the roadType 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>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) | | | | | | | | | | |
| Otherwise, the value shall be set to allTrafficDirections(0) | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| <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> | The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. | | | | | | | | | | |
| Situation container | | | | | | | | | | | |
| <i>informationQuality</i> | See RS_tcStVe_166. Shall be refreshed for every update DENM. | | | | | | | | | | |
| <i>causeCode</i> | stationaryVehicle(94) | | | | | | | | | | |
| <i>subCauseCode</i> | postCrash(3) | | | | | | | | | | |
| Location container | | | | | | | | | | | |
| <i>eventSpeed</i> | Speed of the originating vehicle 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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. | | | | | | | | | | |

| <p><i>traces</i></p> | <p><i>PathHistory</i> of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].</p> <p>If the <i>PathDeltaTime</i> is used in the <i>PathPoints</i>, the <i>PathDeltaTime</i> of the first <i>PathPoint</i> (closest point to the <i>ReferencePosition</i>) shall be refreshed for an update DENM. All other <i>PathPoints</i> shall not be refreshed. If the <i>PathDeltaTime</i> of the first <i>PathPoint</i> exceeds the maximum value in accordance with [TS 102 894-2], the <i>PathDeltaTime</i> shall not be further refreshed. If the <i>PathDeltaTime</i> is not used in the <i>PathPoints</i>, the <i>PathHistory</i> shall not be refreshed for an update DENM.</p> | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|---|---|-----------------------|--------------|-------|----|--|-------|-----|--|-------|---------|--|-----------|----|---|-----------|-----|---|-----------|---------|---|
| <p><i>roadType</i></p> | <p><i>RoadType</i> of the road on which the detecting vehicle 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" data-bbox="534 840 1393 1635"> <thead> <tr> <th data-bbox="534 840 703 925">Urban / non-urban</th> <th data-bbox="703 840 1013 925">Structural separation</th> <th data-bbox="1013 840 1393 925">Data element</th> </tr> </thead> <tbody> <tr> <td data-bbox="534 925 703 1041">Urban</td> <td data-bbox="703 925 1013 1041">No</td> <td data-bbox="1013 925 1393 1041">urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td data-bbox="534 1041 703 1158">Urban</td> <td data-bbox="703 1041 1013 1158">Yes</td> <td data-bbox="1013 1041 1393 1158">urban-WithStructuralSeparationToOppositeLanes(1)</td> </tr> <tr> <td data-bbox="534 1158 703 1274">Urban</td> <td data-bbox="703 1158 1013 1274">Unknown</td> <td data-bbox="1013 1158 1393 1274">urban-NoStructuralSeparationToOppositeLanes(0)</td> </tr> <tr> <td data-bbox="534 1274 703 1391">Non-urban</td> <td data-bbox="703 1274 1013 1391">No</td> <td data-bbox="1013 1274 1393 1391">nonUrban-NoStructuralSeparationToOppositeLanes(2)</td> </tr> <tr> <td data-bbox="534 1391 703 1507">Non-urban</td> <td data-bbox="703 1391 1013 1507">Yes</td> <td data-bbox="1013 1391 1393 1507">nonUrban-WithStructuralSeparationToOppositeLanes(3)</td> </tr> <tr> <td data-bbox="534 1507 703 1635">Non-urban</td> <td data-bbox="703 1507 1013 1635">Unknown</td> <td data-bbox="1013 1507 1393 1635">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) | | | | | | | | | | | | | | | | | | | | |
| <p>Alacarte container</p> | | | | | | | | | | | | | | | | | | | | | | |
| <p><i>lanePosition</i></p> | <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 | |
|---|---|
| stationarySince | <p>Shall be set according to the duration in minutes of the detecting vehicle 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> |

Tested by:

3.3.7.2 CAM

Requirement

RS_tcStVe_178

CAM adaption shall not be used for this vehicle C-ITS service.

Tested by:

3.3.8 Network and transport layer

Requirement

RS_tcStVe_179

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with centre point equal to *eventPosition* and radius equal to *relevanceDistance*.

Tested by:

3.3.9 Security layer

Requirement

RS_tcStVe_181

When the triggering conditions as described in chapter 3.3.2 apply, the application shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by: