Triggering Conditions and Data Quality
CAR 2 CAR Communication Consortium

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COMMUNICATION CONSORTIUM

Traffic Jam

Partners of the C2C-CC

Document information

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Table 1: Document information

CAR 2 CAR Communication Consortium

Changes since last version

Title:					
Explanatory notes:					
3	3	01.12.2015	Reworked according to Change Management process and released as part of CAR 2 CAR Release 1.1.0	Volkswagen AG	
3	2	15.07.2014	Steering wheel angle is a triggering condition rather than a pre-condition	Stefan Begerad	
3	1	29.04.2014	Update after CAM/DENM/CDD Enap Phase; Use case is limited to freeway	Stefan Begerad	
3	0	05.02.2014	Incorporate feedback from WG APP	Stefan Begerad	
2	1	19.12.2013	Incorporate feedback from WG APP	Stefan Begerad	
2	0	31.07.2013	Section 2.1.1.3.2, bullet point a and b: description adjusted: relation between velocities and braking maneuver eased	Stefan Begerad	
1	9	29.07.2013	Specific comments from WG-APP meeting inserted: "steering wheel angel" instead of "steering angle", not only driver but also passenger are allowed to enable hazard lights, detection validity added, note for time and location relevance of use case specific conditions added, combination of conditions for information quality improved,	Stefan Begerad	
1	8	18.07.2013	General comments from WG-APP meeting inserted	Gerhard Fischer	
1	7	04.07.2013	Condition for value three of information quality has been corrected. Bullet point f of use case specific condition has been corrected and bullet point h has been extended by "path history". Precondition 2.1.1.3.1 has been adapted to a	Stefan Begerad	

continuous manner.

Issue	Rev.	Date	Changes	Edited by	Approved
1	6	25.06.2013	Age/duration of pre-condition for both use cases adapted	Stefan Begerad	
1	5	21.06.2013	Link to triggering conditions in chapter 2.1.2.10 corrected	Stefan Begerad	
1	4	20.06.2013	Chapter for Geo Network Layer for the use cases added	Gerhard Fischer	
1	3	19.06.2013	Isolate this use case from Stationary Vehicle Warning - Broken-down Vehicle and Stationary Vehicle Warning – post-crash; Emergency vehicle as triggering condition added	Stefan Begerad	
1	2	17.06.2013	Removed: detectionBlockingTime; the triggering condition about vehicle density; hazard lights if vehicle is stationary for the use case Traffic Jam. Comments have been processed.	Stefan Begerad	
1	1	14.06.2013	Proposal added to be able to differ between urban and non-urban environment as pre-condition	Stefan Begerad	Sebastian Engel
		11.06.2013	First release after initial creation and review phase.	Stefan Begerad	

Table 2: Change history

Open Issues

None.

Content

List of tables

1   Introduction

1.1   Abstract

Other (informational)   **RS_tcTrJa_148**

This document describes the triggering conditions for traffic jam warning for the following two use cases:

- Traffic Jam – Dangerous End of Queue
- Traffic Jam – Traffic Jam Ahead

2 Triggering conditions

2.1 Traffic Jam

2.1.1 Traffic Jam - Dangerous End of Queue

2.1.1.1 Description of Use Case

Requirement   **RS_tcTrJa_93**

The following section describes a situation where an ego vehicle detects the end of a traffic jam, the so called dangerous end of queue. Such a situation is present, when the traffic lane of the ego vehicle is blocked and the vehicle is not able to proceed its way of driving. Urban environment is not part of this use case.

To distinguish this use case from other use cases, the triggering conditions in section 2.1.1.3 define how the end of a traffic jam exactly looks like.

Details:

Detailed by:

Tested by:

2.1.1.2 Relations to other Use Cases

Other (informational)   **RS_tcTrJa_149**

The following use cases are related to the *Traffic Jam - Dangerous End of Queue* use case, because they share similar triggering conditions:

- Dangerous Situations – Electronic Emergency Brake Light.

