Triggering Conditions and Data Quality Special Vehicle Warning

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). Today, the Consortium comprises 61 members, with 11 vehicle manufacturers, 31 equipment suppliers and 29 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.

Disclaimer

Document information

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Table 1: Document information

Changes since last version

Title:	Triggering Conditions and Data Quality Special Vehicle Warning		
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27/03/2019	Minor corrections	Release Management	Steering Committee
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Table 2: Changes since last version

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1 Introduction

Other (informational) **RS_tcSpVe_220**

This document describes the triggering conditions for the emergency vehicle warning. The C-ITS service is divided in the following three sub C-ITS services:

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

2 Definitions

Definition **RS_tcSpVe_642**

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

3 Requirement specifications

Requirement **RS_tcSpVe_242**

This C-ITS service deals with vehicles which are "stationary". A stationary vehicle is defined in RS_BSP_511

Tested by:

3.1 Special vehicle warning - emergency vehicle in operation

3.1.1 Description of C-ITS service

Other (informational) **RS_tcSpVe_221**

An emergency vehicle is any vehicle that is designated and authorized to respond to an emergency. These vehicles are usually operated by designated agencies, often part of the government, but also run by charities, non-governmental organizations and some commercial companies. 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.

Other (informational) **RS_tcSpVe_222**

This chapter describes the triggering conditions for the emergency vehicles warning C-ITS service. The C-ITS service informs drivers of nearby vehicles about an emergency vehicle moving to an operation scene, which is signalled by the use of the light bar.

Requirement **RS_tcSpVe_117**

As soon as the C-ITS service is triggered, a DENM shall be transmitted by the emergency vehicle C-ITS station and shall set data fields of CAM in accordance with the rules specified in the current chapter.

Note: A parallel activation with the C-ITS service *Stationary Safeguarding Emergency Vehicle* has to be avoided. For an emergency vehicle C-ITS station the default C-ITS service is *Emergency Vehicle In Operation*.

Tested by:

Other (informational) **RS_tcSpVe_224**

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’.

Requirement **RS_tcSpVe_118**

The default C-ITS service for an emergency vehicle C-ITS station is ‘e*mergency vehicle in operation’*. A change to the ‘s*tationary safeguarding emergency vehicle’* C-ITS service shall be triggered only under the conditions set out in section 3.2.

Tested by:

3.1.2 Triggering conditions

3.1.2.1 Preconditions

Requirement **RS_tcSpVe_119**

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

- 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 as prescribed in section 3.1.1.
- the triggering conditions regarding 'stationary safeguarding emergency vehicle' shall not be satisfied, see section 3.2.2

Tested by:

3.1.2.2 Service-specific conditions

Requirement **RS_tcSpVe_120**

If the preconditions in RS_tcSpVe_119 and the following condition are satisfied, the generation of a DENM shall be triggered.

a) the light bar is in use.

Tested by:

Requirement **RS_tcSpVe_121**

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

b) the siren is in use

c) the vehicle is not stationary.

Tested by:

3.1.2.3 Information quality

Requirement **RS_tcSpVe_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 '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

Tested by:

Requirement **RS_tcSpVe_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:

3.1.3 Termination conditions

Requirement **RS_tcSpVe_125**

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.

Tested by:

3.1.3.1 Cancellation

Requirement **RS_tcSpVe_126**

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

Tested by:

3.1.3.2 Negation

Requirement **RS_tcSpVe_127**

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

Tested by:

3.1.4 Update

Requirement **RS_tcSpVe_128**

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 chapter 3.1.7.1. in Table 4.

