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 73 members, with 12 vehicle manufacturers, 33 equipment suppliers and 28 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 well as other road users. 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.

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<th>Date:</th>
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<td>Title:</td>
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<td>Document Type:</td>
<td>RS</td>
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<td></td>
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<td>Release</td>
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Table 1: Document information
### Changes since last version

<table>
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<th>Edited by</th>
<th>Approved</th>
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<tr>
<td>13/09/2019</td>
<td>Minor corrections</td>
<td>Release Management</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>31/08/2018</td>
<td>Minor corrections</td>
<td>Release Management</td>
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Table 2: Changes since last version
Table of contents

About the C2C-CC ........................................................................................................................................1
Disclaimer ..................................................................................................................................................1
Document information .................................................................................................................................2
Changes since last version...........................................................................................................................4
Table of contents ......................................................................................................................................5
List of tables .............................................................................................................................................5

1 Introduction .............................................................................................................................................6
  1.1 Abstract .............................................................................................................................................6

2 Definitions and abbreviations.................................................................................................................7
  2.1 Abbreviations .....................................................................................................................................7
  2.2 Definitions .........................................................................................................................................7

3 Triggering conditions ...............................................................................................................................8
  3.1 Adverse weather condition ..............................................................................................................8
      3.1.1 Adverse weather condition — fog ............................................................................................8
      3.1.2 Adverse weather condition — precipitation .........................................................................14
      3.1.3 Adverse weather condition — traction loss ............................................................................20

List of tables

Table 1: Document information....................................................................................................................2
Table 2: Changes since last version ..............................................................................................................4
Table 3: Abbreviations ..................................................................................................................................7
Table 4: Information quality of ‘adverse weather condition — fog’ ..............................................................9
Table 5: DENM data elements of ‘adverse weather condition — fog’ .........................................................11
Table 6: ‘Adverse weather condition’ — fog scenarios ..............................................................................14
Table 7: Information quality of ‘adverse weather condition — precipitation’ ...........................................15
Table 8: DENM data elements of ‘adverse weather condition — precipitation’ .......................................18
Table 9: ‘Adverse weather condition’ — precipitation scenarios ...............................................................20
Table 10: Information quality of ‘adverse weather condition — traction loss’ ...........................................23
Table 11: DENM data elements of ‘adverse weather condition — traction loss’ ......................................25
Table 12: ‘Adverse weather condition’ — traction loss scenarios ............................................................28
1 Introduction

1.1 Abstract

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 Definitions and abbreviations

2.1 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Anti-lock Braking System</td>
</tr>
<tr>
<td>ASN.1</td>
<td>Abstract Syntax Notation One</td>
</tr>
<tr>
<td>ASR</td>
<td>Anti-Slip Regulation</td>
</tr>
<tr>
<td>AT</td>
<td>Authorization Ticket</td>
</tr>
<tr>
<td>AUT</td>
<td>Automatic Transmission</td>
</tr>
<tr>
<td>CAM</td>
<td>Cooperative Awareness Message</td>
</tr>
<tr>
<td>C2C-CC</td>
<td>Car to Car Communication Consortium</td>
</tr>
<tr>
<td>CDD</td>
<td>Common Data Dictionary</td>
</tr>
<tr>
<td>DEN</td>
<td>Decentralized Environmental Notification</td>
</tr>
<tr>
<td>DENM</td>
<td>DEN Message</td>
</tr>
<tr>
<td>ECE</td>
<td>Economic Commission for Europe</td>
</tr>
<tr>
<td>ETSI</td>
<td>European Telecommunications Standards Institute</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
</tr>
<tr>
<td>ITS-S</td>
<td>ITS Station</td>
</tr>
<tr>
<td>KAF</td>
<td>Keep-Alive Forwarding</td>
</tr>
<tr>
<td>TC</td>
<td>Triggering Conditions</td>
</tr>
<tr>
<td>TTC</td>
<td>Time To Collision</td>
</tr>
<tr>
<td>V2V</td>
<td>Vehicle to Vehicle</td>
</tr>
</tbody>
</table>

Table 3: Abbreviations

2.2 Definitions

Definition: RS_tcAdWe_642

‘Vehicle speed’ is the length of the velocity-vector of the reference position point.
3 Triggering conditions

3.1 Adverse weather condition

3.1.1 Adverse weather condition - fog

3.1.1.1 Description of use case

Other (informational)  RS_tacAdWe_185
This section describes the triggering of V2V messages for the Adverse Weather Condition - Fog C-ITS service. A DENM shall be triggered, if fog interferes the driver at a particular extent.