2.1.1.3 Triggering Conditions

2.1.1.3.1 Preconditions

Requirement   **RS_tcTrJa_94**

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

1. The ego vehicle is located in non-urban environment. The location shall be determined by at least one of these ways:
    1.1. The velocity is greater than 80 km/h for a time block of at least 30 s in the last 60 s previous to each detection and the absolute value of the steering wheel angle is smaller than 90 degree for a time block of at least 30 s in the last 60 s previous to each detection (Dangerous End of Queue should not be detected in non-freeway environment. Values shall be discussed).
    1.2. An on-board camera sensor indicates non-urban environment.
    1.3. An on-board digital map indicates non-urban environment.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_95**

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

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_96**

The velocity and angle values shall be measured in a continuous manner. The conditions shall be satisfied throughout the measurement duration. The process shall start all over again, when the conditions are not satisfied within measurement duration.

Details:

Detailed by:

Tested by:

2.1.1.3.2 Use Case Specific Conditions

Requirement   **RS_tcTrJa_105**

Count	Triggering condition	Status
TC_0	The ego vehicle is driving with an initial velocity greater than or equal to 80 km/h and an initial deceleration smaller than or equal to -0.1 m/s². The driver reacts on the dangerous end of queue by reducing the velocity from initial to target velocity smaller than or equal to 30 km/h. The duration between initial and target velocity shall be smaller than or equal to 10 s. An instant deceleration between initial and target velocity smaller than -3.5 m/s² is detected.	driver reaction
TC_1	Passengers of the ego vehicle react on the traffic jam by enabling hazard lights for at least 3 s	driver reaction
TC_2	At least three other vehicles with a velocity of at least 7 km/h have hazard lights enabled for at least 3 s which is determined by at least one of these ways: • Indicated by an on-board camera sensor. • indicated by CAMs.	environment or on-board sensors
TC_3	At least one DENM corresponding to the use case *Dangerous End of Queue* has been received.	Environment
TC_4	At least five different DENM (different *actionIDs*) corresponding to the use case *Traffic Jam Ahead* has been received from the downstream traffic.	Environment
TC_5	At least one DENM corresponding to the use case *Static Safeguarding Emergency Vehicle* has been received, with *linkedCause* equal to *Traffic Condition* or *Dangerous End of Queue*.	Environment
TC_6	On-board sensors of the ego vehicle recognize that the ego vehicle is facing a dangerous end of queue.	on-board sensors

Table 3: "Traffic Jam - Dangerous End of Queue" use case specific conditions

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.

- TC_0 AND (TC_2 OR TC_3 OR TC_4 OR TC_5 OR TC_6)
- TC_1 AND TC_2

Details:

Detailed by:

Tested by:

Other (informational)   **RS_tcTrJa_151**

A new DENM shall not be requested within the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a respective DENM has been requested. In this way, a single event is not able to flood the transmission channel. The *Detection Blocking Time* shall be 60 s no matter how the event is detected. The detection period between two detected events shall be at minimum equal to the *Detection Blocking Time*; the detection algorithm may run during *Detection Blocking Time*.

NOTE: No time period for the braking maneuvers is presented, because the initial ego vehicle velocity has no upper restriction.

Requirement   **RS_tcTrJa_107**

A Condition shall be valid as long as it is active and for an extra time period of 5 s (the time period increases the determinism of the detection algorithm). The validity shall decrease from the moment the condition is not satisfied anymore. The combination of triggering conditions is facilitated this way.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_108**

C2X messages used for evaluating use case specific conditions as described above shall be relevant for the ego vehicle. The relevance shall be determined in one of these ways:

  a. A digital map indicates that the event and the ego vehicle are separated by a distance less than 500 m and share the same driving direction.
  b. A path history match indicates that the event and the ego vehicle are separated by a distance less than 500 m and share the same driving direction.
  c. The Euclidean distance between the event and the ego vehicle shall be smaller than 500 m and the absolute value of the heading difference shall be less than 10 degree. The Traffic Jam reference positions according to the DENMs shall be located within an area spanning from -45 to +45 degree starting at the ego vehicle's longitudinal axis.

NOTE: When counting vehicles or events, pseudonym change should be considered in a way no vehicle or event is counted multiple times.

