Triggering Conditions and Data Quality
CAR 2 CAR Communication Consortium

CAR 2 CAR
COMMUNICATION CONSORTIUM

Adverse Weather Conditions

Partners of the C2C-CC

Document information

Number:		Version:	3.2.0	Date:	21.12.2015
Title:	C2C-CC Triggering Conditions and Data Quality			Document Type:	
Release	1.1.0				
Release Status:	Release				
Status:	Completed				

Table 1: Document information

Changes since last version

Title:					
Explanatory notes:					
3	2	01.12.2015	Reworked according to Change Management process and released as part of CAR 2 CAR Release 1.1.0	Volkswagen AG	
3	1	28.04.2014	Update after CAM/DENM/CDD Enap Phase, added RelevenaceTrafficDirection data element	Sebastian Engel	
3	0	07.02.2014	Fixed layout and minor type faults	Sebastian Engel	
2	2	13.12.2013	Deleted non-urban detection paths	Sebastian Engel	
2	1	12.12.2013	Reworked Triggering Conditions and Update chapter after WG-APP meeting	Sebastian Engel	
2	0	15.11.2013	Added EventHistory, reworked Update chapter after discussion with Opel	Sebastian Engel	
1	5	18.09.2013	Update Blockingtime, relevance Distance	Mirko Richter	
1	4	18.09.2013	Update to new TC Algo Version that minimize generated DENMs	Mirko Richter	
1	3	11.07.2013	Comments from WG-APP meeting inserted	Gerhard Fischer	
1	0	10.06.2013	First release after initial creation and review phase.	Mirko Richter	
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_tcAdWe_184**

This document describes the triggering conditions for adverse weather conditions for the following three use cases:

- Adverse Weather Conditions - Fog
- Adverse Weather Conditions - Precipitation
- Adverse Weather Conditions - Traction Loss

2 Triggering conditions

2.1 Adverse Weather Condition

2.1.1 Adverse Weather Condition - Fog

2.1.1.1 Description of Use Case

Other (informational)   **RS_tcAdWe_185**

This section describes the triggering of V2V messages for the *Adverse Weather Condition - Fog* use case. A DENM shall be triggered, if fog interferes the driver at a particular extent.

Requirement   **RS_tcAdWe_93**

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 generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Details:

Detailed by:

Tested by:

2.1.1.2 Relations to other Use Cases

Other (informational)   **RS_tcAdWe_186**

The following use cases are related to the *Adverse Weather Condition - Fog* use case, because they share similar triggering conditions:

- Adverse Weather Conditions - Precipitation

2.1.1.3 Triggering Conditions

2.1.1.3.1 Preconditions

Requirement   **RS_tcAdWe_94**

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

1. The vehicle velocity is greater than 7 km/h.
2. The vehicle velocity is less than 80 km/h (vehicle velocity greater 80 km/h is not reasonable for reduced visibility. Speed according to filtered CAN bus signal).

Details:

Detailed by:

Tested by:

2.1.1.3.2 Use Case Specific Conditions

Requirement   **RS_tcAdWe_95**

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.

- Driver Reaction and Light Status:

a) The driver enables the rear-fog light and the low beam light is enabled. All of this needs to be valid for a duration greater than 20 seconds (to minimize risk of misuse by driver, conditions have to be valid for a longer period).

b) The driver enables the rear-fog light, the low beam light is enabled and the vehicle velocity is less than 60 km/h (speed according to filtered CAN bus signal). All of this needs to be valid for a duration greater than 20 seconds.

- Visibility Range Measurement Device:

c) The visibility due to fog is less than 80 meters +- 40 meters tolerance for a duration greater than 5 seconds (the obscured view has to be detected for a reasonable time period. Compared to the conditions a) and b), the time period is shorter due to a more reliable information).

d) The visibility due to fog is less than 80 meters +- 40 meters tolerance and the vehicle velocity is less than 60 km/h (if the vehicle is in non-urban area this speed could be an indication for reduced visibility. Speed according to filtered CAN bus signal) for a duration greater than 5 seconds.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_100**

If the conditions b) or d) are evaluated, 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.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_101**

A new or update DENM shall not be generated within the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a respective DENM has been triggered. In this way, a single event is not able to trigger a series of DENMs. For the Visibility Range Measurement Device (condition c and d) the *Detection Blocking Time* shall be 15 seconds. For the other conditions there shall be no *Detection Blocking Time*.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_102**

In order to ensure consistent functional behaviour for the different triggering conditions a)-d) and the *Detection Blocking Time*, the *Minimum Detection Interval* between two detected events shall be 20 s.