Other (informational)  RS_tacAdWe_186
The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘adverse weather conditions — precipitation’.

Requirement  RS_tacAdWe_93
A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.

Tested by:

3.1.1.2 Triggering conditions

3.1.1.2.1 Preconditions

Requirement  RS_tacAdWe_94
The following preconditions shall be satisfied when this use case is triggered:

1. the vehicle speed is greater than 7 km/h;
2. the vehicle speed is less than 80 km/h. (Vehicle speed greater 80 km/h is not reasonable for reduced visibility. Speed according to filtered vehicle bus signal).

Tested by:

3.1.1.2.2 Service-specific conditions

Requirement  RS_tacAdWe_95
If the preconditions in RS_tacAdWe_94 and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered:

- driver reaction and light status:
  a) the driver enables the rear fog-light and the low-beam light is enabled. All these conditions must be valid for more than 20 s (to minimise 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. All these conditions must be valid for a duration greater
than 20 s;

- visibility range measurement device:
  
c) the visibility due to fog is less than 80 m +/- 40 m tolerance for more than 5 s (the obscured view has to be detected for a reasonable period. The period is shorter than for conditions a) and b) due to more reliable information);

d) the visibility due to fog is less than 80 m +/- 40 m tolerance and the vehicle velocity is less than 60 km/h (if the vehicle is in a non-urban area, this speed could be an indication of reduced visibility) for more than 5 s.

Requirement RS_tcAdWe_101
A new or update DENM shall not be generated in the Detection Blocking Time. The Detection Blocking Time is launched after the event is detected and a DENM to that effect has been triggered. In this way, a single event cannot trigger a series of DENMs. For the visibility range measurement device (conditions c and d), the Detection Blocking Time shall be 15 s. For the other conditions there shall be no Detection Blocking Time.

Requirement RS_tcAdWe_102
In order to ensure consistent functional behaviour for the different triggering conditions and the Detection Blocking Time, the Minimum Detection Interval between two detected events shall be 20 s.

3.1.1.2.3 Information quality

Requirement RS_tcAdWe_103
The value of the data element informationQuality in the DENM depends on how the event is detected. The informationQuality value shall be set in accordance with the following table (highest possible value shall be used):

<table>
<thead>
<tr>
<th>Event detection</th>
<th>Value of InformationQuality</th>
</tr>
</thead>
<tbody>
<tr>
<td>No TRCO-compliant implementation</td>
<td>unknown(0)</td>
</tr>
<tr>
<td>Condition a) is fulfilled</td>
<td>1</td>
</tr>
<tr>
<td>Condition b) is fulfilled</td>
<td>2</td>
</tr>
<tr>
<td>Condition c) is fulfilled</td>
<td>3</td>
</tr>
<tr>
<td>Condition d) is fulfilled</td>
<td>4</td>
</tr>
</tbody>
</table>

Requirement RS_tcAdWe_104
If the triggering conditions change between two updates, the `informationQuality` shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the `informationQuality` shall be updated.

Tested by:

### 3.1.1.3 Termination conditions

**Requirement**

RS_tcAdWe_105

A termination of the C-ITS service shall not be considered.

Tested by:

### 3.1.1.3.1 Cancellation

**Requirement**

RS_tcAdWe_106

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

Tested by:

### 3.1.1.3.2 Negation

**Requirement**

RS_tcAdWe_107

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

Tested by:

### 3.1.1.4 Update

**Requirement**

RS_tcAdWe_108

The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

(a) at least one of the conditions is fulfilled after the `Minimum Detection Interval` specified in section 3.1.1.2.2;

(b) the `validityDuration` of the former DENM has not expired;

(c) neither the value of the data element `DeltaLatitude` nor that 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`.

If conditions (a), (b) and (c) as specified are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (`eventPosition`, `eventDeltaTime`, `informationQuality`) shall be stored in the `eventHistory` as an additional `eventPoint`.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent `eventPoint` in first position. Event points in the `eventHistory` with lifetimes that exceed the `validityDuration` shall be deleted from the `eventHistory` for the update DENM. If the distance covered by the `eventHistory` exceeds the threshold allowed by the security, the oldest event points shall be deleted from the `eventHistory`.