Details:

Detailed by:

Tested by:

2.1.1.3.3 Information Quality

Requirement   **RS_tcTrJa_109**

The value of the data element *informationQuality* in the DENM depends on the way this use case is detected. Triggering conditions are divided into groups: Driver reaction, vehicle dynamics, environment and on-board sensors. 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)
At least one condition from the driver reaction AND environment group is fulfilled.	1
At least one condition from the driver reaction AND on-board sensors group is fulfilled.	2

At least one condition from the driver reaction AND environment AND on-board sensors group is fulfilled.	3

Table 4: Information quality of "Traffic Jam - Dangerous End of Queue"

Details:

Detailed by:

Tested by:

2.1.1.4 Termination Conditions

Requirement   **RS_tcTrJa_110**

A termination of the use case shall not be considered.

Details:

Detailed by:

Tested by:

2.1.1.4.1 Cancellation

Requirement   **RS_tcTrJa_111**

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

Details:

Detailed by:

Tested by:

2.1.1.4.2 Negation

Requirement   **RS_tcTrJa_112**

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

Details:

Detailed by:

Tested by:

2.1.1.5 Update

Requirement   **RS_tcTrJa_113**

An update DENM shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.1.6 Repetition Duration and Repetition Interval

Requirement   **RS_tcTrJa_114**

New DENMs shall be repeated for a *repetitionDuration* of 20 s with a *repetitionInterval* of 0.5 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 case of managing two DENMs with the same *causeCode* from the same originating ITS-S has to be handled by the receiving ITS station.

Details:

Detailed by:

Tested by:

2.1.1.7 Traffic class

Requirement   **RS_tcTrJa_115**

New 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_tcTrJa_116**

Table 5 specifies the data elements of the DENM that shall be set.

Data Field	Value
Management Container	
actionID	Identifier of a DENM.Shall be set according to [AD-3].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
referenceTime	*TimestampIts*-Timestamp at which a new DENM, an update DENM or a cancellation DENM is generated. Shall be set according to [AD-3].
termination	Shall not be set, 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	lessThan1000m(4)
relevanceTrafficDirection	upstreamTraffic(1)
validityDuration	20 seconds (it is expected that vehicles are facing a different traffic situation 20 seconds after detection)
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
causeCode	dangerousEndOfQueue(27)
subCauseCode	unavailable(0)
Location Container	
eventSpeed	Speed of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
eventPositionHeading	Heading of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
traces	*PathHistory* of the originating ITS-S. Shall be set according to [AD-3].
roadType	*RoadType* of the road the detecting ITS-S is situated on. Shall be refreshed for an update DENM. Shall be set according to [AD-3] in combination with the following rules:

Urban / Non-Urban	Structural Separation	Data Element
Urban	No	urban-NoStructuralSeparation ToOppositeLanes(0)

Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
Urban	unknown	urban-NoStructuralSeparationToOppositeLanes(0)
Non-Urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
Non-Urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
Non-Urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte Container		
lanePosition	If the lanePosition is provided by an onboard sensor (e.g. radar, camera), the value shall be set according to [AD-3]. The use of GPS and a digital map for the estimation of the lane number is not legitimate for this version of the triggering condition.	
	If the lanePosition is unknown, the data element shall be omitted.	

Table 5: DENM data elements of "Traffic Jam - Dangerous End of Queue"

Details:

Detailed by:

Tested by:

2.1.1.8.2 CAM

Requirement   **RS_tcTrJa_117**

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_tcTrJa_118**

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_tcTrJa_119**

The interface parameter *hopLimit* between the DEN basic service and the GeoNetworking/BTP shall be set to the maximum value, according to [AD-4]. 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_tcTrJa_120**

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

Details:

Detailed by:

Tested by:

2.1.1.11   Scenarios

Other (informational)   **RS_tcTrJa_152**

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

The following list encompasses scenarios which are regarded as relevant or irrelevant considering the present use case:

Count	Description	Status
SC_0	A towing maneuver consisting of two vehicles both with enabled hazard lights no matter whether stationary or moving.	Irrelevant
SC_1	A braking maneuver due to a red traffic light.	Irrelevant
SC_2	Freeway.	Relevant
SC_4	The ego vehicle is arriving at the end of a traffic queue. Other vehicles have hazard lights enabled to notify inbound traffic. Passengers of the ego-vehicle react by enabling hazard lights.	Relevant
SC_5	The ego vehicle is standing still at the end of a traffic queue with no vehicles behind. Hazard lights of the ego vehicle may be enabled.	Relevant
SC_6	The ego vehicle is performing a braking maneuver due to the end of a traffic queue. Hazard lights of the ego vehicle may be enabled.	Relevant
SC_6	Traffic on a different road.	Irrelevant
SC_7	Traffic in the opposite driving direction.	Irrelevant
SC_8	Other vehicles than passenger cars.	Irrelevant
SC_9	Using hazard lights for "saying sorry".	Irrelevant

