Triggering Conditions and Data Quality

CAR 2 CAR Communication Consortium

Special Vehicle Warning

Partners of the C2C-CC

Document information

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Table 1: Document information

Changes since last version

Title:					
Explanatory notes:					
3	3	01.12.2015	Reworked according to Change Management process and released as part of CAR 2 CAR Release 1.1.0	Volkswagen AG	
3	2	25.07.2014	Use-case specific conditions changed – timer behaviour corrected	Klaus Krumbiegel	
3	1	05.05.2014	Correction regarding ASN.1-changes	Klaus Krumbiegel	
3	0	06.02.2014	Small corrections	Klaus Krumbiegel	
2	1	16.12.2013	Update after review by Conti, Denso, Opel	Klaus Krumbiegel	
2	0	30.09.2013	Comments discussed and accepted	Klaus Krumbiegel	
1	8	03.09.2013	Comments incorporated, iscancellation inserted	Klaus Krumbiegel	
1	7	06.08.2013	Message parameter updated, comments incorporated	Klaus Krumbiegel	
1	6	23.07.2013	Table for Message Parameters updated, Triggering conditions changed	Klaus Krumbiegel	
1	5	18.07.2013	General comments from WG-APP meeting inserted	Gerhard Fischer	
1	4	21.06.2013	Message Parameters updated	Gerhard Fischer	
1	3	20.06.2013	Chapter for Geo Network Layer for the use cases added	Gerhard Fischer	
1	2				
1	1				
1	0	11.06.2010	First release after initial creation and review phase.	Dr. Klaus Krumbiegel	
Issue	Rev.	Date	Changes	Edited by	Approved

Table 2: Change history

Open Issues

None.

Content

List of tables

1 Introduction

1.1 Abstract

Other (informational) **RS_tcSpVe_220**

This document describes the triggering conditions for the emergency vehicle warning. The use case is divided in the following three sub use cases:

- Special Vehicle Warning - Emergency Vehicle in Operation
- Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle
- Special Vehicle Warning - Stationary Wrecking Service Warning

2 Triggering conditions

2.1 Special Vehicle Warning

Requirement **RS_tcSpVe_242**

The Special Vehicle Warning Use Cases deals with vehicles which are "stationary". A stationary vehicle is defined as follows:

- The vehicle is moving with an absolute speed less than or equal to 8 centimeter per second. The speed shall be determined by internal vehicle sensors (e.g. wheel ticks), not by a GNSS receiver.

Details:

Detailed by:

Tested by:

2.1.1 Special Vehicle Warning - Emergency Vehicle in Operation

2.1.1.1 Description of Use Case

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 use case. The use case informs drivers of nearby vehicles about an emergency vehicle moving to an operation scene, which is reflected by the use of the light bar.

Requirement **RS_tcSpVe_117**

Once the use case is triggered, a DENM shall be transmitted by emergency vehicle ITS-S and parts of CAM data fields shall be set according to chapter 2.1.2.8.2.

NOTE: A parallel activation with the Use Case *Stationary Safeguarding Emergency Vehicle* has to be avoided. For an emergency vehicle ITS-S the default use case is *Emergency Vehicle In Operation*. A change to the use case *Stationary Safeguarding Emergency Vehicle* shall only be triggered under certain conditions, see chapter 2.1.2. Hence, an emergency vehicle ITS-S shall be either triggered as a *Emergency vehicle in Operation* or as a *Stationary Safeguarding Emergency Vehicle*.

Details:

Detailed by:

Tested by:

2.1.1.2 Relations to other Use Cases

Other (informational) **RS_tcSpVe_224**

The following use cases are related to the *Special Vehicle Warning - Emergency Vehicle in Operation* use case, because they share similar triggering conditions:

- Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle
- Special Vehicle Warning – Stationary Wrecking Service Warning

Requirement **RS_tcSpVe_118**

As mentioned above, the default use case for an emergency vehicle ITS-S is *Emergency Vehicle in Operation*. A change to the use case *Stationary Safeguarding Emergency Vehicle* shall only be triggered under the conditions defined in chapter 2.1.2.

Details:

Detailed by:

Tested by:

2.1.1.3 Triggering Conditions

2.1.1.3.1 Preconditions

Requirement **RS_tcSpVe_119**

The following preconditions shall be satisfied every time before triggering of this use case is initialised:

- The *stationType* is confirmed to be a special vehicle (*stationType* of CAM is set to *specialVehicles*(10)). The Use Case is restricted to emergency vehicles as prescribed in chapter 2.1.1.1.
- The triggering conditions regarding *Stationary Safeguarding Emergency Vehicle* shall not be satisfied, see chapter 2.1.2.3

Details:

Detailed by:

Tested by:

2.1.1.3.2 Use Case Specific Conditions

Requirement **RS_tcSpVe_120**

Once the following condition is satisfied, the generation of a DENM shall be triggered.

a. The light bar is in use.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_121**

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

b. The siren is in use
c. The vehicle is not stationary.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_122**

The vehicle speed shall be determined by the CAN bus signal, not by GNSS. The filtered vehicle speed (with respect to sensor noise due to wheel ticks) shall be used. (chap. 2.1.1.3.2)

Details:

Detailed by:

Tested by:

2.1.1.3.3 Information Quality

Requirement **RS_tcSpVe_123**

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

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

Table 3: Information quality of "Special Vehicle Warning - Emergency Vehicle in Operation"

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_124**

If the Triggering Conditions change in 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.

Details:

Detailed by:

Tested by:

2.1.1.4 Termination Conditions

Requirement **RS_tcSpVe_125**

The use case shall be terminated when the lightbar is not in use any more. At the termination of the use case, updating of DENMs shall be terminated. The *vehicleRole* shall be set to *default*(0), if the light bar is no longer in use.

Details:

Detailed by:

Tested by:

2.1.1.4.1 Cancellation

Requirement **RS_tcSpVe_126**

A cancellation DENM shall not be used for this use case.

Details:

Detailed by:
Tested by:

2.1.1.4.2 Negation

Requirement **RS_tcSpVe_127**

A negation DENM shall not be used for this use case.

Details:
Detailed by:
Tested by:

2.1.1.5 Update

Requirement **RS_tcSpVe_128**

The generated DENM shall be updated every 250 ms if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in chapter 2.1.1.8.1. in Table 4.

Details:
Detailed by:
Tested by:

2.1.1.6 Repetition Duration and Repetition Interval

Requirement **RS_tcSpVe_129**

A repetition of the DENM shall not be used for this use case.

Details:
Detailed by:
Tested by:

2.1.1.7 Traffic class

Requirement **RS_tcSpVe_130**

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

Details:
Detailed by:
Tested by:

2.1.1.8 Message Parameter

2.1.1.8.1 DENM

Requirement **RS_tcSpVe_131**

Table 4 specifies the data elements of the DENM that shall be set.

Data Field	Value
Management Container	
actionID	Identifier of a DENM.Shall be set according to [AD-3].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.

<table>
<tr><td>referenceTime</td><td>TimestampIts-Timestamp at which a new DENM, an update DENM or a cancellation DENM is generated. Shall be set according to [AD-3].</td></tr>
<tr><td>termination</td><td>Shall not be set, because neither negation nor cancellation shall be used in this use case.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set according to [AD-3].
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 seconds</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 Chapter 2.1.1.3.3. Shall be refreshed for every update DENM</td></tr>
<tr><td>causeCode</td><td>emergencyVehicleApproaching (95)</td></tr>
<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 ITS-S. Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>eventPositionHeading</td><td>Heading of the originating ITS-S. Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>Traces</td><td>PathHistory of the originating ITS-S. Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>roadType</td><td>RoadType of the road the detecting ITS-S is situated on.
Shall be refreshed for an update DENM.
Shall be set according to [AD-3] 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-NoStructuralSeparation</td></tr>
</table></td></tr>
</table>

			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 onboard sensor (e.g. radar, camera), the value shall be set according to [AD-3]. The use of GPS 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 ITS-S being stationary.Shall be set according to [AD-3]. Shall be refreshed for an update DENM.		