Tested by:

3.1.5 Repetition duration and repetition interval

Requirement **RS_tcSpVe_129**

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

Tested by:

3.1.6 Traffic class

Requirement **RS_tcSpVe_130**

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

Tested by:

3.1.7 Message parameters

3.1.7.1 DENM

Requirement **RS_tcSpVe_131**

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

Table 4: DENM data elements of 'emergency vehicle in operation'

<table>
<tr><th>Data field</th><th>Value</th></tr>
<tr><td colspan="2">Management container</td></tr>
<tr><td>actionID</td><td>Identifier of a DENM.Shall be set in accordance with [TS 102 894-2].</td></tr>
<tr><td>detectionTime</td><td>TimestampIts-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.</td></tr>
<tr><td>referenceTime</td><td>TimestampIts-timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].</td></tr>
<tr><td>termination</td><td>Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>relevanceDistance</td><td>lessThan1000m(4)</td></tr>
<tr><td>relevanceTrafficDirection</td><td>If the roadType is known the value shall be set as follows:
<table>
<tr><th>RoadType</th><th>Direction</th></tr>
<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>
</table>
Otherwise, the value shall be set to allTrafficDirections(0)</td></tr>
<tr><td>validityDuration</td><td>2 s</td></tr>
<tr><td>stationType</td><td>specialVehicles(10)</td></tr>
<tr><td colspan="2">Situation container</td></tr>
<tr><td>informationQuality</td><td>See RS_tcSpVe_123. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>emergencyVehicleApproaching (95)</td></tr>
</table>

<table>
<tr><td>subCauseCode</td><td>emergencyVehicleApproaching(1)</td></tr>
<tr><td colspan="2">Location container</td></tr>
<tr><td>eventSpeed</td><td>Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>eventPositionHeading</td><td>Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>traces</td><td>PathHistory of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>roadType</td><td>RoadType of the road the detecting C-ITS station is situated on.
Shall be refreshed for an update DENM.
Shall be set in accordance with [TS 102 894-2] in combination with the following rules:
<table>
<tr><th>Urban / non-urban</th><th>Structural separation</th><th>Data element</th></tr>
<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>
<tr><td colspan="3">Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.</td></tr>
</table></td></tr>
<tr><td colspan="2">Alacarte container</td></tr>
<tr><td>lanePosition</td><td>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.</td></tr>
</table>

	If the lanePosition is unknown, the data element shall be omitted. Shall be refreshed for an update DENM.
Alacarte container: StationaryVehicleContainer	
stationarySince	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.

Tested by:

3.1.7.2 CAM

Requirement **RS_tcSpVe_132**

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 RS_tcSpVe_120 is satisfied, the *vehicleRole* shall be set to *emergency*(6).

Tested by:

Requirement **RS_tcSpVe_133**

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

Table 5: CAM data elements of 'emergency vehicle in operation'

Data field	Value
CoopAwareness	
generationDeltaTime	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	
stationType	specialVehicles(10)
referencePosition	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	
heading	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
speed	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating C-ITS station.

	Shall be set in accordance with [TS 102 894-2].
vehicleLength	Length of vehicle. Shall be set in accordance with [TS 102 894-2].
vehicleWidth	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
curvature	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].
curvatureCalcMode	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].
yawRate	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	
vehicleRole	emergency(6)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
pathHistory	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	
lightBarSirenInUse	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.
emergencyPriority	Is not required
causeCode	As specified in DENM (RS_tcSpVe_131)
subCauseCode	As specified in DENM (RS_tcSpVe_131)

Tested by:

3.1.8 Network and transport layer

Requirement **RS_tcSpVe_134**

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

Tested by:

3.1.9 Security layer

Requirement **RS_tcSpVe_136**

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

Tested by:

3.2 Special vehicle warning - stationary safeguarding emergency vehicle

3.2.1 Description of C-ITS service

Other (informational) **RS_tcSpVe_225**

The emergency vehicle safeguards a stationary hazard area, e.g. caused by an accident or fire.

In this C-ITS service, the C2C-CC Basic System informs the driver of an emergency vehicle safeguarding a stationary hazard area.

Requirement **RS_tcSpVe_137**

As soon as the C-ITS service is triggered, the Stationary safeguarding emergency vehicle shall transmit a DENM and shall set data fields of CAM in accordance with the rules specified in the current chapter.

Note: A parallel activation with the C-ITS service *Emergency Vehicle in Operation* has to be avoided, i.e. an emergency vehicle C-ITS station can be either triggered as an *Emergency Vehicle in Operation* or as a *Stationary Safeguarding Emergency Vehicle*.