The information of the current detected event shall be assigned to the DENM data fields of the
updated DENM.

If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event shall be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the repetitionDuration of the former DENM does not expire.

If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

If condition (a) is not fulfilled, the generation of an update DENM is not necessary.

Note: It is up to the receiver to handle event points with lifetimes that exceed the validityDuration after the update DENM has been generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the repetitionDuration of the former DENM has expired.

Tested by:

### 3.1.1.5 Repetition duration and repetition interval

**Requirement**

DENMs that are new or have been updated, 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 in accordance with the above values.

Note: The validityDuration is set to 300 s. Therefore, one can prevent a gap of DENMs if the repetitionDuration of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same causeCode originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

### 3.1.1.6 Traffic class

**Requirement**

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

Tested by:

### 3.1.1.7 Message parameters

#### 3.1.1.7.1 DENM

**Requirement**

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

<table>
<thead>
<tr>
<th>Data field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management container</td>
<td></td>
</tr>
</tbody>
</table>

C2CCC_RS_2002_AdverseWeather.docx 13/09/2019
<table>
<thead>
<tr>
<th><strong>actionID</strong></th>
<th>Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>detectionTime</strong></td>
<td>TimestampIts-timestamp at which the event is detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event.</td>
</tr>
<tr>
<td><strong>referenceTime</strong></td>
<td>TimestampIts-timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
<tr>
<td><strong>termination</strong></td>
<td>Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.</td>
</tr>
<tr>
<td><strong>eventPosition</strong></td>
<td>ReferencePosition. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM.</td>
</tr>
<tr>
<td><strong>relevanceDistance</strong></td>
<td>• 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.)</td>
</tr>
<tr>
<td><strong>relevanceTrafficDirection</strong></td>
<td>allTrafficDirections(0)</td>
</tr>
<tr>
<td><strong>validityDuration</strong></td>
<td>300 s</td>
</tr>
<tr>
<td><strong>stationType</strong></td>
<td>The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
</tbody>
</table>

**Situation container**

| **informationQuality** | See RS_tcAdWe_103. 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 be used for update DENMs only (see section 3.1.1.4). |

**Location container**

| **traces** | PathHistory of the originating C-ITS station with reference to the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. |
| **roadType** | RoadType of the road on which the detecting C-ITS station is situated. Shall be refreshed for an update DENM. Shall be set in accordance with [TS 102 894-2] in combination with the following rules: |
If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.

### 3.1.1.7.2 CAM

**Requirement**

CAM adaption shall not be used for this C-ITS service.

**Tested by:**

### 3.1.1.8 Network and transport layer

**Requirement**

The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

**Tested by:**

### 3.1.1.9 Security layer

**Requirement**

If the triggering conditions as described in section 3.1.1.2 apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was generated). Corresponding new and update DENMs shall be sent with the same AT.

**Tested by:**
Requirement RS_tcAdWe_120
If the AT changes and there is an active DENM transmission (new or update DENM), the transmission shall be stopped. In addition, the EventHistory and the PathHistory shall be deleted. The regular DENM generation process shall then continue.
Tested by:

### 3.1.1.10 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 C-ITS service:

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<tr>
<th>Count</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tbd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tbd</td>
<td></td>
</tr>
</tbody>
</table>

### 3.1.2 Adverse weather condition - precipitation

#### 3.1.2.1 Description of C-ITS service

Other (informational) RS_tcAdWe_191
This section describes the triggering of V2V messages for the Adverse Weather Condition - Precipitation C-ITS service. A DENM shall be triggered, if precipitation interferes the driver at a particular extent.

Other (informational) RS_tcAdWe_192
The following C-ITS services are related to this service, because they share similar triggering conditions:
- ‘adverse weather conditions — fog’.

Requirement RS_tcAdWe_121
A DENM signal shall be sent to the stack only if the triggering conditions described in this section are evaluated as valid. Such a signal prompts the stack to generate a new or an update DENM. If the triggering conditions are not fulfilled, a DENM signal shall not be generated.
Tested by:

#### 3.1.2.2 Triggering conditions

##### 3.1.2.2.1 Preconditions

Requirement RS_tcAdWe_122
The following preconditions shall be satisfied when this use case is triggered:
- the vehicle velocity is greater than 7 km/h (speed according to filtered vehicle bus
signal);  
- the vehicle velocity is less than 80 km/h (speed according to filtered vehicle bus signal);  
- the windshield washer function is not active.