Table 4: DENM data elements of "Special Vehicle Warning - Emergency Vehicle in Operation"

Details:

Detailed by:

Tested by:

2.1.1.8.2 CAM

Requirement **RS_tcSpVe_132**

The *vehicleRole* shall be initialised to be a "default" vehicle (*vehicleRole* of CAM set to *default*(0)). If at least one of the use case specific triggering conditions defined in chapter 2.1.2.3.2. is satisfied the *vehicleRole* shall be set to *emergency*(6).

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_133**

Table 5 specifies the data elements of the CAM that shall be set if the use case is triggered.

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 according to [AD-2].
BasicContainer	
stationType	specialVehicles(10)

referencePosition	Position and position accuracy measured at the reference point of the originating ITS-S. Shall be set according to [AD-3].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
Heading	Heading direction of the originating ITS-S with regards to the true north. Shall be set according to [AD-3].
Speed	Driving speed of the originating ITS-S. Shall be set according to [AD-3].
driveDirection	Vehicle drive direction (Forward or Backward) of the originating ITS-S. Shall be set according to [AD-3].
vehicleLength	Length of vehicle. Shall be set according to [AD-3].
vehicleWidth	Width of a vehicle. Shall be set according to [AD-3].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating ITS-S. Shall be set according to [AD-3].
curvature	Curvature of the vehicle trajectory and the accuracy. Shall be set according to [AD-3].
curvatureCalcMode	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set according to [AD-3].
yawRate	Yaw rate of vehicle at a point in time. Shall be set according to [AD-3].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
vehicleRole	emergency(6)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set according to [AD-3].
pathHistory	Represents the vehicle's recent movement over some past time and/or distance. Shall be set according to [AD-3].
SpecialVehicleContainer shall be set to EmergencyContainer	
lightBarSirenInUse	lightBarActivated bit shall be set to 1(onChange), if the usage of the lightbar 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 (2.1.1.8.1)
subCauseCode	As specified in DENM (2.1.1.8.1)

Table 5: CAM data elements of "Special Vehicle Warning - Emergency Vehicle in Operation"

Details:

Detailed by:

Tested by:

2.1.1.9 Networking and Transport Layer

Requirement **RS_tcSpVe_134**

For the Day One version of this application, the destination area is the same as the relevance area - in this case, a circle of radius *relevanceDistance*. Therefore, the interface parameter *DENM destination area* between the DEN basic service and the Networking & Transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_135**

The interface parameter *hopLimit* between the DEN basic service and the GeoNetworking/BTP shall be set to the maximum value, according to [AD-4] (in current specification of [AD-4]: 10). This indicates that the receiver shall hop this message. The *Advanced forwarding algorithm for GeoBroadcast*, according to [AD-4], shall be used.

Details:

Detailed by:

Tested by:

2.1.1.10 Security Layer

Requirement **RS_tcSpVe_136**

If the triggering conditions as described in chapter 2.1.1.3 apply, a pseudonym (ID) change shall be blocked for DENMs as long as *validityDuration* is not expired (see chapter 2.1.1.8.1). Corresponding new, update and cancellation DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

2.1.2 Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle

2.1.2.1 Description of Use Case

Other (informational) **RS_tcSpVe_225**

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

In this use case, the C2C basic system informs the driver of an emergency vehicle safeguarding a stationary hazard area.

Requirement **RS_tcSpVe_137**

Once the use case is triggered, the Stationary safeguarding emergency vehicle shall transmit a DENM and shall set data fields of CAM according to the rules specified in the current chapter.

NOTE: A parallel activation with the Use Case *Emergency Vehicle in Operation* has to be avoided, i.e. an emergency vehicle ITS-S shall be either triggered as a *Emergency Vehicle in Operation* or as a *Stationary Safeguarding Emergency Vehicle*. The default use case for an emergency vehicle ITS-S is *Emergency Vehicle in Operation*, a change to the *Stationary Safeguarding Emergency Vehicle* shall only be triggered under the conditions defined in this chapter.

Details:

Detailed by:

Tested by:

2.1.2.2 Relations to other Use Cases

Other (informational) **RS_tcSpVe_227**

The following use cases are related to the *Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle* use case, because they share similar triggering conditions:

- Special Vehicle Warning – Emergency Vehicle in Operation
- Special Vehicle Warning – Stationary Wrecking Service Warning

2.1.2.3 Triggering Conditions

2.1.2.3.1 Preconditions

Requirement **RS_tcSpVe_138**

The following preconditions shall be satisfied every time before triggering of this use case is initialised:

- The *stationType* is confirmed to be an emergency vehicle (*stationType* of CAM is set to *specialVehicles*(10)). The Use Case is restricted to emergency vehicles as prescribed in chapter 2.1.1.1.
- The *Standstill Timer* shall be initialised with zero.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_139**

For an emergency vehicle ITS-S the default use case is *Emergency Vehicle In Operation*. A change to the use case *Stationary Safeguarding Emergency Vehicle* shall only be triggered under the use case specific conditions, defined in chapter 2.1.2.3.2.

Details:

Detailed by:

Tested by:

2.1.2.3.2 Use Case Specific Conditions

Requirement **RS_tcSpVe_140**

If the vehicle is stationary and the light bar is in use a *Standstill Timer* shall be initialized 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.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_240**

Once at least one of the following conditions is satisfied, the triggering conditions for this use case are fulfilled and the generation of a DENM shall be triggered.

a. Light bar is in use and engine relay is activated.
b. Light bar is in use, hazard light is activated and parking brake is activated or in case of automatic transmission parking position is chosen.
c. Light bar is in use, hazard lights are activated and the *Standstill Timer* is greater than or equal to 60 seconds.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_142**

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

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_143**

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

d. Status of at least one door or trunk is "open"
e. Driver's seat is detected as "not occupied". The condition shall be detected by one of the following techniques:
    a. Passenger compartment camera
    b. State of the art technique for seat occupation used in seat belt reminder

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_144**

If the use case is triggered due to fulfillment of condition a) or b), the *Standstill Timer* shall be stopped and set to 60 seconds. In the update phase, only the conditions shall be checked, but no timer shall be started.

Details:

Detailed by:

Tested by:

2.1.2.3.3 Information Quality

Requirement **RS_tcSpVe_145**

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

Event detection	Value of InformationQuality
No TC 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

Table 6: Information quality of "Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle"

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_146**

If the Triggering Conditions change in 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.

Details:

Detailed by:

Tested by:

2.1.2.4 Termination Conditions

Requirement **RS_tcSpVe_147**

This use case is terminated by a cancellation of the originating ITS-S. At the termination of the use case, update DENM request shall be terminated.

Details:

Detailed by:

Tested by:

2.1.2.4.1 Cancellation

Requirement **RS_tcSpVe_148**

Once the following condition is satisfied before the time period set in the data element *validityDuration* is expired, the generation of a cancellation DENM shall be triggered.

- All of the use case specific conditions a) to c) in chapter 2.1.2.3.2 are no longer satisfied.

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

Details:

Detailed by:

Tested by:

2.1.2.4.2 Negation

Requirement **RS_tcSpVe_149**

A negation DENM shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.2.5 Update

Requirement **RS_tcSpVe_150**

The generation of an update DENM shall be triggered every 60s, if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in chapter 2.1.2.8.1 in Table 7.

Details:

Detailed by:

Tested by:

2.1.2.6 Repetition Duration and Repetition Interval

Requirement **RS_tcSpVe_151**

New, cancellation and update DENMs shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set according to the values above.

