Triggering Conditions and Data Quality Stationary 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 88 members, with 18 vehicle manufacturers, 39 equipment suppliers and 31 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 Stationary Vehicle Warning		
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31.08.2018	Minor corrections	Release Management	Steering Committee
Date	**Changes**	**Edited by**	**Approved**

Table 2: Changes since last version

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1 Introduction

1.1 Abstract

Other (informational) **RS_tcStVe_183**

This document describes the triggering conditions for stationary vehicle warning for the following three use cases:

- Stationary Vehicle Warning - Stopped Vehicle
- Stationary Vehicle Warning - Broken-down Vehicle
- Stationary Vehicle Warning - Post-Crash

2 Triggering conditions

2.1 Stationary Vehicle Warning

Requirement **RS_tcStVe_208**

The Stationary 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 <= 8 centimeter per second. This state shall be determined by internal vehicle sensors (e.g. wheel ticks).

2.1.1 Stationary Vehicle Warning - Stopped Vehicle

2.1.1.1 Description of Use Case

Other (informational) **RS_tcStVe_184**

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

Requirement **RS_tcStVe_116**

A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated to be valid. Such a signal encourages the stack to either generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Tested by:

2.1.1.2 Relations to other Use Cases

Other (informational) **RS_tcStVe_185**

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

- Special Vehicle Warning - Stationary Wrecking Service Warning
- Stationary Vehicle Warning - Broken-down Vehicle
- Stationary Vehicle Warning - Post-Crash

2.1.1.3 Triggering Conditions

2.1.1.3.1 Preconditions

Requirement **RS_tcStVe_117**

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

1. No break-down warning message, that prevents the driver from continuing driving (for example: red warning symbols, according to ECE regulation No. 121 [Reg121]), is shown on the instrument cluster.

NOTE: No requirement regarding the ignition terminal 15 is put here. However, this does not imply that a clamp 30 ECU or after run time is required in this case.

Tested by:

Requirement **RS_tcStVe_205**

A parallel activation with the other use cases shall be avoided. In case of triggering the use cases *Broken-down Vehicle* and/or *Post-Crash* simultaneously, the use cases shall be prioritized as follows:

1.) Post-Crash (highest priority)

2.) Broken-down Vehicle

3.) Stopped Vehicle (lowest priority)

Tested by:

2.1.1.3.2 Use Case Specific Conditions

Requirement **RS_tcStVe_118**

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

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

Tested by:

Requirement **RS_tcStVe_119**

The vehicle speed shall be determined by the vehicle 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.

Tested by:

Requirement **RS_tcStVe_120**

If the vehicle has enabled hazard lights and the vehicle is stationary, the *Triggering Timer* shall be set to 30 seconds and started. The *Triggering Timer* shall be reduced, if the following situations appear:

a) The timer shall be reduced by 10 seconds, if the automatic transmission (AUT) is set to parking for at least 3 s.

b) The timer shall be reduced by 10 seconds, if the gear box is set to idle for at least 3 s.

c) The timer shall be reduced by 10 seconds, if the parking brake is enabled for at least 3 s.

d) The timer shall be reduced by 10 seconds, if an arbitrary number of the seatbelt buckles change from "connected" to "disconnected" for at least 3 s.

e) The timer shall be set to 0, if an arbitrary number of doors are open for at least 3 s.

f) The timer shall be set to 0, if the ignition terminal is switched from on to off for at least 3 s.

g) The timer shall be set to 0, if the boot (trunk) lid is open for at least 3 s.

h) The timer shall be set to 0, if the bonnet (hood) is open for at least 3 s.

Tested by:

Requirement **RS_tcStVe_121**

All above listed procedures for the timer reduction shall be applied only once during the initial detection. If the *Triggering Timer* has been counted down to 0, no further reduction is necessary in the current detection cycle.

