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). 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.

Disclaimer

Document information

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Table 1: Document information

Changes since last release

Release	Date	Changes	Edited by	Approved
1.6.3	2022-12-16	Minor editorial changes	Release Management	Steering Committee
1.6.2	2022-07-22	• Correction of mixed up use of *stationType* and *vehicleRole* ○ *stationType* is not set to *specialVehicle* (10) anymore but rather in accordance with [TS 102 894-2]. • For further corrections please refer to clause 5 of [C2CCC RelOv]	Release Management	Steering Committee
1.6.1	2021-12-17	Added marking of requirements, indicating relevance for interoperability according to [CPOC]	Release Management	Steering Committee
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Table 2: Changes since last release

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1 Introduction

Other (informational)   **RS_tcSpVe_220**

This document describes the triggering conditions for the emergency vehicle warning. The vehicle C-ITS service is divided in the following three sub vehicle 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 (i)   **RS_tcSpVe_242**

This vehicle 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 vehicle 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 clause describes the triggering conditions for the emergency vehicles warning vehicle C-ITS service. The vehicle 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 (i)   **RS_tcSpVe_117**

As soon as the vehicle 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 clause.

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

Tested by:

Other (informational)   **RS_tcSpVe_224**

The following vehicle 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 (i)   **RS_tcSpVe_118**

The default vehicle C-ITS service for an emergency vehicle C-ITS station is '*emergency vehicle in operation'*. A change to the '*stationary safeguarding emergency vehicle'* vehicle C-ITS service shall be triggered only under the conditions set out in clause 3.2.

Tested by:

3.1.2 Triggering conditions

3.1.2.1 Preconditions

Requirement (i)   **RS_tcSpVe_119**

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

- the vehicle C-ITS service is restricted to emergency vehicles as prescribed in clause 3.1.1.
- the triggering conditions regarding 'stationary safeguarding emergency vehicle' shall not be satisfied, see clause 3.2.2

Tested by:

3.1.2.2 Service-specific conditions

Requirement (i)   **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 (i)   **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 (i)   **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 (i)   **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 (i)   **RS_tcSpVe_125**

The vehicle C-ITS service shall be terminated when the light bar is no longer in use or the triggering conditions of 'stationary safeguarding emergency vehicle' are satisfied. At the termination of the vehicle C-ITS service, updating of DENMs shall be terminated.

Note: *vehicleRole* might be set to *default(0)* if the vehicle C-ITS service is not active.

Tested by:

3.1.3.1 Cancellation

Requirement (i)   **RS_tcSpVe_126**

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

Tested by:

3.1.3.2 Negation

Requirement (i)   **RS_tcSpVe_127**

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

Tested by:

3.1.4 Update

Requirement (i)   **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 RS_tcSpVe_131.

Tested by:

3.1.5 Repetition duration and repetition interval

Requirement (i)   **RS_tcSpVe_129**

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

Tested by:

3.1.6 Traffic class

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

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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
referenceTime	*TimestampIts*-timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
termination	Shall not be set, because neither negation nor cancellation are to be used in this vehicle C-ITS service.
eventPosition	*ReferencePosition*. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
relevanceDistance	lessThan1000m(4)
relevanceTrafficDirection	allTrafficDirections(0)
validityDuration	2 s
stationType	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
informationQuality	See RS_tcSpVe_123. Shall be refreshed for every update DENM.
causeCode	emergencyVehicleApproaching (95)
subCauseCode	emergencyVehicleApproaching(1)
Location container	
eventSpeed	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.
eventPositionHeading	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.
traces	*PathHistory* of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
	Shall be refreshed for an update DENM.
roadType	*RoadType* of the road the detecting vehicle 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:

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)

	Otherwise, 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.

Tested by:

3.1.7.2 CAM

Requirement   (i)   **RS_tcSpVe_132**

The *vehicleRole* may 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).