Details:

Detailed by:

Tested by:

2.1.1.3.3 Information Quality

Requirement   **RS_tcAdWe_103**

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) is fulfilled	2
Condition c) is fulfilled	3
Condition d) is fulfilled	4

Table 3: Information quality of "Adverse Weather Condition - Fog"

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_104**

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_tcAdWe_105**

A termination of the use case shall not be considered.

Details:

Detailed by:

Tested by:

2.1.1.4.1 Cancellation

Requirement   **RS_tcAdWe_106**

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

Details:

Detailed by:

Tested by:

2.1.1.4.2 Negation

Requirement   **RS_tcAdWe_107**

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

Details:

Detailed by:

Tested by:

2.1.1.5 Update

Requirement   **RS_tcAdWe_108**

The following rules shall be applied for the update procedure:
If case 1 occurs the generation of an update DENM shall be triggered. If case 2 or case 3 occurs no update DENM shall be triggered, instead the generation of a new DENM shall be triggered.

Case 1: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.1.3.2. The *validityDuration* of the former DENM is not expired. Neither the value of the data element *DeltaLatitude* nor the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
An update DENM shall be generated. The information of the former DENM data elements (*eventPosition, eventDeltaTime, informationQuality*) have to be stored in the *eventHistory* by an additional *eventPoint*.
The event points shall be ordered in ascending order with respect to their lifetime with the most recent *eventPoint* at the first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* (see chapter 2.1.1.8.1) shall be deleted from the *eventHistory* for the update DENM. If the distance covered by the eventHistory exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the *eventHistory*.
The information of the current detected event have to be assigned to the DENM data fields of the updated DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.1.8.1).
NOTE: If lifetimes of event points exceed the *validityDuration* after the update DENM has been generated, it is up to the receiver to handle these event points.

Case 2: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.1.3.2. The *validityDuration* of the former DENM is not expired. Either the value of the data element *DeltaLatitude* or the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
No update DENM shall be generated, but an additional new DENM shall be generated. The information of the current detected event have to be assigned to the DENM data fields of the additional new DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.1.8.1). The former DENM shall be continued to be transmitted as long as the *repetitionDuration* (see chapter 2.1.1.6) of the former DENM does not expire.

Case 3: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.1.3.2. The *validityDuration* of the former DENM is expired:
No update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.
NOTE: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* (see chapter 2.1.1.6) of the former DENM is expired.

NOTE: If the use case specific conditions are not fulfilled after the *Minimum Detection Interval* (specified in chapter 2.1.1.3.2), the generation of an update DENM is not necessary. If a former DENM is still active, the transmission has to be continued as long as the *repetitionDuration* of the former DENM is not expired.

Details:

Detailed by:

Tested by:

2.1.1.6 Repetition Duration and Repetition Interval

Requirement   **RS_tcAdWe_113**

New and update DENMs shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 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 300 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 ITS originator shall be handled by the receiving ITS station.

Details:

Detailed by:

Tested by:

2.1.1.7 Traffic class

Requirement   **RS_tcAdWe_114**

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_tcAdWe_187**

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. Timestamp is according to the beginning of the detection of the current event. Shall be set according to [AD-3]. Shall be refreshed for an update DENM and set to the detection time of the current event.
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, because neither negation nor cancellation shall be used in this use case.
eventPosition	*ReferencePosition*. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
relevanceDistance	• New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the eventHistory becomes longer. To address all relevant ITS stations, the relevanceDistance is longer in this

	case.)
relevanceTrafficDirection	allTrafficDirections(0)
validityDuration	300 seconds
stationType	The type of the originating ITS-S. Shall be set according to [AD-3].
Situation Container	
informationQuality	See Chapter 2.1.1.3.3. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.
causeCode	adverseWeatherCondition-Visibility(18)
subCauseCode	unavailable(0) or fog(1)
eventHistory	This element shall only be used for update DENMs (see section 2.1.1.5.).
Location Container	
Traces	*PathHistory* of the originating ITS-S with reference to the current event point. Shall be set according to [AD-3]. Shall 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: {{TABLE}} Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.