Tested by:

Other (informational) **RS_tcSpVe_227**

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’.

3.2.2 Triggering conditions

3.2.2.1 Preconditions

Requirement **RS_tcSpVe_138**

The following preconditions shall be satisfied when this use case 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 as prescribed in section 3.1.1.

Tested by:

Requirement **RS_tcSpVe_139**

The default C-ITS service for an emergency vehicle C-ITS station is ‘e*mergency vehicle in*

operation'. A change to the C-ITS service *'stationary safeguarding emergency vehicle'* shall be triggered only under the conditions defined in section 3.2.2.2.

Tested by:

3.2.2.2 Service-specific conditions

Requirement **RS_tcSpVe_140**

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.

Tested by:

Requirement **RS_tcSpVe_240**

If the preconditions in RS_tcSpVe_138 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.

Tested by:

Requirement **RS_tcSpVe_143**

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':

a. passenger compartment camera;

b. state-of-the-art technique for seat occupation used in seatbelt reminder.

Tested by:

Requirement **RS_tcSpVe_144**

If the C-ITS service is triggered due to fulfilment of condition a) or b), 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.

Tested by:

3.2.2.3 Information quality

Requirement **RS_tcSpVe_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 6: 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

Tested by:

Requirement **RS_tcSpVe_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:

3.2.3 Termination conditions

Requirement **RS_tcSpVe_147**

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.

Tested by:

3.2.3.1 Cancellation

Requirement **RS_tcSpVe_148**

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:

- all the C-ITS service specific conditions a) to c) in section 3.2.2.2 are no longer satisfied.

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

Tested by:

3.2.3.2 Negation

Requirement **RS_tcSpVe_149**

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

Tested by:

3.2.4 Update

Requirement **RS_tcSpVe_150**

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 RS_tcSpVe_153.

Tested by:

3.2.5 Repetition duration and repetition interval

Requirement **RS_tcSpVe_151**

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.

Tested by:

3.2.6 Traffic class

Requirement **RS_tcSpVe_152**

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_tcSpVe_153**

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

Table 7: DENM data elements of 'stationary safeguarding emergency vehicle'

Data field	Value
Management container	
actionID	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
detectionTime	*TimestampIts*-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.

<table>
<tr><td>referenceTime</td><td>TimestampIts-timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].</td></tr>
<tr><td>termination</td><td>Shall not be set in the case of new or update DENM. Shall be set to isCancellation(0) in the case of fulfilment of cancellation conditions; see RS_tcSpVe_148.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>relevanceDistance</td><td>lessThan5km(5)</td></tr>
<tr><td>relevanceTrafficDirection</td><td>If the roadType is known, the value shall be set as follows:
<table>
<tr><th>RoadType</th><th>Direction</th></tr>
<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>
</table>
Otherwise, the value shall be set to allTrafficDirections(0)</td></tr>
<tr><td>validityDuration</td><td>180 s</td></tr>
<tr><td>stationType</td><td>specialVehicles(10)</td></tr>
<tr><td colspan="2">Situation container</td></tr>
<tr><td>informationQuality</td><td>See RS_tcSpVe_145. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>rescueAndRecoveryWorkInProgress(15)</td></tr>
<tr><td>subCauseCode</td><td>emergencyVehicles(1)</td></tr>
<tr><td colspan="2">Location container</td></tr>
<tr><td>eventSpeed</td><td>Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>eventPositionHeading</td><td>Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>traces</td><td>PathHistory of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
</table>

<table>
<tr><td></td><td>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.</td></tr>
<tr><td>roadType</td><td>RoadType 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>
<tr><th>Urban / non-urban</th><th>Structural separation</th><th>Data element</th></tr>
<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>
</table>
Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.</td></tr>
<tr><td colspan="2">Alacarte Container</td></tr>
<tr><td>lanePosition</td><td>If the lanePosition is provided by an onboard sensor (e.g. radar, camera), the value shall be set in accordance with [TS 102 894-2]. Use of GNSS and a digital map for the estimation of 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.</td></tr>
<tr><td colspan="2">Alacarte container: StationaryVehicleContainer</td></tr>
</table>

stationarySince	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.