Table 6: Traffic Jam - Dangerous End of Queue scenarios

2.1.1.12   Open Issues

Other (informational)   **RS_tcTrJa_153**

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

The following list encompasses open issues, which are not comprehensively discussed:

a)　　2.1.1.3.1 Precondition about terminal 15: For one thing, this condition is redundant because of the other preconditions (v>=80km/h). (VW)

b)　　Is location (urban/non-urban) examined as precondition on sending site or part of plausibility check on receiving site? (Opel)

c)　　2.1.1.3.1 Preconditions: For location analysis (urban/non-urban), is the steering wheel angel (driver behaviour) or yaw rate (vehicle behaviour) considered? (Audi)

d)　　2.1.1.6 Transmission Interval: Why is this use case repeated with a higher frequency than Stationary Vehicle but not with the same? (Opel) Note: VW Proposal: DENM repetition shall deploy always the same frequency: transmissionInterval=1s.

e)　　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_tcTrJa_154**

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 Traffic Jam - Traffic Jam Ahead

2.1.2.1 Description of Use Case

Requirement   **RS_tcTrJa_121**

The following section describes a situation where an ego vehicle detects a traffic jam. Such a situation shall be present, if the ego vehicle is surrounded by stationary traffic or a heavy volume of traffic. Urban environment is not part of this use case.

It is important that a traffic jam shall be detected only in appropriate situations. All other situations though related with this use case or not, shall not be detected. Section 2.1.2.2 presents use cases with possible relations to this use case.

To distinguish this use case from other use cases, the triggering conditions in section 2.1.2.3 define how a traffic jam exactly looks like.

Details:

Detailed by:

Tested by:

2.1.2.2 Relations to other Use Cases

Other (informational)   **RS_tcTrJa_155**

The following use cases are related to the *Traffic Jam - Traffic Jam Ahead* use case, because they share similar triggering conditions:

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

2.1.2.3 Triggering Conditions

2.1.2.3.1 Preconditions

Requirement   **RS_tcTrJa_122**

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

1. No Stationary Vehicle Warning use case is detected.
2. No Special Vehicle Warning use case is detected.
3. The ego vehicle is located in non-urban environment. The location shall be determined by at least one of these ways:
    3.1. The velocity is greater than 80 km/h for a time block of at least 30 s in the last 180 s previous to each detection and the absolute value of the steering wheel angle is smaller than 90 degree for a time block of at least 30 s in the last 60 s previous to each detection (Traffic jam should not be detected on freeways. Values shall be discussed.).
    3.2. An on-board camera sensor indicates non-urban environment.
    3.3. An on-board digital map indicates non-urban environment.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_123**

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

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_124**

The velocity and angle values shall be measured in a continuous manner. The conditions shall be satisfied throughout the measurement duration. The process shall start all over again, when the conditions are not satisfied within measurement duration.

Details:

Detailed by:

Tested by:

2.1.2.3.2 Use Case Specific Conditions

Requirement   **RS_tcTrJa_131**

Count	Triggering Conditions	Status
TC_0	The ego vehicle is moving with an average velocity less than or equal to 30 km/h and greater than 0 km/h (to avoid an overlapping and to distinguish TC_0 and TC_1 this threshold is introduced). The average velocity shall be calculated over a period of 120 s (the duration condition excludes frequently changing traffic states from triggering). NOTE: This TC covers the scenario Wide Moving Jam. See SC_5 in section 2.1.2.11.	vehicle dynamics
TC_1	The ego vehicle velocity is equal to 0 km/h throughout a duration of at least 30 s. NOTE: This TC covers the scenario Stationary Traffic. See SC_4 in section 2.1.2.11.	vehicle dynamics
TC_2	At least one DENM corresponding to the use case *Traffic Jam Ahead* with the same driving direction has been received.	Environment
TC_3	At least one traffic jam notification with the same driving direction has been received by means of mobile radio.	Environment
TC_4	CAMs indicate a velocity less than or equal to 30 km/h of at least five other vehicles in at most 100 m distance and the same driving direction.	Environment
TC_5	On-board sensors indicate a velocity less than or equal to 30 km/h of at least five other vehicles in at most 100 m distance and the same driving direction.	on-board sensor

Table 7: "Traffic Jam - Traffic Jam Ahead" use case specific conditions

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.