Where {{TABLE}} is:

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)

Table 4: DENM data elements of "Adverse Weather Condition - Fog"

Details:

Detailed by:

Tested by:

2.1.1.8.2 CAM

Requirement   **RS_tcAdWe_116**

CAM adaption shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.1.9 Networking and Transport Layer

Requirement   **RS_tcAdWe_117**

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_tcAdWe_118**

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_tcAdWe_119**

If the triggering conditions as described in chapter 2.1.1.3 apply, a pseudonym (ID) change shall be blocked for new and update DENMs for 15 minutes. Corresponding new and update DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_120**

If a pseudonym change appears and there is an active DENM transmission (new or update DENM), the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* have to be deleted. Afterwards, the regular DENM generation process shall continue. Therefore, a new DENM shall be generated if the triggering conditions (see chapter 2.1.1.3) are satisfied. After the new DENM, update DENMs shall be used in the regular way (see chapter 2.1.1.5).

Details:

Detailed by:

Tested by:

2.1.1.11   Scenarios

Other (informational)   **RS_tcAdWe_188**

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: Adverse Weather Condition - Fog Scenarios

2.1.1.12   Open Issues

Other (informational)   **RS_tcAdWe_189**

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

a)   The following issue shall be incorporated into the profile document: "Keep-Alive-Forwarding shall not be used.".

2.1.1.13   Feature Requests

Other (informational)   **RS_tcAdWe_190**

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

The following list encompasses feature requests for upcoming document releases:

a)   None.

2.1.2 Adverse Weather Condition - Precipitation

2.1.2.1 Description of Use Case

Other (informational)   **RS_tcAdWe_191**

This section describes the triggering of V2V messages for the *Adverse Weather Condition - Precipitation* use case. A DENM shall be triggered, if precipitation interferes the driver at a particular extent.

Requirement   **RS_tcAdWe_121**

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 generate a new DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Details:

Detailed by:

Tested by:

2.1.2.2 Relations to other Use Cases

Other (informational)   **RS_tcAdWe_192**

The following use cases are related to the *Adverse Weather Condition - Precipitation* use case, because they share similar triggering conditions:

·   Adverse Weather Conditions - Fog

2.1.2.3 Triggering Conditions

2.1.2.3.1 Preconditions

Requirement   **RS_tcAdWe_122**

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

1. The vehicle velocity is greater than 7 km/h (speed according to filtered CAN bus signal).
2. The vehicle velocity is less than 80 km/h (speed according to filtered CAN bus signal).
3. Front wash is not active.

Details:

Detailed by:

Tested by:

2.1.2.3.2 Use Case Specific Conditions

Requirement   **RS_tcAdWe_123**

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.

• Wiper Level and Light Status:

a) The wiper level is at maximum state. The low beam light is enabled. All of this needs to be valid for a duration greater than 20 seconds.

b) The wiper level is at maximum state and the vehicle velocity is less than 60 km/h (speed according to filtered CAN bus signal). The low beam light is enabled. All of this needs to be valid for a duration greater than 20 seconds.

- Rain Measurement Device, Wiper Level and Light Status:

c) The quantity of rainfall is at minimum 90 % of the maximum output of the measurement device and the wiper level is at maximum state. The low beam light is enabled. All of this needs to be valid for a duration greater than 20 seconds.

d) The quantity of rainfall is at minimum 90 % of the maximum output of the measurement device and the wiper level is at maximum state. The low beam light is enabled and the vehicle velocity is less than 60 km/h (speed according to filtered CAN bus signal). All of this needs to be valid for a duration greater than 20 seconds.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_128**

If the conditions b) or d) are evaluated, 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.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_129**

Due to the algorithm, the *Minimum Detection Interval* between two detected events shall be 20 s.

Details:

Detailed by:

Tested by:

2.1.2.3.3 Information Quality

Requirement   **RS_tcAdWe_130**

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) is fulfilled	2
Condition c) is fulfilled	3
Condition d) is fulfilled	4

Table 6: Information quality of "Adverse Weather Condition - Precipitation"

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_131**

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_tcAdWe_132**

A termination of the use case shall not be considered.