Tested by:

3.2.7.2 CAM

Requirement **RS_tcSpVe_154**

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 RS_tcSpVe_240 is satisfied the vehicleRole shall be set to *emergency*(6).

Tested by:

Requirement **RS_tcSpVe_155**

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

Table 8: CAM data elements of 'stationary safeguarding emergency vehicle'

Data field	Value
CoopAwareness	
generationDeltaTime	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	
stationType	specialVehicles(10)
referencePosition	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	
heading	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
speed	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
vehicleLength	Length of vehicle. Shall be set in accordance with [TS 102 894-2].

vehicleWidth	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
curvature	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].
curvatureCalcMode	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].
yawRate	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	
vehicleRole	emergency(6)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
pathHistory	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	
lightBarSirenInUse	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.
emergencyPriority	Is not required
causeCode	As specified in DENM (RS_tcSpVe_153)
subCauseCode	As specified in DENM (RS_tcSpVe_153)

Tested by:

3.2.8 Network and transport layer

Requirement **RS_tcSpVe_156**

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

Tested by:

3.2.9 Security layer

Requirement **RS_tcSpVe_158**

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

Tested by:

3.3 Special vehicle warning - stationary recovery service warning

3.3.1 Description of C-ITS service

Other (informational) **RS_tcSpVe_229**

This C-ITS service supports a broken-down vehicle, i.e. standing on the right lane of the road representing a hazardous location. The C-ITS service of the moving recovery service, e.g. carrying a broken-down vehicle, is covered by the common CAM.

3.3.2 Relations to other C-ITS services

Other (informational) **RS_tcSpVe_230**

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’.

3.3.3 Triggering conditions

3.3.3.1 Preconditions

Requirement **RS_tcSpVe_159**

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

- the *stationType* is confirmed as an special vehicle (*stationType* of CAM is set to specialVehicles(10)). The C-ITS service is restricted to recovery service vehicles.

Tested by:

3.3.3.2 Service-specific conditions

Requirement **RS_tcSpVe_160**

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.

Tested by:

Requirement **RS_tcSpVe_241**

If the preconditions in RS_tcSpVe_159 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.

Tested by:

Requirement **RS_tcSpVe_163**

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’:

a. passenger compartment camera;

b. state-of-the-art technique for seat occupation used in seatbelt reminder.

Tested by:

Requirement **RS_tcSpVe_164**

If the C-ITS service is triggered due to fulfilment of condition a), 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.

Tested by:

3.3.3.3 Information quality

Requirement **RS_tcSpVe_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 9: 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

Tested by:

Requirement **RS_tcSpVe_166**

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:

3.3.4 Termination conditions

Requirement **RS_tcSpVe_167**

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.

Tested by:

3.3.4.1 Cancellation

Requirement **RS_tcSpVe_168**

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):

- C-ITS service-specific conditions a) and b) in section 3.3.3.2 are not satisfied.

Tested by:

3.3.4.2 Negation

Requirement **RS_tcSpVe_169**

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

Tested by:

3.3.5 Update

Requirement **RS_tcSpVe_170**

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 RS_tcSpVe_153.

Tested by:

3.3.6 Repetition duration and repetition interval

Requirement **RS_tcSpVe_171**

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.

Tested by:

3.3.7 Traffic class

Requirement **RS_tcSpVe_172**

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

Tested by:

3.3.8 Message parameters

3.3.8.1 DENM

Requirement **RS_tcSpVe_173**

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

Table 10: DENM data elements of 'stationary recovery service warning'

<table>
<tr><th>Data field</th><th>Value</th></tr>
<tr><td colspan="2">Management container</td></tr>
<tr><td>actionID</td><td>Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].</td></tr>
<tr><td>detectionTime</td><td>TimestampIts-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.</td></tr>
<tr><td>referenceTime</td><td>TimestampIts-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].</td></tr>
<tr><td>termination</td><td>Shall not be set in case of new or update DENM. Shall be set to isCancellation(0) in case of fulfillment of cancellation conditions, see RS_tcSpVe_168.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set in accordance with [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>relevanceDistance</td><td>lessThan5km(5)</td></tr>
<tr><td>relevanceTrafficDirection</td><td>If the roadType is known the value shall be set as follows:
<table>
<tr><th>RoadType</th><th>Direction</th></tr>
<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>
</table>
Otherwise, the value shall be set to allTrafficDirections(0)</td></tr>
<tr><td>validityDuration</td><td>180 s</td></tr>
<tr><td>stationType</td><td>specialVehicles(10)</td></tr>
</table>