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

NOTE: The case of managing two DENMs with the same *causeCode* from the same originating ITS-S has to be handled by the receiving ITS-S.

Details:

Detailed by:

Tested by:

2.1.2.7 Traffic class

Requirement **RS_tcSpVe_152**

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

Details:

Detailed by:
Tested by:

2.1.2.8 Message Parameter

2.1.2.8.1 DENM

Requirement **RS_tcSpVe_153**

Table 7 specifies the data elements of the DENM that shall be set.

<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 according to [AD-3].</td></tr>
<tr><td>detectionTime</td><td>TimestampIts-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [AD-3].
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 according to [AD-3].</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 fufillment of cancellation conditions, see chapter 2.1.2.4.1.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set according to [AD-3].
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 seconds</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 Chapter 2.1.2.3.3. 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 ITS-S. Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>eventPositionHeading</td><td>Heading of the originating ITS-S. Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
<tr><td>traces</td><td>PathHistory of the originating ITS-S. Shall be set according to [AD-3].</td></tr>
</table>

<table>
<tr><td></td><td>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 according to [AD-3], 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 the detecting ITS-S is situated on.
Shall be refreshed for an update DENM.
Shall be set according to [AD-3] 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 according to [AD-3]. The use of GPS 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>
<tr><td>stationarySince</td><td>Shall be set according to the duration in minutes of the detecting ITS-S being stationary.Shall be set according to [AD-3].
Shall be refreshed for an update DENM.</td></tr>
</table>

Table 7: DENM data elements of "Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle"

Details:

Detailed by:

Tested by:

2.1.2.8.2 CAM

Requirement **RS_tcSpVe_154**

The *vehicleRole* is initialised to be a "default" vehicle (*vehicleRole* of CAM set to *default*(0)). If at least one of the use case specific triggering conditions defined in chapter 2.1.2.3.2. is satisfied the *vehicleRole* shall be set to *emergency*(6).

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_155**

Table 8 specifies the data elements of the CAM that shall be set if the use case is triggered.

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 according to [AD-2].
BasicContainer	
stationType	specialVehicles(10)
referencePosition	Position and position accuracy measured at the reference point of the originating ITS-S. Shall be set according to [AD-3].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
heading	Heading direction of the originating ITS-S with regards to the true north. Shall be set according to [AD-3].
speed	Driving speed of the originating ITS-S. Shall be set according to [AD-3].
driveDirection	Vehicle drive direction (Forward or Backward) of the originating ITS-S. Shall be set according to [AD-3].
vehicleLength	Length of vehicle. Shall be set according to [AD-3].
vehicleWidth	Width of a vehicle. Shall be set according to [AD-3].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating ITS-S. Shall be set according to [AD-3].
curvature	Curvature of the vehicle trajectory and the accuracy.

	Shall be set according to [AD-3].
curvatureCalcMode	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set according to [AD-3].
yawRate	Yaw rate of vehicle at a point in time. Shall be set according to [AD-3].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
vehicleRole	emergency(6)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set according to [AD-3].
pathHistory	Represents the vehicle's recent movement over some past time and/or distance. Shall be set according to [AD-3].
SpecialVehicleContainer shall be set to EmergencyContainer	
lightBarSirenInUse	lightBarActivated bit shall be set to 1(onChange), if the usage of the lightbar 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 (2.1.2.8.1)
subCauseCode	As specified in DENM (2.1.2.8.1)

Table 8: CAM data elements of "Special Vehicle Warning - Stationary Safeguarding Emergency Vehicle"

Details:

Detailed by:

Tested by:

2.1.2.9 Networking and Transport Layer

Requirement **RS_tcSpVe_156**

For the Day One version of this application, the destination area is the same as the relevance area - in this case, a circle of radius *relevanceDistance*. Therefore, the interface parameter *DENM destination area* between the DEN basic service and the Networking & Transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_157**

The interface parameter *hopLimit* between the DEN basic service and the GeoNetworking/BTP shall be set to the maximum value, according to [AD-4] (in current specification of [AD-4]: 10). This indicates that the receiver shall hop this message. The *Advanced forwarding algorithm for GeoBroadcast*, according to [AD-4], shall be used.