- TC_0
- TC_1 AND (TC_2 OR TC_3 OR TC_4 OR TC_5)

Details:

Detailed by:

Tested by:

Other (informational)   **RS_tcTrJa_156**

A new DENM shall not be requested within the *Detection Blocking Time*. The *Detection Blocking Time* is launched after the event is detected and a respective DENM has been requested. In this way, a single event is not able to flood the transmission channel. The *Detection Blocking Time* shall be 180 s no matter how the event is detected. The detection period between two detected events shall be at minimum equal to the *Detection Blocking Time*; the detection algorithm may run during *Detection Blocking Time*.

Requirement   **RS_tcTrJa_133**

A condition shall be valid as long as it is active and for an extra time period of 5 s (the time period increases the determinism of the detection algorithm). The validity decreases from the moment the condition is not satisfied anymore. The combination of triggering conditions is facilitated this way.

Details:

Detailed by:

Tested by:

Requirement   **RS_tcTrJa_134**

C2X and mobile radio events for evaluating use case specific conditions as described above shall be relevant for the ego vehicle. The relevance shall be determined by at least one of these ways:

   a. A digital map indicates that the event and the ego vehicle are separated by a distance less than 500 m and share the same driving direction.
   b. A path history match indicates that the event and the ego vehicle are separated by a distance less than 500 m and share the same driving direction.
   c. The Euclidean distance between event and ego vehicle shall be smaller than 500 m and the absolute value of the heading difference shall be less than 10 degree. The Traffic Jam reference positions according to DENMs shall be located within an area spanning from -45 to +45 degree starting at the ego vehicle's longitudinal axis.

NOTE: When counting vehicles or events, pseudonym change should be considered in a way no vehicle or event is counted multiple times.

Details:

Detailed by:

Tested by:

2.1.2.3.3 Information Quality

Requirement   **RS_tcTrJa_135**

The value of the data element *informationQuality* in the DENM depends on the way the event is detected. Triggering conditions are divided into groups: Driver reaction, vehicle dynamics, environment and on-board sensors. 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)
Al least one condition from the vehicle dynamics group is fulfilled. This means condition TC_0 is fulfilled.	1
At least one condition from the vehicle dynamics AND environment group is fulfilled.	2
At least one condition from the vehicle dynamics AND on-board sensor group is fulfilled.	3

At least one condition from the vehicle dynamics AND environment group AND on-board sensor group is fulfilled	4

Table 8: Information quality of "Traffic Jam - Traffic Jam Ahead"

Details:

Detailed by:

Tested by:

2.1.2.4 Termination Conditions

Requirement **RS_tcTrJa_136**

A termination of the use case shall not be considered.

Details:

Detailed by:

Tested by:

2.1.2.4.1 Cancellation

Requirement **RS_tcTrJa_137**

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

Details:

Detailed by:

Tested by:

2.1.2.4.2 Negation

Requirement **RS_tcTrJa_138**

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

Details:

Detailed by:

Tested by:

2.1.2.5 Update

Requirement **RS_tcTrJa_139**

An update DENM shall not be used for this use case.

Details:

Detailed by:

Tested by:

2.1.2.6 Repetition Duration and Repetition Interval

Requirement **RS_tcTrJa_140**

New DENMs shall be repeated for a *repetitionDuration* of 60 s with a *repetitionInterval* of 1 s.

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

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

Details:

Detailed by:

Tested by:

2.1.2.7 Traffic class

Requirement   **RS_tcTrJa_141**

New 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_tcTrJa_142**

Table 9 specifies the data elements of the DENM that shall be set.

Data Field	Value
Management Container	
actionID	Identifier of a DENM.Shall be set according to [AD-3].
detectionTime	*TimestampIts*-Timestamp at which the event is detected by the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
referenceTime	*TimestampIts*-Timestamp at which a new DENM, an update DENM or a cancellation DENM is generated. Shall be set according to [AD-3].
termination	Shall not be set, 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	lessThan1000m(4)
relevanceTrafficDirection	upstreamTraffic(1)
validityDuration	60 seconds (a traffic jam situation is expected to last at least 60 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
causeCode	trafficCondition(1)
subCauseCode	unavailable(0)
Location Container	
eventSpeed	Speed of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
eventPositionHeading	Heading of the originating ITS-S. Shall be set according to [AD-3]. Shall be refreshed for an update DENM.
traces	*PathHistory* of the originating ITS-S. Shall be set according to [AD-3].
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}}

Inner table for roadType:

Urban / Non-Urban	Structural Separation	Data Element
Urban	No	urban-NoStructuralSeparationToOppositeLanes(0)

	Urban	Yes	urban-WithStructuralSeparationToOppositeLanes(1)
	Urban	unknown	urban-NoStructuralSeparationToOppositeLanes(0)
	Non-Urban	No	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Non-Urban	Yes	nonUrban-WithStructuralSeparationToOppositeLanes(3)
	Non-Urban	Unknown	nonUrban-NoStructuralSeparationToOppositeLanes(2)
	Otherwise, if the information about the urban/non-urban status cannot be determined, the data element shall be omitted.		
Alacarte Container			
lanePosition	If the lanePosition is provided by an onboard sensor (e.g. radar, camera), the value shall be set according to [AD-3]. The use of GPS and a digital map for the estimation of the lane number is not legitimate for this version of the triggering condition.		
	If the lanePosition is unknown, the data element shall be omitted.		

Table 9: DENM data elements of "Traffic Jam - Traffic Jam Ahead"

Details:

Detailed by:

Tested by:

2.1.2.8.2 CAM

Requirement   **RS_tcTrJa_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_tcTrJa_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_tcTrJa_145**

The interface parameter *hopLimit* between the DEN basic service and the GeoNetworking/BTPshall be set to the maximum value, according to [AD-4]. 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_tcTrJa_146**

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

Details:

Detailed by:

Tested by:

2.1.2.11 Scenarios

Other (informational)   **RS_tcTrJa_158**

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

The following list encompasses scenarios which are regarded as relevant or irrelevant considering the present use case:

Count	Description	Status
SC_0	Freeway.	Relevant
SC_1	The ego vehicle is in a breakdown state.	Irrelevant
SC_2	The ego vehicle is in a crash state.	Irrelevant.
SC_3	The ego vehicle performs a rescue and recovery operation.	Irrelevant
SC_4	The ego-vehicle is stationary surrounded by other road users.	Relevant
SC_5	The ego-vehicle is surrounded by stop-and-go traffic.	Relevant
SC_6	Traffic on a different road.	Irrelevant
SC_7	Traffic in the opposite driving direction.	Irrelevant
SC_8	Other vehicles than passenger cars.	Irrelevant

Table 10: Traffic Jam - Traffic Jam Ahead scenarios

2.1.2.12 Open Issues

Other (informational)   **RS_tcTrJa_159**

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

The following list encompasses open issues, which are not comprehensively discussed:

a)   2.1.2.3.1 Preconditions: For location analysis (urban/non-urban), is the steering wheel angel (driver behaviour) or yaw rate (vehicle behaviour) considered (Audi)?

b)   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_tcTrJa_160**

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

The following list encompasses feature requests for upcoming document releases:
None.

3   Appendix

3.1   List of abbreviations

Other (informational)   **RS_tcTrJa_161**

ABS	Anti-lock Breaking System
ASN.1	Abstract Syntax Notation One
ASR	Anti-Slide 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
TTC	Time To Collision
V2V	Vehicle to Vehicle
TC	Triggering Condition

Table 11: Abbreviations

3.2   Applicable documents

Other (informational)   **RS_tcTrJa_162**

[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)
[AD-5]	
[AD-6]	
[AD-7]	

[AD-8]
[AD-9]

Table 12: Applicable documents

3.3 Related documents

Other (informational)   **RS_tcTrJa_163**

[RD-1]
[RD-2]
[RD-3]
[RD-4]
[RD-5]
[RD-6]

Table 13: Related documents