Tested by:

Requirement **RS_tcStVe_122**

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

Tested by:

2.1.1.3.3 Information Quality

Requirement **RS_tcStVe_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)
None of the conditions a) – h) are fulfilled.	1
At least one condition of a) – d) is fulfilled.	2
At least one condition of e) – h) is fulfilled.	3

Table 3: Information quality of "Stationary Vehicle - Stopped Vehicle"

Tested by:

Requirement **RS_tcStVe_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.

In the update phase, only the conditions that would lead to a timer reduction shall be evaluated, but not the timer itself.

Tested by:

2.1.1.4 Termination Conditions

Requirement **RS_tcStVe_125**

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.

Tested by:

2.1.1.4.1 Cancellation

Requirement **RS_tcStVe_126**

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

a) The vehicle is not stationary anymore for a duration of 5 seconds.

b) The hazard lights are disabled.

c) The position of the vehicle has changed more than 500 m (e.g. by a tow away process).

NOTE: The cancellation condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that cancellation condition.

Tested by:

2.1.1.4.2 Negation

Requirement **RS_tcStVe_127**

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

Tested by:

2.1.1.5 Update

Requirement **RS_tcStVe_128**

If the previously detected *Stopped Vehicle* was not cancelled (chapter 2.1.1.4.1), the generation of an update DENM shall be triggered every 15 s.

Tested by:

Requirement **RS_tcStVe_129**

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

Tested by:

Requirement **RS_tcStVe_130**

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.1.8.1).

NOTE: The update condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that update condition.

Tested by:

2.1.1.6 Repetition Duration and Repetition Interval

Requirement **RS_tcStVe_131**

DENMs, that are new, have been updated or have been cancelled, shall be repeated for a *repetitionDuration* of 15 s with a *repetitionInterval* of 1 s. Therefore the interface parameters

Repetition duration and *Repetition interval* between the application and the DEN basic service shall be set according to the values above.

NOTE: The *validityDuration* is set to 30 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* 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.

Tested by:

2.1.1.7 Traffic class

Requirement **RS_tcStVe_132**

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

Tested by:

2.1.1.8 Message Parameter

2.1.1.8.1 DENM

Requirement **RS_tcStVe_133**

Table 4 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 [TS 102 894-2].</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 [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 according to [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 a cancellation DENM.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set according to [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></td></tr>
</table>

<table>
<tr><td></td><td>Otherwise, the value shall be set to allTrafficDirections(0)</td></tr>
<tr><td>validityDuration</td><td>30 seconds</td></tr>
<tr><td>stationType</td><td>The type of the originating ITS-S. Shall be set according to [TS 102 894-2].</td></tr>
<tr><td colspan="2">Situation Container</td></tr>
<tr><td>informationQuality</td><td>See RS_tcStVe_123. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>stationaryVehicle(94)</td></tr>
<tr><td>subCauseCode</td><td>unavailable(0)</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 [TS 102 894-2].
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 [TS 102 894-2].
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 [TS 102 894-2].
If the PathDeltaTime is used in the PathPoints, the PathDeltaTime of the first PathPoint (closest point to the ReferencePosition) shall be refreshed for an update DENM. All other PathPoints shall not be refreshed. If the PathDeltaTime of the first PathPoint exceeds the maximum value according to [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 the detecting ITS-S is situated on.
Shall be refreshed for an update DENM.
Shall be set according to [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)
	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 [TS 102 894-2]. 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 [TS 102 894-2]. Shall be refreshed for an update DENM.		

Table 4: DENM data elements of "Stationary Vehicle Warning - Stopped Vehicle"

Tested by:

2.1.1.8.2 CAM

Requirement **RS_tcStVe_134**

CAM adaption shall not be used for this use case.

Tested by:

2.1.1.9 Networking and Transport Layer

Requirement **RS_tcStVe_135**

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*.

Tested by:

2.1.1.10 Security Layer

Requirement **RS_tcStVe_137**

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

Tested by:

2.1.1.11 Scenarios

Other (informational) **RS_tcStVe_186**

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
	tbd.	
	tbd.	