Details:

Detailed by:

Tested by:

2.1.2.10 Security Layer

Requirement **RS_tcSpVe_158**

If the triggering conditions as described in chapter 2.1.2.3 apply, a pseudonym (ID) change shall be blocked for DENMs as long as *validityDuration* is not expired (see chapter 2.1.2.8.1). Corresponding new, update and cancellation DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

2.1.3 Special Vehicle Warning - Stationary Wrecking Service Warning

2.1.3.1 Description of Use Case

Other (informational) **RS_tcSpVe_229**

The wrecking service supports a broken vehicle, i.e. standing on the right lane of the road representing a hazardous location. The use case of the moving wrecking service e.g. carrying a broken vehicle is covered by the common CAM.

2.1.3.2 Relations to other Use Cases

Other (informational) **RS_tcSpVe_230**

The following use cases are related to the *Special Vehicle Warning - Stationary Wrecking Service Warning* use case, because they share similar triggering conditions:

- Special Vehicle Warning – Emergency Vehicle in Operation
- Special Vehicle Warning – Stationary Safeguarding Emergency Vehicle

2.1.3.3 Triggering Conditions

2.1.3.3.1 Preconditions

Requirement **RS_tcSpVe_159**

The following preconditions shall be satisfied every time before triggering of this use case is initialised:

- The *stationType* is confirmed to be an special vehicle (*stationType* of CAM is set to *specialVehicles*(10)). The Use Case is restricted to wrecking service cars.
- The *Standstill Timer* shall be initialised with zero.

Details:

Detailed by:

Tested by:

2.1.3.3.2 Use Case Specific Conditions

Requirement **RS_tcSpVe_160**

If the vehicle is stationary and the light bar is in use a *Standstill Timer* shall be initialized 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.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_241**

Once at least one of the following conditions is satisfied, the triggering conditions for this use case are fulfilled and the generation of a DENM shall be triggered.

a. Light bar is in use, hazard lights are activated and parking brake is activated or in case of automatic transmission parking position is chosen.
b. Light bar is in use, hazard lights are activated and the *Standstill Timer* is greater than or equal 60 seconds.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_162**

The vehicle speed shall be determined by the CAN bus signal, not by GNSS. The filtered vehicle velocity (with respect to sensor noise due to wheel ticks) shall be used. This requirement shall be applied for all following occurrences of vehicle speed analysis.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_163**

The level of Information quality can be improved by the following characteristics:

c. Status of driver door is "open"
d. Driver's seat is detected as "not occupied". The condition shall be detected by one of the following techniques:
    a. Passenger compartment camera
    b. State of the art technique for seat occupation used in seat belt reminder

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_164**

If the use case is triggered due to fulfillment of condition a), the *Standstill Timer* shall be stopped and set to 60 seconds. In the update phase, only the conditions shall be checked, but no timer shall be started.

Details:

Detailed by:

Tested by:

2.1.3.3.3 Information Quality

Requirement **RS_tcSpVe_165**

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

Event detection	Value of InformationQuality
No TC compliant implementation	unknown(0)
Condition b) fulfilled	1
Conditions 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

Table 9: Information quality of "Special Vehicle Warning - Stationary Wrecking Service Warning"

Details:

Detailed by:
Tested by:

Requirement **RS_tcSpVe_166**

If the Triggering Conditions change in 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.

Details:
Detailed by:
Tested by:

2.1.3.4 Termination Conditions

Requirement **RS_tcSpVe_167**

This use case is terminated by a cancellation of the originating ITS-S. At the termination of the use case, update DENM request shall be terminated.

Details:
Detailed by:
Tested by:

2.1.3.4.1 Cancellation

Requirement **RS_tcSpVe_168**

Once the following condition is satisfied before the time period set in the data element *validityDuration* is expired, the generation of a cancellation DENM shall be triggered.