Details:

Detailed by:

Tested by:

2.1.2.4.1 Cancellation

Requirement   **RS_tcAdWe_133**

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

Details:

Detailed by:

Tested by:

2.1.2.4.2 Negation

Requirement   **RS_tcAdWe_134**

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

Details:

Detailed by:

Tested by:

2.1.2.5 Update

Requirement   **RS_tcAdWe_135**

The following rules shall be applied for the update procedure:
If case 1 occurs the generation of an update DENM shall be triggered. If case 2 or case 3 occurs no update DENM shall be triggered, instead the generation of a new DENM shall be triggered.

Case 1: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.2.3.2. The *validityDuration* of the former DENM is not expired. Neither the value of the data element *DeltaLatitude* nor the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
An update DENM shall be generated. The information of the former DENM data elements (*eventPosition, eventDeltaTime, informationQuality*) have to be stored in the *eventHistory* by an additional *eventPoint*.
The event points shall be ordered in ascending order with respect to their lifetime with the most recent *eventPoint* at the first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* (see chapter 2.1.2.8.1) shall be deleted from the *eventHistory* for

the update DENM. If the distance covered by the eventHistory exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the *eventHistory*. The information of the current detected event have to be assigned to the DENM data fields of the updated DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.2.8.1).
NOTE: If lifetimes of event points exceed the *validityDuration* after the update DENM has been generated, it is up to the receiver to handle these event points.

Case 2: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.2.3.2. The *validityDuration* of the former DENM is not expired. Either the value of the data element *DeltaLatitude* or the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
No update DENM shall be generated, but an additional new DENM shall be generated. The information of the current detected event have to be assigned to the DENM data fields of the additional new DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.2.8.1). The former DENM shall be continued to be transmitted as long as the *repetitionDuration* (see chapter 2.1.2.6) of the former DENM does not expire.

Case 3: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.2.3.2. The *validityDuration* of the former DENM is expired:
No update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.
NOTE: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* (see chapter 2.1.2.6) of the former DENM is expired.

NOTE: If the use case specific conditions are not fulfilled after the *Minimum Detection Interval* (specified in chapter 2.1.2.3.2), the generation of an update DENM is not necessary. If a former DENM is still active, the transmission has to be continued as long as the *repetitionDuration* of the former DENM is not expired.

Details:

Detailed by:

Tested by:

2.1.2.6 Repetition Duration and Repetition Interval

Requirement   **RS_tcAdWe_140**

New and update DENMs shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 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 300 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 ITS originator shall be handled by the receiving ITS station.

Details:

Detailed by:

Tested by:

2.1.2.7 Traffic class

Requirement   **RS_tcAdWe_141**

New 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_tcAdWe_193**

Table 7 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. Timestamp is according to the beginning of the detection of the current event point. Shall be set according to [AD-3]. Shall be refreshed for an update DENM and set to the detection time of the current event point.
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, because neither negation nor cancellation shall be used in this use case.
eventPosition	*ReferencePosition*. Shall be set according to [AD-3]. Shall be refreshed for an update DENM and set to the position of the current event point.
relevanceDistance	• New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the *eventHistory* becomes longer. To address all relevant ITS stations, the *relevanceDistance* is longer in this case.)
relevanceTrafficDirection	allTrafficDirections(0)
validityDuration	300 seconds
stationType	The type of the originating ITS-S. Shall be set according to [AD-3].
Situation Container	
informationQuality	See Chapter 2.1.2.3.3. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.
causeCode	adverseWeatherCondition-Precipitation(19)
subCauseCode	unavailable(0), heavyRain(1) or heavySnowfall(2)
eventHistory	This element shall only be used for update DENMs (see section 2.1.2.5.).
Location Container	
traces	*PathHistory* of the originating ITS-S with reference to the current event point. Shall be set according to [AD-3]. Shall 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 and set to the roadType of the current event point.
	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.

Table 7: DENM data elements of "Adverse Weather Condition - Precipitation"

Details:

Detailed by:

Tested by:

2.1.2.8.2 CAM

Requirement   **RS_tcAdWe_143**

CAM adaption shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.2.9 Networking and Transport Layer

Requirement   **RS_tcAdWe_144**

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_tcAdWe_145**

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_tcAdWe_146**

If the triggering conditions as described in chapter 2.1.2.3 apply, a pseudonym (ID) change shall be blocked for new and update DENMs for 15 minutes. Corresponding new and update DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_147**

If a pseudonym change appears and there is an active DENM transmission (new or update DENM), the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* have to be deleted. Afterwards, the regular DENM generation process shall continue. Therefore, a new DENM shall be generated if the triggering conditions (see chapter 2.1.2.3) are satisfied. After the new DENM, update DENMs shall be used in the regular way (see chapter 2.1.2.5).