Table 5: Stationary Vehicle Warning - Stopped Vehicle scenarios

2.1.2 Stationary Vehicle Warning - Broken-down Vehicle

2.1.2.1 Description of Use Case

Other (informational) **RS_tcStVe_190**

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

Requirement **RS_tcStVe_138**

A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated to be valid. Such a signal encourages the stack to either generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Tested by:

2.1.2.2 Relations to other Use Cases

Other (informational) **RS_tcStVe_191**

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

- Special Vehicle Warning - Stationary Wrecking Service Warning
- Stationary Vehicle Warning - Stopped Vehicle
- Stationary Vehicle Warning - Post-Crash

2.1.2.3 Triggering Conditions

2.1.2.3.1 Preconditions

Requirement **RS_tcStVe_139**

The following precondition shall be satisfied every time before triggering of this use case is initialized:

1.) A break-down warning message, that prevents the driver of continuing driving (for example: red warning symbols, according to ECE regulation No. 121 [Reg121]), is shown on the instrument cluster.

NOTE: No requirement regarding the ignition terminal 15 is put here. However, this does not imply that a clamp 30 ECU or after run time is required in this case.

Tested by:

Requirement **RS_tcStVe_206**

A parallel activation with the other use cases shall be avoided. In case of triggering the use cases *Stopped Vehicle* and/or *Post-Crash* simultaneously, the use cases shall be prioritized as follows:

1.) Post-Crash (highest priority)

2.) Broken-down Vehicle

3.) Stopped Vehicle (lowest priority)

Tested by:

2.1.2.3.2 Use Case Specific Conditions

Requirement **RS_tcStVe_140**

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

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

Tested by:

Requirement **RS_tcStVe_141**

The vehicle speed shall be determined by the vehicle 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.

Tested by:

Requirement **RS_tcStVe_142**

If the vehicle has enabled hazard lights and the vehicle is stationary, the *Triggering Timer* shall be set to 30 seconds and started. The *Triggering Timer* shall be reduced, if the following situations appear:

a) The timer shall be reduced by 10 seconds, if the automatic transmission (AUT) is set to parking for at least 3 s.

b) The timer shall be reduced by 10 seconds, if the gear box is set to idle for at least 3 s.

c) The timer shall be reduced by 10 seconds, if the parking brake is enabled for at least 3 s.

d) The timer shall be reduced by 10 seconds, if an arbitrary number of the seatbelt buckles change from "connected" to "disconnected" for at least 3 s.

e) The timer shall be set to 0, if an arbitrary number of doors are open for at least 3 s.

f) The timer shall be set to 0, if the ignition terminal is switched from on to off for at least 3 s.

g) The timer shall be set to 0, if the boot (trunk) lid is open for at least 3 s.

h) The timer shall be set to 0, if the bonnet (hood) is open for at least 3 s.

Tested by:

Requirement **RS_tcStVe_143**

All above listed procedures for the timer reduction shall be applied only once during the initial detection. If the *Triggering Timer* has been counted down to 0, no further reduction is necessary in the current detection cycle.

Tested by:

Requirement **RS_tcStVe_144**

During the runtime of the *Triggering Timer*, the hazard lights shall be enabled and the vehicle shall be stationary all the time. Otherwise the detection shall be cancelled.

Tested by:

2.1.2.3.3 Information Quality

Requirement **RS_tcStVe_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)
None of the conditions a) – h) are fulfilled.	1
At least one condition of a) – d) is fulfilled.	2
At least one condition of e) – h) is fulfilled.	3

Table 6: Information quality of "Stationary Vehicle - Broken-down Vehicle"

Tested by:

Requirement **RS_tcStVe_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.

In the update phase, only the conditions that would lead to a timer reduction shall be evaluated, but not the timer itself.

Tested by:

2.1.2.4 Termination Conditions

Requirement **RS_tcStVe_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.