- Use case specific conditions a) to b) in chapter 2.1.3.3.2 are not satisfied.

The *vehicleRole* shall be set to *default*(0).

Details:
Detailed by:
Tested by:

2.1.3.4.2 Negation

Requirement **RS_tcSpVe_169**

A negation DENM shall not be used for this use case.

Details:
Detailed by:
Tested by:

2.1.3.5 Update

Requirement **RS_tcSpVe_170**

The generation of an update DENM shall be triggered every 60s, if the triggering conditions are still satisfied. All data fields that are assigned new values are defined in chapter 2.1.2.8.1 in Table 10.

Details:
Detailed by:
Tested by:

2.1.3.6 Repetition Duration and Repetition Interval

Requirement **RS_tcSpVe_171**

New, cancellation and update DENMs shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s. Therefore the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set according to the values above.

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

NOTE: The case of managing two DENMs with the same *causeCode* from the same originating ITS-S has to be handled by the receiving ITS-S.

Details:

Detailed by:

Tested by:

2.1.3.7 Traffic class

Requirement **RS_tcSpVe_172**

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

Details:

Detailed by:

Tested by:

2.1.3.8 Message Parameter

2.1.3.8.1 DENM

Requirement **RS_tcSpVe_173**

Table 10 specifies the data elements of the DENM that shall be set.

Data Field	**Value**
Management Container	
actionID	Identifier of a DENM.Shall be set according to [AD-3].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [AD-3]. 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 according to [AD-3].
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 chapter 2.1.3.4.1.
eventPosition	*ReferencePosition*. Shall be set according to [AD-3]. 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 1 2 3	allTrafficDirections(0) upstreamTraffic(1) allTrafficDirections(0) upstreamTraffic(1)	
	Otherwise, the value shall be set to allTrafficDirections(0)		
validityDuration	180 seconds		
stationType	specialVehicles(10)		
Situation Container			
informationQuality	See Chapter 2.1.3.3.3. Shall be refreshed for every update DENM		
causeCode	rescueAndRecoveryWorkInProgress(15)		
subCauseCode	unavailable(0)		
Location Container			
eventSpeed	Speed of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.		
eventPositionHeading	Heading of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.		
Traces	*PathHistory* of the originating ITS-S. Shall be set according to [AD-3]. 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 according to [AD-3], 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.		
roadType	*RoadType* of the road the detecting ITS-S is situated on. Shall be refreshed for an update DENM. Shall be set according to [AD-3] 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 according to [AD-3]. The use of GPS 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 ITS-S being stationary.Shall be set according to [AD-3]. Shall be refreshed for an update DENM.		

Table 10: DENM data elements of "Special Vehicle Warning - Stationary Wrecking Service Warning"

Details:

Detailed by:

Tested by:

2.1.3.8.2 CAM

Requirement **RS_tcSpVe_174**

The *vehicleRole* shall be initialised as a "default" vehicle (*vehicleRole* of CAM set to *default*(0)). If at least one of the use case specific triggering conditions defined in chapter 2.1.3.3.2 is satisfied the *vehicleRole* shall be set to *rescue*(5).

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_175**

Table 11 specifies the data elements of the CAM that shall be set if the use case is triggered.

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 according to [AD-2].