<table>
<tr><th colspan="2">Situation container</th></tr>
<tr><td>informationQuality</td><td>See RS_tcSpVe_165. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>rescueAndRecoveryWorkInProgress(15)</td></tr>
<tr><td>subCauseCode</td><td>unavailable(0)</td></tr>
<tr><th colspan="2">Location container</th></tr>
<tr><td>eventSpeed</td><td>Speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].

Shall be refreshed for an update DENM.</td></tr>
<tr><td>eventPositionHeading</td><td>Heading of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].

Shall be refreshed for an update DENM.</td></tr>
<tr><td>traces</td><td>PathHistory of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].

Shall be refreshed for an update DENM.

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.

If the PathDeltaTime is not used in the PathPoints, the PathHistory shall not be refreshed for an update DENM.</td></tr>
<tr><td>roadType</td><td>RoadType 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>
<tr><th>Urban / non-urban</th><th>Structural separation</th><th>Data element</th></tr>
<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>
</table></td></tr>
</table>

	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			
lanePosition	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			
stationarySince	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.		

Tested by:

3.3.8.2 CAM

Requirement **RS_tcSpVe_174**

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 RS_tcSpVe_241 is satisfied the *vehicleRole* shall be set to *rescue*(5).

Tested by:

Requirement **RS_tcSpVe_175**

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

Table 11: CAM data elements of 'stationary recovery service warning'

Data field	Value
CoopAwareness	
generationDeltaTime	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	
stationType	specialVehicles(10)
referencePosition	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	
heading	Heading direction of the originating C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
Speed	Driving speed of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
vehicleLength	Length of vehicle. Shall be set in accordance with [TS 102 894-2].
vehicleWidth	Width of vehicle. Shall be set in accordance with [TS 102 894-2].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].
curvature	Curvature of the vehicle trajectory and the accuracy. Shall be set in accordance with [TS 102 894-2].
curvatureCalcMode	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].
yawRate	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	
vehicleRole	rescue(5)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set in accordance with [TS 102 894-2].
pathHistory	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	

lightBarSirenInUse	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.
causeCode	As specified in DENM (RS_tcSpVe_173)
subCauseCode	As specified in DENM (RS_tcSpVe_173)

Tested by:

3.3.9 Network and transport layer

Requirement **RS_tcSpVe_176**

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

Tested by:

3.3.10 Security layer

Requirement **RS_tcSpVe_178**

When the triggering conditions as described in chapter 3.3.3 apply, the use case shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:

4 Appendix

4.1 Scenarios

Other (informational) **RS_tcSpVe_232**

This section has an informational character and is not part of the requirement specification.

The following list encompasses scenarios which are regarded as relevant or irrelevant considering the present C-ITS service:

Count	Description	Status
SC_0	Urban/nonurban environment	Irrelevant
SC_1	Current road situation and conditions	Not directly relevant
SC_2	Traffic in the opposite driving direction.	Irrelevant
SC_3	The special vehicle drives to an emergency site using the light bar. The sirene might be used.	Relevant
SC_4	The special vehicle stops at an emergency site in order to safeguard the situation. The intention of the special vehicle and the crew has to be detected. A change in the use-cases from “in operation” to “safeguarding” must be detected.	Relevant
SC_5	The special vehicle leaves an emergency site. A change in the use-cases from “safeguarding” to “in operation” might be detected depending on situation.	Relevant
SC_6	The recovery service carries a broken vehicle using the light bar. This case is covered by usual CAMs. The recovery service is considered as a usual vehicle in road traffic.	Irrelevant

Table 12: Scenarios