
Triggering Conditions and Data Quality Stationary Vehicle Warning

CAR 2 CAR Communication Consortium



CAR 2 CAR

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 and its members work in close cooperation with the European and international standardisation organisations.

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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 (i) **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 clause 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 clause focuses on situations without particular information about the reason of the stopping manoeuvre.

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 (i) **RS_tcStVe_116**

A DENM signal for 'Stationary vehicle warning - stopped vehicle' C-ITS service shall be sent to the stack only if the conditions described in the clauses 3.1.2, 3.1.3 and 3.1.4 are evaluated as being met. If these conditions are not fulfilled, a DENM signal for this C-ITS service shall not be generated.

Note: A DENM signal prompts the stack to generate a new, update or cancellation DENM respectively.

Tested by:

3.1.2 Triggering conditions

3.1.2.1 Preconditions

Requirement (i) **RS_tcStVe_117**

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

- 1.) No tell-tale, indicator, nor message is shown to the driver, requiring the driver to stop the vehicle because serious damage to the engine or other equipment is immediate or imminent.

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 (i)**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 (i)****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 (i)**RS_tcStVe_120**

If the vehicle is stationary, the *Triggering Timer* shall be set to 30 s and shall be started counting down.

The *Triggering Timer* shall be further reduced by 10 s for each of the following conditions that is fulfilled:

- a) the automatic transmission (AUT) is set to 'park' for at least 3 s;
- b) the gear box is set to idle for at least 3 s;
- c) the parking brake is enabled for at least 3 s;
- d) an arbitrary number of the seatbelt buckles change from 'connected' to 'disconnected' for at least 3 s;

The *Triggering Timer* shall be set to 0 s if at least one of the following conditions is fulfilled:

- e.1) an arbitrary number of doors are open for at least 3 s OR
- e.2) $\langle \text{PTW} \rangle$ the side or main stand is used for at least 3 s $\langle / \text{PTW} \rangle$;
- f) the ignition terminal is switched from on to off for at least 3 s;
- g) the boot is open for at least 3 s;
- h) the bonnet is open for at least 3 s.

Tested by:

Requirement (i)**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 (i)

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 (i)

RS_tcStVe_123

The value of the data element *informationQuality* in the DENM depends on the current conditions from a) to h) of the requirement RS_tcStVe_120. 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

Note: an update of the information quality is performed as described in RS_tcStVe_124.

Tested by:

3.1.3 Termination conditions

Requirement (i)

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 (i)

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 (i)

RS_tcStVe_127

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

Tested by:

3.1.4 Update

Requirement (i)

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 (i)

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 (i)

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 (i)

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 (i)

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 (i)

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 (i)

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:	
	RoadType	Direction
	0	<i>allTrafficDirections(0)</i>
	1	<i>upstreamTraffic(1)</i>

	2	allTrafficDirections(0)	
	3	upstreamTraffic(1)	
	Otherwise, the value shall be set to allTrafficDirections(0)		
<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- 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			
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 (i)

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 (i)

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 (i)**RS_tcStVe_137**

When the triggering conditions as described in clause 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 clause 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 clause 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 (i)**RS_tcStVe_138**

A DENM signal for 'Stationary vehicle warning - broken-down vehicle' C-ITS service shall be sent to the stack only if the conditions described in the clauses 3.2.2, 3.2.3 and 3.2.4 are evaluated as being met. If these conditions are not fulfilled, a DENM signal for this C-ITS service shall not be generated.

Note: A DENM signal prompts the stack to generate a new, update or cancellation DENM respectively.

Tested by:

3.2.2 Triggering conditions

3.2.2.1 Preconditions

Requirement (i)**RS_tcStVe_139**

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

- 1.) A tell-tale, indicator, or message is shown to the driver, requiring the driver to stop the vehicle because serious damage to the engine or other equipment is immediate or imminent.

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 (i)

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 (i)

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 (i)

RS_tcStVe_142

If the vehicle is stationary, the *Triggering Timer* shall be set to 30 s and started counting down. The *Triggering Timer* shall be further reduced by 10 s for each of the following conditions that is fulfilled:

- a) the automatic transmission (AUT) is set to 'park' for at least 3 s;
- b) the gear box is set to idle for at least 3 s;
- c) the parking brake is enabled for at least 3 s;
- d) an arbitrary number of the seatbelt buckles change from 'connected' to 'disconnected' for at least 3 s;

The *Triggering Timer* shall be set to 0 s if at least one of the following conditions is fulfilled:

- e.1) an arbitrary number of doors are open for at least 3 s OR
- e.2) <PTW>the side or main stand is used for at least 3 s</PTW>;
- f) the ignition terminal is switched from on to off for at least 3 s;
- g) the boot is open for at least 3 s;
- h) the bonnet is open for at least 3 s.

Tested by:

Requirement (i)

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 (i) 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 (i) RS_tcStVe_145

The value of the data element *informationQuality* in the DENM depends on the current conditions from a) to h) of the requirement RS_tcStVe_142. 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

Note: an update of the information quality is performed as described in RS_tcStVe_146.

Tested by:

3.2.3 Termination conditions

Requirement (i) 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 (i) 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 (i)

RS_tcStVe_149

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

Tested by:

3.2.4 Update

Requirement (i)

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 (i)

RS_tcStVe_151

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

Tested by:

Requirement (i)

RS_tcStVe_152

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

Tested by:

Requirement (i)

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 (i)

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 (i)

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 (i)

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 (i)

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 (i)

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 isCancellation(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 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: 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.										

<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)
<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 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 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 (i)

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 (i)

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 (i)

RS_tcStVe_161

When the triggering conditions as described in clause 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 clause 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 (i)

RS_tcStVe_162

A DENM signal for ‘Stationary vehicle warning - post-crash’ C-ITS service shall be sent to the stack only if the conditions described in the clauses 3.3.2, 3.3.3 and 3.3.4 are evaluated as being met. If these conditions are not fulfilled, a DENM signal for this C-ITS service shall not be generated.

Note: A DENM signal prompts the stack to generate a new, update or cancellation DENM respectively.

Tested by:

3.3.2 Triggering conditions

3.3.2.1 Preconditions

Requirement (i)

RS_tcStVe_163

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

Tested by:

Requirement (i)

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 (i)

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 (i)

RS_tcStVe_166

The value of the data element *informationQuality* in the DENM depends on the current conditions from a) to d) of the requirement RS_tcStVe_164. 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

Note: an update of the information quality is performed as described in RS_tcStVe_167.

Tested by:

3.3.3 Termination conditions

Requirement (i)

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 (i)

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 (i)

RS_tcStVe_170

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

Tested by:

3.3.4 Update

Requirement (i)

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 (i)**RS_tcStVe_172**

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

Tested by:

Requirement (i)**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 (i)**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 (i)**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 (i)**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 (i)**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 (i)

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 isCancellation(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 style="text-align: center;">0</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td style="text-align: center;">1</td> <td>upstreamTraffic(1)</td> </tr> <tr> <td style="text-align: center;">2</td> <td>allTrafficDirections(0)</td> </tr> <tr> <td style="text-align: center;">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.		
<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 <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>		
<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- 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			
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 (i)

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 (i)

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 (i)

RS_tcStVe_181

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

Tested by: