Triggering Conditions and Data Quality Adverse Weather Conditions

CAR 2 CAR Communication Consortium

About the C2C-CC

Enhancing road safety and traffic efficiency by means of Cooperative Intelligent Transport Systems and Services (C-ITS) is the dedicated goal of the CAR 2 CAR Communication Consortium. The industrial driven, non-commercial association was founded in 2002 by vehicle manufacturers affiliated with the idea of cooperative road traffic based on Vehicle-to-Vehicle Communications (V2V) and supported by Vehicle-to-Infrastructure Communications (V2I). Today, the Consortium comprises 61 members, with 11 vehicle manufacturers, 31 equipment suppliers and 29 research organisations.

Over the years, the CAR 2 CAR Communication Consortium has evolved to be one of the key players in preparing the initial deployment of C-ITS in Europe and the subsequent innovation phases. CAR 2 CAR members focus on wireless V2V communication applications based on ITS-G5 and concentrate all efforts on creating standards to ensure the interoperability of cooperative systems, spanning all vehicle classes across borders and brands. As a key contributor, the CAR 2 CAR Communication Consortium works in close cooperation with the European and international standardisation organisations such as ETSI and CEN.

Disclaimer

Document information

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Table 1: Document information

Changes since last version

Title:	Triggering Conditions and Data Quality Adverse Weather Conditions		
Explanatory notes:			
27/03/2020	Minor corrections	Release Management	Steering Committee
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Table 2: Changes since last version

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1 Introduction

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 Definitions

Definition **RS_tcAdWe_642**

‘*Vehicle speed*’ is the length of the velocity-vector of the reference position point.

3 Requirement specifications

3.1 Adverse weather condition - fog

3.1.1 Description of use case

Other (informational) **RS_tcAdWe_185**

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

Other (informational) **RS_tcAdWe_186**

The following C-ITS services are related to this service, because they share similar triggering conditions:

- ‘adverse weather conditions — precipitation’.

Requirement **RS_tcAdWe_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:

3.1.2 Triggering conditions

3.1.2.1 Preconditions

Requirement **RS_tcAdWe_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).

Tested by:

3.1.2.2 Service-specific conditions

Requirement **RS_tcAdWe_95**

If the preconditions in RS_tcAdWe_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.

Tested by:

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*.

Tested by:

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.

Tested by:

3.1.2.3 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 3: Information quality of 'adverse weather condition — fog'

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition a) is fulfilled	1
Condition b) is fulfilled	2
Condition c) is fulfilled	3
Condition d) is fulfilled	4

Tested by:

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:

3.1.3 Termination conditions

Requirement **RS_tcAdWe_105**

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

Tested by:

3.1.3.1 Cancellation

Requirement **RS_tcAdWe_106**

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

Tested by:

3.1.3.2 Negation

Requirement **RS_tcAdWe_107**

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

Tested by:

3.1.4 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 in chapter 3.1.2.2 is fulfilled and a period with a duration greater than or equal to the *minimum detection interval* passed since the last new or update DENM;

(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 condition (a) is fulfilled, but conditions (b) and/or (c) are not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: If condition (b) is fulfilled, the former DENM is continued to be transmitted in parallel as long as the *repetitionDuration* of the former DENM does not expire.

Note: If condition (b) is not fulfilled, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

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:

3.1.5 Repetition duration and repetition interval

Requirement **RS_tcAdWe_113**

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:

3.1.6 Traffic class

Requirement **RS_tcAdWe_114**

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

Tested by:

3.1.7 Message parameters

3.1.7.1 DENM

Requirement **RS_tcAdWe_187**

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

Table 4: DENM data elements of 'adverse weather condition — fog'

Data field	Value

Management container	
actionID	Identifier of a DENM.Shall be set in accordance with [TS 102 894-2].
detectionTime	*TimestampIts*-timestamp at which the event is detected by the originating 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.
referenceTime	*TimestampIts*-timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
termination	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
eventPosition	*ReferencePosition*. Shall be set in accordance with [TS 102 894-2]. 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 s
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_103. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.
causeCode	adverseWeatherCondition-Visibility(18)
subCauseCode	fog(1)
eventHistory	This element shall be used for update DENMs only (see section 3.1.4).
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:

	Urban / non-urban	Structural separation	Data element
	Urban	No	urban-NoStructuralSeparation ToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparation ToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparation ToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparation ToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparation ToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparation ToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		

Tested by:

3.1.7.2 CAM

Requirement **RS_tcAdWe_116**

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

Tested by:

3.1.8 Network and transport layer

Requirement **RS_tcAdWe_117**

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with center point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.1.9 Security layer

Requirement **RS_tcAdWe_119**

When the triggering conditions as described in chapter 3.1.2 apply, the use case shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:

3.2 Adverse weather condition - precipitation

3.2.1 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:

3.2.2 Triggering conditions

3.2.2.1 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;
- the vehicle velocity is less than 80 km/h;
- the windshield washer function is not active.