Tested by:

3.1.2.2 Service-specific conditions

Requirement RS_tcAdWe_123

If the preconditions in RS_tcAdWe_122 and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered.

- wiper level and light status:
  a) the wiper operates at its maximum speed level. The low-beam light is enabled. All these conditions must be valid for more than 20 s;
  b) the wiper operates at its maximum speed level and the vehicle velocity is less than 60 km/h (speed according to filtered vehicle bus signal). The low-beam light is enabled. All these conditions must be valid for more than 20 s;

- rain measurement device, wiper level and light status:
  c) the quantity of rainfall is at least 90 % of the maximum output of the measurement device and the wiper operates at its maximum speed level. The low-beam light is enabled. All of this needs to be valid for more than 20 s;
  d) the quantity of rainfall is at least 90 % of the maximum output of the measurement device and the wiper operates at its maximum speed level. The low-beam light is enabled and the vehicle velocity is less than 60 km/h (speed according to filtered vehicle bus signal). All these conditions must be valid for more than 20 s.

Tested by:

Requirement RS_tcAdWe_129

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

Tested by:

3.1.2.3 Information quality

Requirement RS_tcAdWe_130

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

<table>
<thead>
<tr>
<th>Event detection</th>
<th>Value of InformationQuality</th>
</tr>
</thead>
</table>

Table 7: Information quality of ‘adverse weather condition — precipitation’
<table>
<thead>
<tr>
<th>No TRCO-compliant implementation</th>
<th>unknown(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition a) is fulfilled</td>
<td>1</td>
</tr>
<tr>
<td>Condition b) is fulfilled</td>
<td>2</td>
</tr>
<tr>
<td>Condition c) is fulfilled</td>
<td>3</td>
</tr>
<tr>
<td>Condition d) is fulfilled</td>
<td>4</td>
</tr>
</tbody>
</table>

Tested by:

**Requirement**  
RS_tcAdWe_131

If the triggering conditions change between two updates, the *informationQuality* shall not be changed until the next update. If the changed conditions are still fulfilled while the DENM is updated, the *informationQuality* shall be updated.

Tested by:

### 3.1.2.3 Termination conditions

**Requirement**  
RS_tcAdWe_132

A termination of the C-ITS service shall not be considered.

Tested by:

### 3.1.2.3.1 Cancellation

**Requirement**  
RS_tcAdWe_133

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

Tested by:

### 3.1.2.3.2 Negation

**Requirement**  
RS_tcAdWe_134

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

Tested by:

### 3.1.2.4 Update

**Requirement**  
RS_tcAdWe_135

The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

(a) at least one of the conditions is fulfilled after the *Minimum Detection Interval* specified in section 3.1.2.2.2;

(b) the *validityDuration* of the former DENM has not expired;
(c) neither the value of the data element \textit{DeltaLatitude} nor that of the data element \textit{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 \textit{DeltaLatitude} and \textit{DeltaLongitude}.

If conditions (a), (b) and (c) as specified are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (\textit{eventPosition}, \textit{eventDeltaTime}, \textit{informationQuality}) must be stored in the \textit{eventHistory} as an additional \textit{eventPoint}.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent \textit{eventPoint} in first position. Event points in the \textit{eventHistory} with lifetimes that exceed the \textit{validityDuration} shall be deleted from the \textit{eventHistory} for the update DENM. If the distance covered by the \textit{eventHistory} exceeds the threshold that is allowed by the security, the oldest event points shall be deleted from the \textit{eventHistory}.

The information of the current detected event must be assigned to the DENM data fields of the updated DENM.

If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event must be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the \textit{repetitionDuration} of the former DENM does not expire.

If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

If condition (a) is not fulfilled, the generation of an update DENM is not necessary.

Note: It is up to the receiver to handle event points with lifetimes that exceed the \textit{validityDuration} after the update DENM has been generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the \textit{repetitionDuration} of the former DENM has expired.

Tested by:

\textbf{3.1.2.5 Repetition duration and repetition interval}

\textbf{Requirement} \hspace{1cm} RS\_tcAdWe\_140

DENMs that are new or have been updated, shall be repeated for a \textit{repetitionDuration} of 180 s with a \textit{repetitionInterval} of 4 s. Therefore the interface parameters \textit{Repetition duration} and \textit{Repetition interval} between the application and the DEN basic service shall be set according to the above values.

Note: The \textit{validityDuration} is set to 300 s. Therefore, one can prevent a gap of DENMs if the \textit{repetitionDuration} of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same \textit{causeCode} originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

\textbf{3.1.2.6 Traffic class}

\textbf{Requirement} \hspace{1cm} RS\_tcAdWe\_141
New and update DENMs shall be set to traffic class 1.

Tested by:

### 3.1.2.7 Message parameters

#### 3.1.2.7.1 DENM

| Requirement | RS_tcAdWe_193 |

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

Table 8: DENM data elements of ‘adverse weather condition — precipitation’

<table>
<thead>
<tr>
<th>Data field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management container</strong></td>
<td></td>
</tr>
<tr>
<td>actionID</td>
<td>Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
<tr>
<td>detectionTime</td>
<td>Timestamp of the event detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event point.</td>
</tr>
<tr>
<td>referenceTime</td>
<td>Timestamp of a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
<tr>
<td>termination</td>
<td>Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.</td>
</tr>
<tr>
<td>eventPosition</td>
<td>ReferencePosition. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the position of the current event point.</td>
</tr>
<tr>
<td>relevanceDistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New DENM: lessThan1000m(4)</td>
</tr>
<tr>
<td></td>
<td>• 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.)</td>
</tr>
<tr>
<td>relevanceTrafficDirection</td>
<td>allTrafficDirections(0)</td>
</tr>
<tr>
<td>validityDuration</td>
<td>300 s</td>
</tr>
<tr>
<td>stationType</td>
<td>The type of the originating C-ITS station. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
<tr>
<td><strong>Situation container</strong></td>
<td></td>
</tr>
<tr>
<td>informationQuality</td>
<td>See RS_tcAdWe_130. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.</td>
</tr>
<tr>
<td>causeCode</td>
<td>adverseWeatherCondition-Precipitation(19)</td>
</tr>
<tr>
<td>subCauseCode</td>
<td>unavailable(0), heavyRain(1) or heavySnowfall(2)</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>eventHistory</td>
<td>This element shall be used for update DENMs only (see section 3.1.2.4).</td>
</tr>
</tbody>
</table>

**Location container**

**traces**

PathHistory of the originating C-ITS station with reference to the current event point.

Shall be set in accordance with [TS 102 894-2].

Shall be refreshed for an update DENM.

**roadType**

RoadType of the road on which the detecting C-ITS station is situated.

Shall be refreshed for an update DENM and set to the roadType of the current event point.

Shall be set in accordance with [TS 102 894-2] in combination with the following rules:

<table>
<thead>
<tr>
<th>Urban / Non-Urban</th>
<th>Structural separation</th>
<th>Data element</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.

**3.1.2.7.2 CAM**

**Requirement**

CAM adaption shall not be used for this C-ITS service.

Tested by:
3.1.2.8 Network and transport layer

Requirement

The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

Tested by:

3.1.2.9 Security layer

Requirement

If the triggering conditions as described in section 3.1.2.2 apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was generated). Corresponding new and update DENMs shall be sent with the same AT.

Tested by:

Requirement

If the AT changes and there is active transmission of a new or update DENM, the transmission shall be stopped. In addition, the *EventHistory* and the *PathHistory* shall be deleted. Afterwards, the regular DENM generation process shall continue.

Tested by:

3.1.2.10 Scenarios

Other (informational)

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:

<table>
<thead>
<tr>
<th>Count</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>tbd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tbd</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.3 Adverse weather condition - traction loss

3.1.3.1 Description of C-ITS service

Other (informational)

This section describes the triggering of V2V messages for the *Adverse Weather Condition - Traction Loss* C-ITS service. A DENM shall be triggered, if a traction loss caused by slipperiness is detected at a particular extent.
Other (informational)

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

- none

Requirement

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

Tested by:

### 3.1.3.2 Triggering conditions

#### 3.1.3.2.1 Preconditions

**Requirement**

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

- reverse gear is not enabled;
- no errors concerning engine, drive train and braking system are reported.

Tested by:

#### 3.1.3.2.2 Service-specific conditions

**Requirement**

If the precondition in RS_tcAdWe_149 and at least one of the following conditions are satisfied, the triggering conditions for this C-ITS service are fulfilled and the generation of a DENM shall be triggered.