Requirement   (i)   **RS_tcSpVe_133**

The following table specifies the data elements of the CAM that shall be set if the vehicle 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	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
referencePosition	Position and position accuracy measured at the reference point of the originating vehicle 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 vehicle C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
speed	Driving speed of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating vehicle 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 vehicle 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   (i)   **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 centre point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.1.9 Security layer

Requirement   (i)   **RS_tcSpVe_136**

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 Special vehicle warning - stationary safeguarding emergency vehicle

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

Requirement (i)   **RS_tcSpVe_137**

As soon as the vehicle 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 clause.

Note: A parallel activation with the vehicle 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 vehicle 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 (i)   **RS_tcSpVe_138**

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

* the vehicle C-ITS service is restricted to emergency vehicles as prescribed in clause 3.1.1.

Tested by:

Requirement (i)   **RS_tcSpVe_139**

The default vehicle C-ITS service for an emergency vehicle C-ITS station is 'e*mergency vehicle in operation'.* A change to the vehicle C-ITS service *'stationary safeguarding emergency vehicle'* shall be triggered only under the conditions defined in clause 3.2.2.2.

Tested by:

3.2.2.2 Service-specific conditions

Requirement (i)   **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 (i)   **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 vehicle C-ITS service are fulfilled and the generation of a DENM shall be triggered:

a) the light bar is in use and either the ignition is off or the run lock (engine relay that keeps the motor running while the key is removed) is activated;

b) the light bar is in use and the vehicle's state suggests parking mode. (parking brake activated in case of manual transmission cars, 'park' selected in case of automatic transmission cars, stand is being used in case of PTWs);

c) the light bar is in use and the *Standstill Timer* is 60 s or more.

Tested by:

Requirement   (i)   **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';

d.1) in case of PTWs, the status of the locked storage space is 'open';

e) the driver's seat is detected, by a state-of-the-art technique for seat occupation, as being 'not occupied'.

Tested by:

Requirement   (i)   **RS_tcSpVe_144**

If the vehicle 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   (i)   **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   (i)   **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   (i)   **RS_tcSpVe_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, updating of DENMs shall be terminated.

Note: *vehicleRole* might be set to *default(0)* if the vehicle C-ITS service is not active.

Tested by:

3.2.3.1 Cancellation

Requirement   (i)   **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 vehicle C-ITS service specific conditions a) to c) in clause 3.2.2.2 are no longer satisfied.

Tested by:

3.2.3.2 Negation

Requirement   (i)   **RS_tcSpVe_149**

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

Tested by:

3.2.4   Update

Requirement   (i)   **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   (i)   **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 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_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   (i)   **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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
referenceTime	*TimestampIts*-timestamp at which a new, update or cancellation DENM is generated. Shall be set in accordance with [TS 102 894-2].
termination	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.
eventPosition	*ReferencePosition*. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
relevanceDistance	lessThan5km(5)
relevanceTrafficDirection	If the roadType is known, the value shall be set as follows: | RoadType	Direction
0	allTrafficDirections(0)
1	upstreamTraffic(1)
2	allTrafficDirections(0)	

	3	upstreamTraffic(1)

	Otherwise, the value shall be set to allTrafficDirections(0)
validityDuration	180 s
stationType	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].

Situation container	
informationQuality	See RS_tcSpVe_145. Shall be refreshed for every update DENM.
causeCode	rescueAndRecoveryWorkInProgress(15)
subCauseCode	emergencyVehicles(1)

Location container	
eventSpeed	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.
eventPositionHeading	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.
traces	*PathHistory* of the originating vehicle 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.
roadType	*RoadType* 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-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)
	Otherwise, 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 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.		
Alacarte container: StationaryVehicleContainer			
stationarySince	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]. Shall be refreshed for an update DENM.		