Details:

Detailed by:

Tested by:

2.1.2.11   Scenarios

Other (informational)   **RS_tcAdWe_194**

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: Adverse Weather Condition - Precepitation Scenarios

2.1.2.12   Open Issues

Other (informational)   **RS_tcAdWe_195**

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

a)   The following issue shall be incorporated into the profile document: "Keep-Alive-Forwarding shall not be used.".

2.1.2.13   Feature Requests

Other (informational)   **RS_tcAdWe_196**

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

The following list encompasses feature requests for upcoming document releases:

a)   None.

2.1.3 Adverse Weather Condition - Traction Loss

2.1.3.1 Description of Use Case

Other (informational)   **RS_tcAdWe_197**

This section describes the triggering of V2V messages for the *Adverse Weather Condition - Traction Loss* use case. A DENM shall be triggered, if a traction loss caused by slipperiness is detected at a particular extent.

Requirement   **RS_tcAdWe_148**

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 generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Details:

Detailed by:

Tested by:

2.1.3.2 Relations to other Use Cases

Other (informational)   **RS_tcAdWe_198**

The following use cases are related to the *Adverse Weather Condition - Traction Loss* use case, because they share similar triggering conditions:

- None

2.1.3.3 Triggering Conditions

2.1.3.3.1 Preconditions

Requirement   **RS_tcAdWe_149**

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

1. Reverse gear is not enabled.
2. No errors concerning engine, drive train and braking system are reported.

Details:

Detailed by:

Tested by:

2.1.3.3.2 Use Case Specific Conditions

Requirement   **RS_tcAdWe_150**

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.

- Positive acceleration:

a) ASR, acceleration pedal, vehicle acceleration and vehicle velocity:

An ASR-request must be active for at least 200 ms (according to other safety functions depending on ASR). The acceleration pedal is pressed in average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered CAN bus signal) is less than 40 % of the vehicle acceleration on µ-High (dry asphalt 0.85) at the same start speed and driving

manoeuvre (No detailed values have been put here to incorporate different drive concepts, e.g. two-wheel drive vs. four-wheel drive).

b) ASR, acceleration pedal, vehicle acceleration and vehicle velocity:

An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed in average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered CAN bus signal) is less than 20 % of the vehicle acceleration on µ-High (dry asphalt 0.85) at the same start speed and driving manoeuvre.

c) ASR, acceleration pedal, vehicle acceleration and vehicle velocity:

An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed in average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered CAN bus signal) is less than 10 % of the vehicle acceleration on µ-High (dry asphalt 0.85) at the same start speed and driving manoeuvre.

d) ASR and acceleration pedal :

An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed in average less than 30 % (ensure not to cause an ASR intervention on ground with high friction value) while ASR intervention is active.

- Negative acceleration (deceleration):

e) ABS, braking pressure and deceleration:

ABS intervention is active for more than 200 ms (according to other safety functions depending on ABS). Braking pressure is more than 20 % of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered CAN bus signal) is less than 50 % of the vehicle deceleration on µ-high (dry asphalt 0.85) at the same start speed and driving manoeuvre.

f) ABS, braking pressure and deceleration:

ABS intervention is active for more than 200 ms. Braking pressure is more than 20 % of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered CAN bus signal) is less than 25 % of the vehicle deceleration on µ-high (dry asphalt 0.85) at the same start speed and driving manoeuvre.

g) ABS, Braking pressure and Deceleration:

ABS intervention is active for more than 200 ms. Braking pressure is more than 20 % (ensure not to cause an ABS intervention on ground with high friction value) of maximum capable braking pressure. The deceleration of the vehicle (deceleration according to filtered CAN bus signal) is less than 10 % of the vehicle deceleration on µ-high (dry asphalt 0.85) at the same start speed and driving manoeuvre.

h) ABS and braking pressure:

ABS intervention is active for more than 200 ms. Braking pressure is less than 20 % of maximum capable braking pressure.