- on the basis of positive acceleration:
  a) on the basis of Anti-Slip Regulation (ASR), acceleration pedal, vehicle acceleration and vehicle velocity. An ASR-request must be active for at least 200 ms (as for other safety functions depending on ASR). The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered vehicle 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 cover different drive configurations, e.g. two-wheel vs. four-wheel drive);
  b) on the basis of ASR, acceleration pedal, vehicle acceleration and vehicle velocity. An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the vehicle (acceleration according to filtered vehicle 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) on the basis of ASR, acceleration pedal, vehicle acceleration and vehicle velocity. An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed on average more than 30 % while ASR intervention is active. The acceleration of the
vehicle (acceleration according to filtered vehicle 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) on the basis of ASR and acceleration pedal. An ASR-request must be active for at least 200 ms. The acceleration pedal is pressed on average less than 30 % (so as not to cause an ASR intervention on ground with high friction value) while ASR intervention is active;

• on the basis of negative acceleration (deceleration):

e) on the basis of Anti-lock Braking System (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 vehicle 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) on the basis of 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 vehicle 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) on the basis of ABS, braking pressure and deceleration. ABS intervention is active for more than 200 ms. Braking pressure is more than 20 % (so as 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 vehicle 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) on the basis of ABS and braking pressure. ABS intervention is active for more than 200 ms. Braking pressure is less than 20 % of maximum capable braking pressure;

• on the basis of friction coefficient estimation:

i) the friction coefficient is less than 0.3 for at least 5 s (the friction coefficient of ice is < 0.2; for snow and loose chippings, it is approx. 0.4. The friction coefficient needs to be detected for a certain period);

j) the friction coefficient is less than 0.2 for at least 5 s.

Note: For PTW the throttle position or any other device providing this functionality in the future shall be taken as equivalent to the accelerator pedal of the cars.

Tested by:

**Requirement RS_tcAdWe_162**

A new or update DENM shall not be generated in the Detection Blocking Time. The Detection Blocking Time is launched after the event is detected and a DENM to that effect 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.

Tested by:
3.1.3.2.3 Information quality

Requirement RS_tcAdWe_164

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

<table>
<thead>
<tr>
<th>Event detection</th>
<th>Value of InformationQuality</th>
</tr>
</thead>
<tbody>
<tr>
<td>No TRCO compliant implementation</td>
<td>unknown(0)</td>
</tr>
<tr>
<td>Condition a) or e) is fulfilled</td>
<td>1</td>
</tr>
<tr>
<td>Condition b) fulfilled</td>
<td>2</td>
</tr>
<tr>
<td>Condition c) or f) is fulfilled</td>
<td>3</td>
</tr>
<tr>
<td>Condition g) fulfilled</td>
<td>4</td>
</tr>
<tr>
<td>Condition d) or h) fulfilled</td>
<td>5</td>
</tr>
<tr>
<td>Condition i) is fulfilled</td>
<td>6</td>
</tr>
<tr>
<td>Condition j) is fulfilled</td>
<td>7</td>
</tr>
</tbody>
</table>

Tested by:

3.1.3.2.3 Termination conditions

Requirement RS_tcAdWe_166

A termination of the C-ITS service shall not be considered.

Tested by:

3.1.3.3.1 Cancellation
Requirement RS_tcAdWe_167
A cancellation DENM shall not be used for this C-ITS service.
Tested by:

3.1.3.3.2 Negation

Requirement RS_tcAdWe_168
A negation DENM shall not be used for this C-ITS service.
Tested by:

3.1.3.4 Update

Requirement RS_tcAdWe_169
The appropriate update procedure of the DENM shall be determined on the basis of the following conditions:

(a) at least one of the conditions is fulfilled after the Minimum Detection Interval specified in section 3.1.3.2.2;
(b) the validityDuration of the former DENM has not expired;
(c) neither the value of the data element DeltaLatitude nor that 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.

If conditions (a), (b) and (c) as specified are fulfilled, an update DENM shall be generated. The information of the former DENM data elements (eventPosition, eventDeltaTime, informationQuality) must be stored in the eventHistory as an additional eventPoint.

The event points shall be ordered in ascending order with respect to their lifetime, with the most recent eventPoint in first position. Event points in the eventHistory with lifetimes that exceed the validityDuration 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 must be assigned to the DENM data fields of the updated DENM.