BasicContainer	
stationType	specialVehicles(10)
referencePosition	Position and position accuracy measured at the reference point of the originating ITS-S. Shall be set according to [AD-3].
HighFrequencyContainer shall be set to BasicVehicleContainerHighFrequency	
heading	Heading direction of the originating ITS-S with regards to the true north. Shall be set according to [AD-3].
speed	Driving speed of the originating ITS-S. Shall be set according to [AD-3].
driveDirection	Vehicle drive direction (Forward or Backward) of the originating ITS-S. Shall be set according to [AD-3].
vehicleLength	Length of vehicle. Shall be set according to [AD-3].
vehicleWidth	Width of a vehicle. Shall be set according to [AD-3].
longitudinalAcceleration	Vehicle longitudinal acceleration of the originating ITS-S. Shall be set according to [AD-3].
curvature	Curvature of the vehicle trajectory and the accuracy. Shall be set according to [AD-3].
curvatureCalcMode	Describes whether the yaw rate is used to calculate the curvature for a reported curvature value. Shall be set according to [AD-3].
yawRate	Yaw rate of vehicle at a point in time. Shall be set according to [AD-3].
LowFrequencyContainer shall be set to BasicVehicleContainerLowFrequency	
vehicleRole	rescue(5)
exteriorLights	Describes the status of the exterior light switches of a vehicle. Shall be set according to [AD-3].
pathHistory	Represents the vehicle's recent movement over some past time and/or distance. Shall be set according to [AD-3].
SpecialVehicleContainer shall be set to SafetyCarContainer	
lightBarSirenInUse	lightBarActivated bit shall be set to 1(onChange), if the usage of the lightbar 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 (2.1.3.8.1)
subCauseCode	As specified in DENM (2.1.3.8.1)

Table 11: CAM data elements of "Special Vehicle Warning - Stationary Wrecking Service Warning"

Details:

Detailed by:

Tested by:

2.1.3.9 Networking and Transport Layer

Requirement **RS_tcSpVe_176**

For the Day One version of this application, the destination area is the same as the relevance area - in this case, a circle of radius *relevanceDistance*. Therefore, the interface parameter *DENM destination area* between the DEN basic service and the Networking & Transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

Details:

Detailed by:

Tested by:

Requirement **RS_tcSpVe_177**

The interface parameter *hopLimit* between the DEN basic service and the GeoNetworking/BTP shall be set to the maximum value, according to [AD-4] (in current specification of [AD-4]: 10). This indicates that the receiver shall hop this message. The *Advanced forwarding algorithm for GeoBroadcast*, according to [AD-4], shall be used.

Details:

Detailed by:

Tested by:

2.1.3.10 Security Layer

Requirement **RS_tcSpVe_178**

If the triggering conditions as described in chapter 2.1.3.3 apply, a pseudonym (ID) change shall be blocked for DENMs as long as *validityDuration* is not expired (see chapter 2.1.3.8.1). Corresponding new, update and cancellation DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

3 Appendix

3.1 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 use case:

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 wrecking service carries a broken vehicle using the light bar. This case is covered by usual CAMs. The wrecking service is considered as a usual vehicle in road traffic.	Irrelevant

Table 12: Scenarios

3.2 Open Issues

3.3 Feature Requests

3.4 List of abbreviations

Other (informational) **RS_tcSpVe_236**

ABS	Anti-lock Breaking System
ASN.1	Abstract Syntax Notation One
ASR	Anti-Slip Regulation
AUT	Automatic Transmission
CAM	Cooperative Awareness Message
C2C-CC	Car to Car Communication Consortium
CDD	Common Data Dictionary
DEN	Decentralized Environmental Notification
DENM	DEN Message

ECE	Economic Commission for Europe
ETSI	European Telecommunications Standards Institute
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ITS	Intelligent Transport System
ITS-S	ITS Station
KAF	Keep-Alive Forwarding
TTC	Time To Collision
V2V	Vehicle to Vehicle
TC	Triggering Conditions

Table 13: Abbreviations

3.5 Applicable documents

Other (informational) **RS_tcSpVe_237**

[AD-1]	Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service Draft ETSI EN 302 637-3 V1.2.7 (2014-07)
[AD-2]	Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service Draft ETSI EN 302 637-2 V1.3.5 (2014-06)
[AD-3]	Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary; ETSI TS 102 894-2 V1.1.2 (2014-07)
[AD-4]	Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality Draft ETSI EN 302 636-4-1 V1.0.2 (2013-09)

Table 14: Applicable documents

3.6 Related documents

RS_tcSpVe_243