- Friction coefficient estimation:

i) The friction coefficient is less than 0.3 for at least 5 seconds (the friction coefficient of ice is < 0.2, the friction coefficient for snow and loose chipping is app. 0.4. The friction coefficient needs to be detected for a certain time period).

j) The friction coefficient is less than 0.2 for at least 5 seconds.

Details:

Detailed by:

Tested by:

Requirement **RS_tcAdWe_161**

If the conditions a) to c) or e) to g) are evaluated, the vehicle acceleration/deceleration shall be determined by the CAN bus signal, not by GNSS analysis.

Details:

Detailed by:

Tested by:

Requirement **RS_tcAdWe_162**

A new or update DENM shall not be generated within the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a respective DENM has been triggered. This way, a single event is not able to trigger a series of DENMs. For friction coefficient estimation (condition i) and j)) the *Detection Blocking Time* shall be 15 seconds. For the other conditions the *Detection Blocking Time* shall be 20 s.

Details:

Detailed by:

Tested by:

Requirement **RS_tcAdWe_163**

In order to ensure consistent functional behaviour for the different triggering conditions a)-d) and the *Detection Blocking Time*, the *Minimum Detection Interval* between two detected events shall be 20 s.

Details:

Detailed by:

Tested by:

2.1.3.3.3 Information Quality

Requirement **RS_tcAdWe_164**

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) or e) is fulfilled	1
Condition b) fulfilled	2
Condition c) or f) is fulfilled	3
Condition g) fulfilled	4
Condition d) or h) fulfilled	5
Condition i) is fulfilled	6
Condition j) is fulfilled	7

Table 9: Information quality of "Adverse Weather Condition - Traction Loss"

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_165**

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_tcAdWe_166**

A termination of the use case shall not be considered.

Details:

Detailed by:

Tested by:

2.1.3.4.1 Cancellation

Requirement   **RS_tcAdWe_167**

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

Details:

Detailed by:

Tested by:

2.1.3.4.2 Negation

Requirement   **RS_tcAdWe_168**

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

Details:

Detailed by:

Tested by:

2.1.3.5 Update

Requirement   **RS_tcAdWe_169**

The following rules shall be applied for the update procedure:
If case 1 occurs, the generation of an update DENM shall be triggered. If case 2 or case 3 occurs no update DENM shall be triggered, instead the generation of a new DENM shall be triggered.

Case 1: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.3.3.2. The *validityDuration* of the former DENM is not expired. Neither the value of the data element *DeltaLatitude* nor the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
An update DENM shall be generated. The information of the former DENM data elements (*eventPosition, eventDeltaTime, informationQuality*) have to be stored in the *eventHistory* by an additional *eventPoint*.
The event points shall be ordered in ascending order with respect to their lifetime with the most recent *eventPoint* at the first position. Event points in the *eventHistory* with lifetimes that exceed the *validityDuration* (see chapter 2.1.3.8.1) shall be deleted from the *eventHistory* for

the update DENM. If the distance covered by the *eventHistory* exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the *eventHistory*. The information of the current detected event have to be assigned to the DENM data fields of the updated DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.3.8.1).
NOTE: If lifetimes of event points exceed the *validityDuration* after the update DENM has been generated, it is up to the receiver to handle these event points.

Case 2: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.3.3.2. The *validityDuration* of the former DENM is not expired. Either the value of the data element *DeltaLatitude* or the value of the data element *DeltaLongitude*, representing the distance between the current detected event and the former detected event, exceeds the threshold that can be covered by the data elements *DeltaLatitude* and *DeltaLongitude* (in current specification of [AD-3]: 13107 microdegrees):
No update DENM shall be generated, but an additional new DENM shall be generated. The information of the current detected event have to be assigned to the DENM data fields of the additional new DENM (e.g. *detectionTime* or *informationQuality*, see chapter 2.1.3.8.1). The former DENM shall be continued to be transmitted as long as the *repetitionDuration* (see chapter 2.1.3.6) of the former DENM does not expire.

Case 3: At least one of the use case specific conditions is fulfilled after the *Minimum Detection Interval*, specified in chapter 2.1.3.3.2. The *validityDuration* of the former DENM is expired:
No update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.
NOTE: In this case, the transmission of the former DENM has already been terminated, because the *repetitionDuration* (see chapter 2.1.3.6) of the former DENM is expired.

NOTE: If the use case specific conditions are not fulfilled after the *Minimum Detection Interval* (specified in chapter 2.1.3.3.2), the generation of an update DENM is not necessary. If a former DENM is still active, the transmission has to be continued as long as the *repetitionDuration* of the former DENM is not expired."