Tested by:

2.1.2.4.1 Cancellation

Requirement **RS_tcStVe_148**

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

a) The ego vehicle is not stationary anymore for a duration of 5 seconds.

b) The hazard lights are disabled.

c) The position of the vehicle has changed more than 500 m (e.g. by a tow away process).

NOTE: The cancellation condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that cancellation condition.

Tested by:

2.1.2.4.2 Negation

Requirement **RS_tcStVe_149**

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

Tested by:

2.1.2.5 Update

Requirement **RS_tcStVe_150**

If the previously detected *Broken-down Vehicle* was not cancelled (chapter 2.1.2.4.1), the generation of an update DENM shall be triggered every 15 s.

Tested by:

Requirement **RS_tcStVe_151**

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

Tested by:

Requirement **RS_tcStVe_152**

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

Tested by:

Requirement **RS_tcStVe_153**

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.2.8.1).

NOTE: The update condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that update condition.

Tested by:

2.1.2.6 Repetition Duration and Repetition Interval

Requirement **RS_tcStVe_154**

DENMs, that are new, have been updated or have been cancelled, shall be repeated for a *repetitionDuration* of 15 s with a *repetitionInterval* of 1 s. Therefore the interface parameters *Repetition duration* and *Repetition interval* between the application and the DEN basic service shall be set according to the values above.

Tested by:

Requirement **RS_tcStVe_155**

In case of an enabled ignition terminal 15, the *validityDuration* shall be set to 30 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM is expired and the update has not been received yet.

NOTE: The *validityDuration* in the case of a disabled ignition terminal 15 is set to a higher value compared to the enabled ignition terminal 15 case. This is due to the fact, that update DENM cannot be triggered and not sent any longer in this case. Therefore the last DENM shall be kept alive longer.

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.

Tested by:

2.1.2.7 Traffic class

Requirement **RS_tcStVe_156**

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

Tested by:

2.1.2.8 Message Parameter

2.1.2.8.1 DENM

Requirement **RS_tcStVe_157**

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 [TS 102 894-2].</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 [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 according to [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 a cancellation DENM.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set according to [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>• Ignition terminal 15 enabled: 30 seconds
• Ignition terminal 15 disabled: 900 seconds</td></tr>
<tr><td>stationType</td><td>The type of the originating ITS-S. Shall be set according to [TS 102 894-2].</td></tr>
<tr><td colspan="2">Situation Container</td></tr>
<tr><td>informationQuality</td><td>See RS_tcStVe_145. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>stationaryVehicle(94)</td></tr>
<tr><td>subCauseCode</td><td>vehicleBreakdown(2)</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 [TS 102 894-2].
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 [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
</table>

<table>
<tr><td>traces</td><td>PathHistory of the originating ITS-S. Shall be set according to [TS 102 894-2].

If the PathDeltaTime is used in the PathPoints, the PathDeltaTime of the first PathPoint (closest point to the ReferencePosition) shall be refreshed for an update DENM. All other PathPoints shall not be refreshed. If the PathDeltaTime of the first PathPoint exceeds the maximum value according to [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 the detecting ITS-S is situated on.

Shall be refreshed for an update DENM.

Shall be set according to [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 according to [TS 102 894-2]. 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>
</table>

stationarySince	Shall be set according to the duration in minutes of the detecting ITS-S being stationary.Shall be set according to [TS 102 894-2]. Shall be refreshed for an update DENM.

Table 7: DENM data elements of "Stationary Vehicle Warning - Broken-down Vehicle"

Tested by:

2.1.2.8.2 CAM

Requirement **RS_tcStVe_158**

CAM adaption shall not be used for this use case.

Tested by:

2.1.2.9 Networking and Transport Layer

Requirement **RS_tcStVe_159**

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*.

Tested by:

2.1.2.10 Security Layer

Requirement **RS_tcStVe_161**

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

Tested by:

2.1.2.11 Scenarios

Other (informational) **RS_tcStVe_192**

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
	tbd.	
	tbd.	