Tested by:

3.2.2.2 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. 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. 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:

3.2.2.3 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 5: Information quality of 'adverse weather condition — precipitation'

Event detection	Value of InformationQuality
No TRCO-compliant implementation	unknown(0)
Condition a) is fulfilled	1
Condition b) is fulfilled	2
Condition c) is fulfilled	3
Condition d) is fulfilled	4

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:

3.2.3 Termination conditions

Requirement **RS_tcAdWe_132**

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

Tested by:

3.2.3.1 Cancellation

Requirement **RS_tcAdWe_133**

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

Tested by:

3.2.3.2 Negation

Requirement **RS_tcAdWe_134**

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

Tested by:

3.2.4 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 in chapter 3.2.2.2 is fulfilled and a period with a duration greater than or equal to the minimum detection interval passed since the last new or update DENM;

(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 condition (a) is fulfilled, but conditions (b) and/or (c) are not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: If condition (b) is fulfilled, the former DENM is continued to be transmitted in parallel

as long as the *repetitionDuration* of the former DENM does not expire.

Note: If condition (b) is not fulfilled, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

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:

3.2.5 Repetition duration and repetition interval

Requirement **RS_tcAdWe_140**

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 according to 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:

3.2.6 Traffic class

Requirement **RS_tcAdWe_141**

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

Tested by:

3.2.7 Message parameters

3.2.7.1 DENM

Requirement **RS_tcAdWe_193**

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

Table 6: DENM data elements of 'adverse weather condition — precipitation'

Data field	Value
Management container	
actionID	Identifier of a DENM.Shall be set in accordance with [TS 102 894-2].

<table>
<tr><td rowspan="2">detectionTime</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 point. Shall be set in accordance with [TS 102 894-2].</td></tr>
<tr><td>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>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>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>• 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>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 colspan="2">Situation container</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)</td></tr>
<tr><td>eventHistory</td><td>This element shall be used for update DENMs only (see section 3.2.4).</td></tr>
<tr><td colspan="2">Location container</td></tr>
<tr><td>traces</td><td>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.</td></tr>
<tr><td>roadType</td><td>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>
<tr><th>Urban / Non-Urban</th><th>Structural separation</th><th>Data element</th></tr>
</table></td></tr>
</table>

	Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)
	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	Unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		

Tested by:

3.2.7.2 CAM

Requirement **RS_tcAdWe_143**

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

Tested by:

3.2.8 Network and transport layer

Requirement **RS_tcAdWe_144**

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with center point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.2.9 Security layer

Requirement **RS_tcAdWe_146**

When the triggering conditions as described in chapter 3.2.2 apply, the use case shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:

3.3 Adverse weather condition - traction loss

3.3.1 Description of C-ITS service

Other (informational) **RS_tcAdWe_197**

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) **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

Requirement **RS_tcAdWe_148**

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:

3.3.2 Triggering conditions

3.3.2.1 Preconditions

Requirement **RS_tcAdWe_149**

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:

3.3.2.2 Service-specific conditions

Requirement **RS_tcAdWe_150**

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), throttle position, 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 throttle position is pressed on average more than 30 % of the max value 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, throttle position, vehicle acceleration and vehicle velocity. An

ASR-request must be active for at least 200 ms. The throttle position is pressed on average more than 30 % of the max value 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, throttle position, vehicle acceleration and vehicle velocity. An ASR-request must be active for at least 200 ms. The throttle position is pressed on average more than 30 % of the max value 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 throttle position. An ASR-request must be active for at least 200 ms. The throttle position is pressed on average less than 30 % of the max value (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: Throttle position refers also to an equivalent request by other driver input systems or automatic system like ACC.