Details:

Detailed by:

Tested by:

2.1.3.6 Repetition Duration and Repetition Interval

Requirement   **RS_tcAdWe_174**

By default, new and update DENMs shall be repeated for a *repetitionDuration* of 300 s with a *repetitionInterval* of 1 s.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_175**

If the DENM is triggered in an urban area, which shall be determined by a digital map or an onboard sensor algorithm, the DENM shall be repeated for a *repetitionDuration* of 180 s with a *repetitionInterval* of 4 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 600 s or 300 s, respectively. 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 ITS originator shall be handled by the receiving ITS station.

Details:

Detailed by:

Tested by:

2.1.3.7 Traffic class

Requirement   **RS_tcAdWe_176**

New 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_tcAdWe_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 [AD-3].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Timestamp is according to the beginning of the detection of the current event point. Shall be set according to [AD-3]. Shall be refreshed for an update DENM and set to the detection time of the current event point.
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, because neither negation nor cancellation shall be used in this use case.
eventPosition	*ReferencePosition*. Shall be set according to [AD-3]. Shall be refreshed for an update DENM and set to the position of the current event point.
relevanceDistance	• New DENM: lessThan1000m(4) • Update DENM: lessThan5km(5) (By using updates, the distance covered by the *eventHistory* becomes longer. To address all relevant ITS stations, the *relevanceDistance* is longer in this case.)
relevanceTrafficDirection	allTrafficDirections(0)

validityDuration	Default: 600 s In urban area, determined by digital map or onboard sensor algorithm: 300 s (If the vehicle has no information about the urban/non-urban status, the default value shall be used.)
stationType	The type of the originating ITS-S. Shall be set according to [AD-3].
Situation Container	
informationQuality	See Chapter 2.1.3.3.3. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.
causeCode	adverseWeatherCondition-Adhesion(6)
subCauseCode	unavailable(0)
eventHistory	This element shall only be used for update DENMs (see section 2.1.3.5.).
Location Container	
traces	*PathHistory* of the originating ITS-S with reference to the current event point. Shall be set according to [AD-3]. Shall 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 and set to the *roadType* of the current event point. Shall be set according to [AD-3] in combination with the following rules: Table below Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.

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)

Table 10: DENM data elements of "Adverse Weather Condition - Traction Loss"

Details:

Detailed by:

Tested by:

2.1.3.8.2 CAM

Requirement   **RS_tcAdWe_178**

CAM adaption shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.3.9 Networking and Transport Layer

Requirement   **RS_tcAdWe_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*.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_180**

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_tcAdWe_181**

If the triggering conditions as described in chapter 2.1.3.3 apply, a pseudonym (ID) change shall be blocked for new and update DENMs for 15 minutes. Corresponding new and update DENMs shall be sent with the same pseudonym.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcAdWe_182**

If a pseudonym change appears and there is an active DENM transmission (new or update DENM), the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* have to be deleted. Afterwards, the regular DENM generation process shall continue. Therefore, a new DENM shall be generated if the triggering conditions (see chapter 2.1.3.3) are satisfied. After the new DENM, update DENMs shall be used in the regular way (see chapter 2.1.3.5).

Details:

Detailed by:

Tested by:

2.1.3.11   Scenarios

Other (informational)   **RS_tcAdWe_206**

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: Adverse Weather Condition - Traction Loss Scenarios

2.1.3.12   Open Issues

Other (informational)   **RS_tcAdWe_207**

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

a)   The following issue shall be incorporated into the profile document: "Keep-Alive-Forwarding shall not be used.".

2.1.3.13   Feature Requests

Other (informational)   **RS_tcAdWe_208**

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

The following list encompasses feature requests for upcoming document releases:

a)   None.

3   Appendix

3.1   List of abbreviations

Other (informational)   **RS_tcAdWe_209**

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
TC	Triggering Conditions
TTC	Time To Collision
V2V	Vehicle to Vehicle

Table 12: Abbreviations

3.2   Applicable documents

Other (informational)   **RS_tcAdWe_210**

[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 V1.0.0 (2012-10)
[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 13: Applicable documents

3.3 Related documents

Other (informational)   **RS_tcAdWe_211**

[RD-1]

Table 14: Related documents