Table 8: Stationary Vehicle Warning - Broken-down Vehicle scenarios

2.1.3 Stationary Vehicle Warning - Post-Crash

2.1.3.1 Description of Use Case

Other (informational) **RS_tcStVe_195**

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

Requirement **RS_tcStVe_162**

A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated to be valid. Such a signal encourages the stack to either generate a new, update or cancellation DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Tested by:

2.1.3.2 Relations to other Use Cases

Other (informational) **RS_tcStVe_196**

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

- Stationary Vehicle Warning - Stopped Vehicle
- Stationary Vehicle Warning - Broken-down Vehicle

2.1.3.3 Triggering Conditions

2.1.3.3.1 Preconditions

Requirement **RS_tcStVe_163**

No precondition shall be satisfied for this use case.

Tested by:

Requirement **RS_tcStVe_207**

A parallel activation with the other use cases shall be avoided. In case of triggering the use cases *Stopped Vehicle* and/or *Broken-down Vehicle* simultaneously, the use cases shall be prioritized as follows:

1.) Post-Crash (highest priority)

2.) Broken-down Vehicle

3.) Stopped Vehicle (lowest priority)

Tested by:

2.1.3.3.2 Use Case Specific Conditions

Requirement **RS_tcStVe_164**

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) An eCall has been triggered manually by an occupant of the vehicle by the eCall

button and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately.

b) A low severity crash is detected without the activation of an irreversible occupant restraint system (e.g. high-voltage battery cut-off, door unlock) and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately.

c) A pedestrian collision is detected with the activation of at least one irreversible pedestrian protection system (e.g. pop up engine hood, outside airbag) and the vehicle becomes stationary within 15 s. If the vehicle is already stationary, the condition is fulfilled immediately.

d) A high severity crash is detected with the activation of at least one irreversible occupant restraint system (e.g. pyrotechnic belt-tightener, airbag).

NOTE: The condition "vehicle becomes/is stationary" is defined in RS_tcStVe_208.

Tested by:

Requirement **RS_tcStVe_165**

The vehicle speed shall be determined by the vehicle 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.

NOTE: The conditions have only to be checked, if the necessary power supply is present. This means a crash secure implementation of the system is not required.

Tested by:

2.1.3.3.3 Information Quality

Requirement **RS_tcStVe_166**

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) is fulfilled.	1
Condition b) or c) is fulfilled.	2
Condition d) is fulfilled.	3

Table 9: Information quality of "Stationary Vehicle - Post-Crash"

Tested by:

Requirement **RS_tcStVe_167**

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.

Tested by:

2.1.3.4 Termination Conditions

Requirement **RS_tcStVe_168**

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.

Tested by:

2.1.3.4.1 Cancellation

Requirement **RS_tcStVe_169**

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

a) The ego vehicle is not stationary for a duration of 15 seconds.

b) The position of the vehicle has changed more than 500 m (e.g. by a tow away process).

NOTE: The cancellation condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that cancellation condition.

Tested by:

2.1.3.4.2 Negation

Requirement **RS_tcStVe_170**

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

Tested by:

2.1.3.5 Update

Requirement **RS_tcStVe_171**

An update DENM shall be triggered every 60 s if the use case has not been cancelled.

Tested by:

Requirement **RS_tcStVe_172**

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

Tested by:

Requirement **RS_tcStVe_173**

New values shall be assigned to data fields or elements in the DENM according to the changed event (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.3.8.1).

NOTE: The update condition does not imply that the C2C-CC Basic System need to be permanent operational or extends it operation during that update condition.

Tested by:

2.1.3.6 Repetition Duration and Repetition Interval

Requirement **RS_tcStVe_174**

DENMs, that are new, have been updated or have been cancelled, shall be repeated for a *repetitionDuration* of 60s 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.