If conditions (a) and (b) are fulfilled, but condition (c) is not fulfilled, no update DENM shall be generated. Instead, an additional new DENM shall be generated. The information of the current detected event shall be assigned to the DENM data fields of the additional new DENM. The former DENM shall continue to be transmitted as long as the repetitionDuration of the former DENM does not expire.

If condition (a) is fulfilled, but condition (b) is not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

If condition (a) is not fulfilled, the generation of an update DENM is not necessary.
Note: It is up to the receiver to handle event points with lifetimes that exceed the validityDuration after the update DENM has been generated.

Note: In this case, the transmission of the former DENM has already been terminated, because the repetitionDuration of the former DENM has expired.

3.1.3.5 Repetition duration and repetition interval

Requirement RS_tcAdWe_174
By default, DENMs that are new or have been updated shall be repeated for a repetitionDuration of 300 s with a repetitionInterval of 1 s.

Tested by:

Requirement RS_tcAdWe_175
However, if the DENM is triggered in an urban area, which as determined by a digital map or an on-board sensor algorithm, it 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 in accordance with to the above values.

Note: The validityDuration is set to 600 s or 300 s, respectively. Therefore, one can prevent a gap of DENMs if the repetitionDuration of the original DENM has expired and the update has not yet been received.

Note: Where two DENMs with the same causeCode originate from the same C-ITS station, the case shall be managed by the receiving C-ITS station.

Tested by:

3.1.3.6 Traffic class

Requirement RS_tcAdWe_176
New and update DENMs shall be set to traffic class 1.

Tested by:

3.1.3.7 Message parameters

3.1.3.7.1 DENM

Requirement RS_tcAdWe_177
The following table specifies the data elements of the DENM that shall be set.

<table>
<thead>
<tr>
<th>Data field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management container</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: DENM data elements of ‘adverse weather condition — traction loss’
<table>
<thead>
<tr>
<th><strong>actionID</strong></th>
<th>Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>detectionTime</strong></td>
<td>Timestamp at which the event is detected by the originating C-ITS station. The timestamp reflects the beginning of the detection of the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the detection time of the current event point.</td>
</tr>
<tr>
<td><strong>referenceTime</strong></td>
<td>Timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].</td>
</tr>
<tr>
<td><strong>termination</strong></td>
<td>Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.</td>
</tr>
<tr>
<td><strong>eventPosition</strong></td>
<td>ReferencePosition. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM and set to the position of the current event point.</td>
</tr>
</tbody>
</table>
| **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 areas, as determined by digital map or on-board 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 C-ITS station. Shall be set in accordance with [TS 102 894-2]. |

**Situation container**

| **informationQuality** | See RS_tcAdWe_164. 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 be used for update DENMs only (see section 3.1.3.4). |

**Location container**

| **traces** | PathHistory of the originating C-ITS station with reference to the current event point. Shall be set in accordance with [TS 102 894-2]. Shall be refreshed for an update DENM. |
| **roadType** | RoadType of the road the detecting C-ITS station is situated on. |
Shall be refreshed for an update DENM and set to the *roadType* of the current event point.

Shall be set in accordance with [TS 102 894-2] in combination with the following rules:

<table>
<thead>
<tr>
<th>Urban / non-urban</th>
<th>Structural separation</th>
<th>Data element</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.

---

### 3.1.3.7.2 CAM

**Requirement**  
RS_tcAdWe_178  
CAM adaption shall not be used for this C-ITS service.

**Tested by:**

---

### 3.1.3.8 Network and transport layer

**Requirement**  
RS_tcAdWe_179  
The interface parameter *DENM destination area* between the DEN basic service and the networking and transport layer shall be equal to a circular shape with radius equal to *relevanceDistance*.

**Tested by:**

---

### 3.1.3.9 Security layer

**Requirement**  
RS_tcAdWe_181  
If the triggering conditions as described in section 3.1.3.2 apply, an AT change shall be blocked for new and update DENMs for 15 minutes (starting from the moment the new DENM was
generated). Corresponding new and update DENMs shall be sent with the same AT.
Tested by:

Requirement
RS_tcAdWe_182
If the AT changes and there is active transmission of a new or update DENM, the transmission shall be stopped. In addition, the EventHistory and the PathHistory shall be deleted. The regular DENM generation process shall then continue.
Tested by:

3.1.3.10 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:

Table 12: ‘Adverse weather condition’ — traction loss scenarios

<table>
<thead>
<tr>
<th>Count</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tbd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tbd</td>
<td></td>
</tr>
</tbody>
</table>