Tested by:

3.2.7.2 CAM

Requirement   (i)   **RS_tcSpVe_154**

The *vehicleRole* may 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   (i)   **RS_tcSpVe_155**

The following table specifies the data elements of the CAM that shall be set if the vehicle 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	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
referencePosition	Position and position accuracy measured at the reference point of the originating vehicle 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 vehicle C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
speed	Driving speed of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating vehicle 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 vehicle 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
IncidentIndication	*causeCode and subCauseCode* as specified in DENM (RS_tcSpVe_153)

Tested by:

3.2.8 Network and transport layer

Requirement   (i)   **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 centre point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.2.9 Security layer

Requirement   (i)   **RS_tcSpVe_158**

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 Special vehicle warning - stationary recovery service warning

3.3.1 Description of vehicle C-ITS service

Other (informational)   **RS_tcSpVe_229**

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

Other (informational)   **RS_tcSpVe_230**

The following vehicle 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'.

3.3.2 Triggering conditions

3.3.2.1 Preconditions

Requirement   (i)   **RS_tcSpVe_159**

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

* the vehicle C-ITS service is restricted to recovery service vehicles.

Tested by:

3.3.2.2 Service-specific conditions

Requirement   (i)   **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   (i)   **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 vehicle C-ITS service are fulfilled and the generation of a DENM shall be triggered:

a) the light bar is in use and the parking brake is activated or (in the case of automatic transmission) 'park' is selected;
b) the light bar is in use and the *Standstill Timer* is 60 s or more.

Tested by:

Requirement   (i)   **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   (i)   **RS_tcSpVe_164**

If the vehicle 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:

3.3.2.3 Information quality

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

3.3.3 Termination conditions

Requirement (i)   **RS_tcSpVe_167**

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, updating of DENMs shall be terminated.

Note: *vehicleRole* might be set to *default(0)* if the vehicle C-ITS service is not active.

Tested by:

3.3.3.1 Cancellation

Requirement (i)   **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:

- vehicle C-ITS service-specific conditions a) and b) in clause 3.3.2.2 are not satisfied.

Tested by:

3.3.3.2 Negation

Requirement (i)   **RS_tcSpVe_169**

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

Tested by:

3.3.4 Update

Requirement (i) **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:

3.3.5 Repetition duration and repetition interval

Requirement (i) **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 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_tcSpVe_172**

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_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'

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 vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].

	Shall be refreshed for an update DENM.
referenceTime	*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].
termination	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.
eventPosition	*ReferencePosition*. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.
relevanceDistance	lessThan5km(5)
relevanceTrafficDirection	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)
validityDuration	180 s
stationType	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
Situation container	
informationQuality	See RS_tcSpVe_165. Shall be refreshed for every update DENM.
causeCode	rescueAndRecoveryWorkInProgress(15)
subCauseCode	unavailable(0)
Location container	
eventSpeed	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.
eventPositionHeading	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.
traces	*PathHistory* of the originating vehicle 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.
roadType	*RoadType* 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-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	
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 vehicle C-ITS station being stationary. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.

Tested by:

3.3.7.2 CAM

Requirement   (i)   **RS_tcSpVe_174**

The *vehicleRole* may 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   (i)   **RS_tcSpVe_175**

The following table specifies the data elements of the CAM that shall be set if the vehicle 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	The type of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
referencePosition	Position and position accuracy measured at the reference point of the originating vehicle 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 vehicle C-ITS station in relation to true north. Shall be set in accordance with [TS 102 894-2].
Speed	Driving speed of the originating vehicle C-ITS station. Shall be set in accordance with [TS 102 894-2].
driveDirection	Vehicle drive direction (forward or backward) of the originating vehicle 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 vehicle 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 RescueContainer	
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.

Tested by:

3.3.8 Network and transport layer

Requirement   (i)   **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 centre point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.3.9 Security layer

Requirement   (i)   **RS_tcSpVe_178**

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:

4 Appendix

4.1 Scenarios

Other (informational) **RS_tcSpVe_232**

This clause 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 vehicle 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' has to 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