Tested by:

Requirement **RS_tcStVe_175**

In case of an enabled ignition terminal 15, the *validityDuration* shall be set to 180 s. Therefore, one can prevent a gap of DENMs if the *repetitionDuration* of the original DENM is expired and the update has not been received yet.

NOTE: The *validityDuration* in the case of a disabled ignition terminal 15 is set to a higher value compared to the enabled ignition terminal 15 case. This is due to the fact, that update DENM cannot be triggered and not sent any longer in this case. Therefore the last DENM shall be kept alive longer.

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.

Tested by:

2.1.3.7 Traffic class

Requirement **RS_tcStVe_176**

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

Tested by:

2.1.3.8 Message Parameter

2.1.3.8.1 DENM

Requirement **RS_tcStVe_177**

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 [TS 102 894-2].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [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 according to [TS 102 894-2].

<table>
<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 a cancellation DENM.</td></tr>
<tr><td>eventPosition</td><td>ReferencePosition. Shall be set according to [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>• Ignition terminal 15 enabled: 180 seconds
• Ignition terminal 15 disabled: 1800 seconds</td></tr>
<tr><td>stationType</td><td>The type of the originating ITS-S. Shall be set according to [TS 102 894-2].</td></tr>
<tr><td colspan="2">Situation Container</td></tr>
<tr><td>informationQuality</td><td>See RS_tcStVe_166. Shall be refreshed for every update DENM.</td></tr>
<tr><td>causeCode</td><td>stationaryVehicle(94)</td></tr>
<tr><td>subCauseCode</td><td>postCrash(3)</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 [TS 102 894-2].
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 [TS 102 894-2].
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 [TS 102 894-2].
If the PathDeltaTime is used in the PathPoints, the PathDeltaTime of the first PathPoint (closest point to the ReferencePosition) shall be refreshed for an update DENM. All other PathPoints shall not be refreshed. If the PathDeltaTime of the first PathPoint exceeds the maximum value according to [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 the detecting ITS-S is situated on.
Shall be refreshed for an update DENM.</td></tr>
</table>

<table>
<tr><td></td><td>Shall be set according to [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-NoStructuralSeparation ToOppositeLanes(0)</td></tr>
<tr><td>Urban</td><td>Yes</td><td>urban-WithStructuralSeparation ToOppositeLanes(1)</td></tr>
<tr><td>Urban</td><td>unknown</td><td>urban-NoStructuralSeparation ToOppositeLanes(0)</td></tr>
<tr><td>Non-Urban</td><td>No</td><td>nonUrban-NoStructuralSeparation ToOppositeLanes(2)</td></tr>
<tr><td>Non-Urban</td><td>Yes</td><td>nonUrban-WithStructuralSeparation ToOppositeLanes(3)</td></tr>
<tr><td>Non-Urban</td><td>Unknown</td><td>nonUrban-NoStructuralSeparation ToOppositeLanes(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 [TS 102 894-2]. 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 [TS 102 894-2].
Shall be refreshed for an update DENM.</td></tr>
</table>

Table 10: DENM data elements of "Stationary Vehicle Warning - Post-Crash"

Tested by:

2.1.3.8.2 CAM

Requirement **RS_tcStVe_178**

CAM adaption shall not be used for this use case.

Tested by:

2.1.3.9 Networking and Transport Layer

Requirement **RS_tcStVe_179**

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*.

Tested by:

2.1.3.10 Security Layer

Requirement **RS_tcStVe_181**

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

Tested by:

2.1.3.11 Scenarios

Other (informational) **RS_tcStVe_197**

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
	tbd.	
	tbd.	

Table 11: Stationary Vehicle Warning - Post-Crash scenarios

3 Appendix

3.1 List of abbreviations

Other (informational) **RS_tcStVe_200**

ABS	Anti-lock Braking System
ASN.1	Abstract Syntax Notation One
ASR	Anti-Slip Regulation
AT	Authorization Ticket
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
TC	Triggering Conditions
TTC	Time To Collision
V2V	Vehicle to Vehicle

Table 12: Abbreviations