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:

Requirement **RS_tcAdWe_163**

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

Tested by:

3.3.2.3 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 7: Information quality of 'adverse weather condition — traction loss'

Event detection	Value of InformationQuality
No TRCO 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

Tested by:

Requirement **RS_tcAdWe_165**

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

Tested by:

3.3.3 Termination conditions

Requirement **RS_tcAdWe_166**

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

Tested by:

3.3.3.1 Cancellation

Requirement **RS_tcAdWe_167**

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

Tested by:

3.3.3.2 Negation

Requirement **RS_tcAdWe_168**

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

Tested by:

3.3.4 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 in chapter 3.3.2.2 is fulfilled and a period with a duration greater than or equal to the *minimum detection interval* passed since the last new or update DENM;

(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 condition (a) is fulfilled, but conditions (b) and/or (c) are not fulfilled, no update DENM shall be generated, but a new DENM according to the currently detected event shall be generated.

Note: If condition (b) is fulfilled, the former DENM is continued to be transmitted in parallel as long as the *repetitionDuration* of the former DENM does not expire.

Note: If condition (b) is not fulfilled, the transmission of the former DENM has already been terminated, because the *repetitionDuration* of the former DENM has expired.

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:

3.3.5 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. Therefore, the interface parameters Repetition duration and Repetition interval between the application and the DEN basic service shall be set in accordance to these values.

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

Tested by:

Requirement **RS_tcAdWe_175**

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.

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 has to be managed by the receiving C-ITS station.

Tested by:

3.3.6 Traffic class

Requirement **RS_tcAdWe_176**

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

Tested by:

3.3.7 Message parameters

3.3.7.1 DENM

Requirement **RS_tcAdWe_177**

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

Table 8: DENM data elements of 'adverse weather condition — traction loss'

Data field	Value
Management container	
actionID	Identifier of a DENM. Shall be set in accordance with [TS 102 894-2].
detectionTime	*TimestampIts*-timestamp at which the event is detected by the originating 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.
referenceTime	*TimestampIts*-timestamp at which a new DENM or an update DENM is generated. Shall be set in accordance with [TS 102 894-2].
termination	Shall not be set, because neither negation nor cancellation are to be used in this C-ITS service.
eventPosition	*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.
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	

<table>
<tr><td>informationQuality</td><td colspan="3">See RS_tcAdWe_164. Shall be refreshed for every update DENM and set to the informationQuality of the current event point.</td></tr>
<tr><td>causeCode</td><td colspan="3">adverseWeatherCondition-Adhesion(6)</td></tr>
<tr><td>subCauseCode</td><td colspan="3">unavailable(0)</td></tr>
<tr><td>eventHistory</td><td colspan="3">This element shall be used for update DENMs only (see section 3.3.4).</td></tr>
<tr><td colspan="4">Location container</td></tr>
<tr><td>traces</td><td colspan="3">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.</td></tr>
<tr><td rowspan="11">roadType</td><td colspan="3">RoadType of the road the detecting C-ITS station is situated on.</td></tr>
<tr><td colspan="3">Shall be refreshed for an update DENM and set to the roadType of the current event point.</td></tr>
<tr><td colspan="3">Shall be set in accordance with [TS 102 894-2] in combination with the following rules:</td></tr>
<tr><td>Urban / non-urban</td><td>Structural separation</td><td>Data element</td></tr>
<tr><td>Urban</td><td>No</td><td>urban-NoStructuralSeparation ToOppositeLanes(0)</td></tr>
<tr><td>Urban</td><td>Yes</td><td>urban-WithStructuralSeparation ToOppositeLanes(1)</td></tr>
<tr><td>Urban</td><td>Unknown</td><td>urban-NoStructuralSeparation ToOppositeLanes(0)</td></tr>
<tr><td>Non-urban</td><td>No</td><td>nonUrban-NoStructuralSeparation ToOppositeLanes(2)</td></tr>
<tr><td>Non-urban</td><td>Yes</td><td>nonUrban-WithStructuralSeparation ToOppositeLanes(3)</td></tr>
<tr><td>Non-urban</td><td>Unknown</td><td>nonUrban-NoStructuralSeparation ToOppositeLanes(2)</td></tr>
<tr><td colspan="3">If the information about the urban/non-urban status cannot be determined, the data element shall be omitted.</td></tr>
</table>

Tested by:

3.3.7.2 CAM

Requirement **RS_tcAdWe_178**

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

Tested by:

3.3.8 Network and transport layer

Requirement **RS_tcAdWe_179**

The interface parameter destination area in IF.DEN.1 [ETSI EN 302 637-3] shall be equal to a circular shape with center point equal to *eventPosition* and radius equal to r*elevanceDistance*.

Tested by:

3.3.9 Security layer

Requirement **RS_tcAdWe_181**

When the triggering conditions as described in chapter 3.3.2 apply, the use case shall request the blocking of the AT changeover as defined in RS_BSP_184.

Tested by:
