



C-ITS SERVICE AND USE CASE DEFINITIONS

**HAZARDOUS LOCATIONS NOTIFICATION (HLN)
[C-ROADS SUD03]**

VERSION 3.0.0

C-Roads Platform

Working Group 2 Technical Aspects

Taskforce 2 Service Harmonisation

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Introduction

The document ‘Service and Use Case Descriptions 01 Intro Document’ [C-Roads SUD01] explains the structure of the service and use case descriptions harmonized in C-Roads. Also, it gives an overview of all harmonized service and use cases and in which document they are described. Each service and its use cases are described in a separate chapter in a separate document. Together, these documents form the integral deliverable of the service and use case descriptions.

All References (in square brackets) refer to the global reference document [WG2 REF], which is part of the whole set of documents of a specific C-Roads release.

3. Hazardous Locations Notification (HLN)

3.1 HLN: Service introduction

Service introduction	
Summary	Hazardous Locations Notification (HLN) is a warning message related to one or a series of potentially hazardous events on the road. The approaching drivers get information and therefore warnings about the location and type of hazard they are approaching and – if available – also the duration of the event.
Background	Hazardous locations/situations create a risk to drivers potentially causing (more) accidents resulting in injuries/fatalities. This C-ITS service directly informs involved and relevant drivers so they can adapt their driving behaviour accordingly.
Objective	The aim of this service is to warn drivers of hazardous locations on their route in order to increase overall road safety by providing in-vehicle information about hazards, including the location and type of hazard, possibly also the remaining distance to the hazardous location, the duration of the events causing the hazard, as well as lane and speed advice.
Expected benefits	<ul style="list-style-type: none"> • More attentive driving while approaching and passing a hazardous location in order to minimise the risk of collisions/accidents resulting in fewer incidents/injuries/fatalities among drivers.
Use cases	<ul style="list-style-type: none"> • Accident Zone (HLN – AZ) • Traffic Jam Ahead (HLN – TJA) • Stationary Vehicle (HLN – SV) • Weather Condition Warning (HLN – WCW) • Temporarily Slippery Road (I2V) (HLN – TSR) • Animal or Person on the Road (HLN – APR) • Obstacle on the Road (HLN – OR) • Emergency or Rescue/Recovery Vehicle in Intervention (HLN – ERVI) • Emergency or Prioritised Vehicle Approaching (HLN – EPVA) • Railway Level Crossing (HLN – RLX) • Unsecured Blockage of a Road (HLN – UBR) • Alert Wrong Way Driving (HLN – AWWD) • Public Transport Vehicle Crossing (HLN – PTVC) • Public Transport Vehicle at a Stop (HLN – PTVS) <p>Other HLN use case descriptions are under review and may be added in future releases.</p>

3.2 HLN: Use Cases

3.2.1 HLN – Accident Zone (HLN-AZ)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	The road operator detects that an accident has happened on the road network and sends the information to drivers who can benefit from this information.
Background	<p>This use case is about exchanging information about accident zones between infrastructure and vehicles and describes the following scenario:</p> <ul style="list-style-type: none"> • Sending event information from the TCC to the vehicles. <p>This scenario (TCC to vehicles) deals with the available infrastructure content (mainly the kind of events which are available in the TCC) and how this content/these events can be mapped into coded accident information.</p>
Objective	Warn drivers of accident zones ahead and around their position in order to increase overall road safety.
Desired behaviour	Precisely and correctly inform drivers to adapt their driving behaviour (e.g., reduce the approaching speed, drive more cautiously, etc.) before and whilst passing the accident zone.
Expected benefits	<ul style="list-style-type: none"> • Increased road safety and lower numbers of persons killed or injured in traffic accidents. • Lower numbers of incidents and secondary damages following a dangerous situation on the road for road operators and drivers. • Higher quality of traffic information services for service providers. • More relaxed/comfortable driving for drivers.
Use case description	
Situation	The drivers get informed about an accident zone in their vicinity, according to their driving direction.
Logic of transmission	I2V
Actors and relations	<p>Road operator: The road operator provides information about the accident zone detected on the road network mentioned in the use cases specifications and distributes respective warnings as C-ITS messages.</p> <p>Drivers: The drivers are informed about the accident zone ahead on their route by their chosen channel of information.</p>

Use case scenario	<p>Service provider: The service provider distributes C-ITS messages actively and dynamically to the subscribers (end-users).</p> <ul style="list-style-type: none"> • An accident is detected and confirmed in the TCC, the warning message is coded according to the specified definition and sent via defined channels to an ITS station, which sends the information. • The road operator generates the event information within the TCC and distributes it via various channels with one message ID to vehicles. • The service provider collects and distributes the HLN-AZ C-ITS message from/to his active users in the area. • The drivers are informed ahead of the accident zone.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The road operators back-office systems in the TCC send event information to a C-ITS system which then creates, and sends C-ITS messages based on that content. When drivers approach an accident area, the vehicle receives the C-ITS messages. • The information can then be presented via the In-Vehicle HMI early enough and should be only moderately intrusive (manufacturer's decision), allowing the driver to adjust his driving behaviour (e.g., speed and position) on the road. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • The information quality of the “Accident Zone” use case mostly depends on the accurate detection of the event and the confirmation level/maturity of the information in the back-office systems/TCC of road operators. • For service providers the overall speed and latency in message generation and transmission as well as the selection of the geographical dissemination area, including a single warning message ID, is a major dependency to implement this use case successfully. • Various sensor measurements and procedures for traffic detection are needed in the back-office systems of the road operators in order to generate accurate information for the “Accident Zone” use case. Therefore, the availability of the service could be limited according to the limitations of the sensors used for event detection. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might be translated to the preferred language of the driver.
Link to other use cases	<ul style="list-style-type: none"> • IVI-TS: The IVI use case can be used to also send an appropriate warning sign to the vehicles • HLN-ERVI: If an emergency or rescue or recovery vehicle is at the accident location, possibly two DENMs are sent if the Verv is C-ITS equipped

Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN – AZ is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • For this use case, causeCode shall be set to accident2 and subCauseCode shall be set to one of the following (the road operator selects the best fitting value): <ul style="list-style-type: none"> ○ 0 (unavailable): used, if no further information is available ○ 1 (multiple vehicles accident): for accidents with at least two vehicles involved ○ 2 (heavy accident): serious injury or fatal accident ○ 3 (accident involving lorry): used if an HGV/lorry is involved ○ 4 (accident involving bus): used if a bus is involved ○ 5 (accident involving hazardous materials): used for accidents involving hazardous materials according to ADR (Accord relatif au transport international des marchandises Dangereuses par Route; REF) ○ 6 (accident in opposite lane) shall not be used. If the accident is on the opposite lane, this situation should be described by HLN-TJA ○ 7 (unsecured accident): used if the accident zone is unprotected • stationType:15 (also in case of a central C-ITS station) • eventSpeed shall not be used. • detectionZonesToEventPosition represented by pathHistory elements shall be provided as specified in [C-Roads MP]. • a point based or single linear relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location or the upstream start of the accident zone. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ For point based events: eventZone shall not be provided. ○ For linear events: eventZone shall be provided and shall reflect the geographical extent of the accident zone. • informationQuality shall be set according to the definition specified in [C-Roads MP]. • Message management shall be done by either providing short validity durations or by actively terminating messages. • <i>NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.</i>
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p>

	<p>This use case is based on the causeCode accident2 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>accident2</td><td>1</td><td>1</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	accident2	1	1
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
accident2	1	1								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN – AZ• messageType = DENM <p>Geographic area (Quadtree) for DENM:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>									

3.2.2 HLN – Traffic Jam Ahead (HLN-TJA)

Type of road network	Motorways, Dual carriageways, Rural roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	A road operator detects a traffic jam and sends the information to the drivers (mentioning the position and length of the traffic jam, as well as the affected section/lanes, if the information is available).
Background	With C-ITS, the availability and the accuracy of traffic jam ahead warnings is better than conventional means, and therefore drivers are warned with a higher quality of information, including the accuracy of the road segments, potentially affected lanes and vehicle speeds.
Objective	<p>The objective of this use case is to warn about a queue, but more importantly to warn about a potentially dangerous end of queue. The drivers can modify their driving behaviour (speed, lanes) towards the end of the queue.</p> <p>The accuracy of the position of the end of the queue is usually very low. This use case could help to improve it, since it can be signalled by vehicles encountering it when they adjust their speed and/or vehicle trajectory near the end of the traffic jam.</p>
Desired behaviour	<ul style="list-style-type: none"> Well informed drivers adapting their driving behaviour (e.g., reducing their approaching speed, before arriving at the end of the traffic jam and while passing it). Precise and correctly informed drivers also drive more cautiously and concentrated near the end of the traffic jam. The constant speed adaptation of single vehicles when approaching the end of queue area has also an impact on the overall traffic flow.
Expected benefits	<p>More homogenous traffic flow with less accident-related congestion, leading to:</p> <ul style="list-style-type: none"> Economic benefits: saving resources, money, and time for all stakeholders, Social benefits: traffic safety, reduced number of incidents, Personal benefits: more comfortable driving, Environment benefits: reduced CO2 emissions and environmental pollution.
Use case description	
Situation	A traffic jam could either occur on one specific lane (e.g., at an exit of a motorway), or on all lanes of a section of the road.

	<p>The TJA warning message for the respective lane or road section is sent out to end-users approaching the traffic jam area on various channels of information, but with one message ID.</p> <p>Sources of information could be:</p> <ul style="list-style-type: none"> • Cameras (incident detection ones as well), • Traffic loops, • Operating agents/road operator equipped patrol vehicles, • Other vehicles which have detected the danger.
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> • Road operator: The road operator detects and confirms TJA situations and forwards them to the C-ITS System. The operator in the TCC or (one or several) equipped vehicles braking is/are the sender of the TJA warning. • Service provider: Disseminates TJA related information, to/from vehicles/drivers. • Drivers: End-receiver is the mobile C-ITS station in the vehicle (and in the future possibly ACC system) or the driver.
Use case scenario	<ul style="list-style-type: none"> • The operator in the TCC gets informed about a traffic jam on the road network. • The operator feeds the information into his TCC, confirms it with the length and/or lane, and then disseminates the message to the drivers. • The vehicles near the traffic jam area receive the information and present it to their drivers. • The drivers adapt their driving behaviour accordingly. • In future, the in-vehicle ACC system could follow the warning message related advice directly. • The road operator can have a system that automatically updates the length and/or lane of the traffic jam and communicate the end of the traffic jam area when a regular travelling speed is confirmed.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The in-vehicle information should be adapted to the relative position between the vehicle and the TJA warning positions. • The presented information may vary depending on the position of the receiving vehicles or may not be presented at all if the vehicle is too close to the end of the queue. • The in-vehicle information could inform the driver that ACC is active and working according to the driver's set of preferences. • Related information is presented to the user via the dashboard. Layout and sequence of presentation is left to specific implementation. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • The accuracy of the end of queue information provided by the road operator can be low, depending on the systems used to update it and the

	<p>available information sources used by the road operator. For example, for single sensor networks like loop detectors, the highest accuracy is the distance between two installed loop detectors, which would mean a low quality of locating the end of the queue.</p> <ul style="list-style-type: none"> • The vehicles equipped with C-ITS could improve the quality of localisation and increase awareness of drivers approaching the traffic jam area. For high accuracy of this use case, it needs a high percentage of equipped vehicles included in message generation at the end of the traffic jam area. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might be translated to the preferred language of the driver.
Link to other use cases	HLN-AZ: this use case is also triggered by HLN-AZ, if the accident is on the other driving direction
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN – TJA is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • In case the extent of the traffic jam is not known, <ul style="list-style-type: none"> ○ causeCode dangerousEndOfQueue27 and subCauseCode 0 (unavailable) shall be used. ○ a point-based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ▪ The eventPosition shall be set to the upstream end of queue and the positionConfidenceEllipse shall be based on available data or shall be set to "unavailable" if no data is available. ▪ awarenessDistance shall not be provided. ▪ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be provided. • In case the extent of the traffic jam is known, <ul style="list-style-type: none"> ○ causeCode trafficCondition1 and subCauseCode 5 (trafficJam) shall be used. <i>NOTE: Current vehicle implementations require causeCode trafficCondition1 and subCauseCode 0 (unavailable) in this situation. An update to the C-ROADS specified usage of trafficCondition1/5 is already planned for these legacy vehicles.</i> ○ a single linear relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ▪ The eventPosition shall be set at the upstream end of the queue or even further ahead of the upstream end of queue. ▪ awarenessDistance shall not be provided. ▪ trafficDirection shall be provided as specified in [C-Roads MP]. ▪ eventZone shall be provided as specified in [C-Roads MP], starting at the eventPosition, continuing downstream describing the extent of the traffic jam to the point, where vehicles can progress freely at the allowed speed.

	<ul style="list-style-type: none">• stationType: 15 (also in case of a central C-ITS station)• detectionZonesToEventPosition shall be provided as specified in [C-Roads MP].• informationQuality shall be set according to the definition in [C-Roads MP].• If no cancellation is used, validityDuration should be set to a maximum of 12 minutes, because an end of queue can appear and reappear frequently.• Message management shall be done by either providing short validity durations (maximum 12 minutes) or by actively terminating messages. <p>NOTE: For both scenarios (27/0 and 1/5): If the end of queue position changes, the eventPosition needs to be updated and the positionConfidence needs to reflect the accuracy of the event position. The positionConfidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.</p>												
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode dangerousEnd-OfQueue27 or trafficCondition1 and therefore requires an appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><th></th><th colspan="2">SSP position</th></tr><tr><th>CauseCodeType / Container</th><th>Octet position</th><th>Bit position</th></tr><tr><td>dangerousEndOfQueue27</td><td>2</td><td>6</td></tr><tr><td>trafficCondition1</td><td>1</td><td>0</td></tr></table> <p>The here listed SSP for cC1 shall be granted only for C-ITS stations used by road operators or any contractor on their behalf. The SSP for causeCode dangerousEndOfQueue27 shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</p>		SSP position		CauseCodeType / Container	Octet position	Bit position	dangerousEndOfQueue27	2	6	trafficCondition1	1	0
	SSP position												
CauseCodeType / Container	Octet position	Bit position											
dangerousEndOfQueue27	2	6											
trafficCondition1	1	0											
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>												

<p>Communication technology requirements: IP based</p>	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none"> • serviceType = HLN – TJA • messageType = DENM <p>Geographic area (Quadtree) for DENM:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>
<p>Test and validation requirements</p>	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>

3.2.3 HLN – Stationary vehicle (HLN-SV)

Type of road network	Motorways, Dual carriageways, Rural roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	<p>The Stationary Vehicle(s) service warns approaching drivers of stationary/broken-down vehicles ahead that present a hazard to other vehicles on the road. It is a preventive safety service, as drivers are informed in advance and have more time to prepare for danger.</p> <p>The road operator could have event management systems to trigger conventional (non-C-ITS) and C-ITS I2V messages to warn other vehicle drivers of stationary/broken-down vehicles. In line with the ETSI ITS standard, this service could rely on V2V ITS-G5 communication, in particular on the messages sent by the stationary/broken-down vehicle and processed/filtered by nearby receiving vehicles.</p> <p>An interesting variation of this use case that contributes to the quality of the information is that the stationary/broken-down vehicle information is also processed by a nearby roadside unit and then, in order to further distribute the same warning via the roadside infrastructure, other RSU's connected through the road operator distribute the SV warning by resending it.</p>
Background	<p>While the C-ITS platform presents a single entry for this use case, [ETSI TR 102 638] includes two distinct use cases:</p> <ul style="list-style-type: none"> • Slow vehicle warning as a use case of cooperative awareness application, • Stationary vehicle as a use case of road hazard warning application. <p>The Stationary Vehicle warning is achieved through a DENM (event notification) by the sender vehicle application, which sends a notification with a specific Stationary Vehicle cause code based on the state of the vehicle (broken, stopped with emergency lights on, etc.).</p> <p>The variant of I2V information via a stationary vehicle was tested with regard to the I2V part, i.e., the infrastructure informs vehicles about a stationary vehicle.</p> <p>So far, no thorough and operative scenario demonstration has been done, where stationary vehicles, roadside unit(s) and incoming vehicles share all the same hazard in a fully cooperative manner, so that as many interested vehicles as possible are informed.</p>
Objective	Avoiding collisions (mostly rear-end) with stationary vehicles on the road and increasing road safety.
Desired behaviour	<ul style="list-style-type: none"> • The vehicle drivers adapt their driving behaviour by slowing down and/or changing lanes.


	<ul style="list-style-type: none"> As the I2V warning is targeted and accurate by the road operator's event management system, reliability is high and driver attention is increased near these traffic situations or areas. In the future, the SV information may be used by Advanced Driver Assistance Systems for supported and automated driving. In addition, the driver awareness is raised to the possible presence of vulnerable road user(s) (VRU) on the road.
Expected benefits	<ul style="list-style-type: none"> As reported in the study [Introduction to the C-Roads WG2 Deployment Documentation and Requirements], the main benefit is expected in road safety, whereas minimal impact is expected in traffic efficiency and fuel consumption. Concerning safety, this service helps to prevent dangerous manoeuvres as drivers are informed in advance and have more time to prepare for the hazard and take appropriate countermeasures, also with regard to possible vulnerable road users nearby.
Use case description	
Situation	<p>The road operators' event management systems forward the necessary information to the C-ITS communication system.</p> <p>Sources of information can be:</p> <ul style="list-style-type: none"> Cameras (incident detection ones as well), Operating agents/road operator equipped patrol vehicles, Other C-ITS-equipped vehicles which have detected the danger. <p>A Stationary Vehicle itself is expected to inform drivers in their vicinity about broken down vehicles as specified in [C2C CC Vehicle C-ITS station profile], see esp. "Triggering Conditions and Data Quality Stationary Vehicle Warning".</p>
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> Road operators: Detect slow moving or broken-down vehicles with their event management systems, verify and forward C-ITS messages via different communication channels with one warning message ID. Drivers: The drivers may act as information source and end-user of SV warning messages. Service providers: Distribute positions of stationary/broken-down vehicles via different communication networks to their users approaching the event position of the warning.
Use case scenario	<ul style="list-style-type: none"> The road operator detects a slow moving or broken-down vehicle (conventional (non-C-ITS) vehicle or C-ITS equipped vehicle). The road operator generates an appropriate warning message that is sent I2V to the C-ITS Systems in the relevant area. Approaching vehicles receive the warning and drivers adapt their driving behaviour.

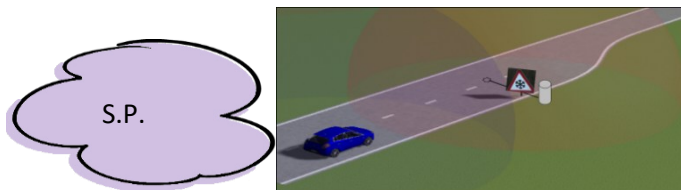
Intended Presentation/Alert principle	<ul style="list-style-type: none"> The driver is provided with related information, presented on the dashboard. Layout and sequence of presentation is left to OEM-specific implementation. The warning to the driver must be presented early enough to allow drivers to adjust the speed of their vehicles, but not so early that the warning is forgotten. The warning can be repeated when approaching the position of the event. The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might be translated to the preferred language of the driver.
Link to other use cases	HLN-ERVI: If an emergency or rescue or recovery vehicle arrives at the stationary vehicle, the HLN-ERVI use case will be triggered by the emergency or recovery vehicle.
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> The DENM message for HLN – SV is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. For this use case, causeCode stationaryVehicle94 and subCauseCode 0 (unavailable) or 2 (vehicle breakdown) shall be used. eventSpeed shall not be used. stationType: 15 (also in case of a central C-ITS station) informationQuality shall be set according to the definition specified in [C-Roads MP]. detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. a point based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> The eventPosition shall be set to the location of the stationary/broken-down vehicle. awarenessDistance shall not be provided. trafficDirection shall be provided as specified in [C-Roads MP]. eventZone shall not be provided. lanePositions shall be provided if the information is available and reliable. The stationaryVehicle DE shall not be provided. Message management shall be done by either providing short validity durations or by actively terminating messages. <i>NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.</i>

Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode stationaryVehicle94 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>stationaryVehicle94</td><td>3</td><td>2</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	stationaryVehicle94	3	2
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
stationaryVehicle94	3	2								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN – SV• messageType = DENM <p>Geographic area (Quadtree) for DENM:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>									

3.2.4 HLN – Weather Condition Warning (HLN-WCW)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	<p>In the Weather Condition Warning (WCW) use case, drivers are informed about static and dynamic road weather conditions. As reported in the [Study on the Deployment of C-ITS in Europe: Final Report], this service provides "(...) accurate and up-to-date local weather information. Drivers are informed about dangerous weather conditions ahead, especially where the danger is difficult to perceive visually, such as black ice or strong gusts of wind.</p> <p>Vehicles are sent information from roadside units warning the driver of dangerous, or changeable weather conditions. Alternatively, the messages may be transmitted via the cellular network. This service is applicable to all roads and vehicle types." [C-ITS Platform Final report]</p>
Background	<p>With reference to the Commission Delegated Regulation (EU) 886/2013, weather condition is within the minimum set of road safety-related traffic information services free of charge to users on European Roads (Article 3, category (h)). Article 2 defines exceptional weather conditions as "unusual, severe or unseasonal weather conditions which might affect safe driving".</p> <p>The Weather Conditions Warning (WCW) use case is intended to inform drivers via in-vehicle information systems of weather conditions (current or expected) and road status along the road. WCW information is provided by means of I2V communication, referring to a sub use case of Hazardous Location Notifications, as specified in [ETSI TR 102 638] and coherently in the [C-ITS Platform Final report].</p>
Objective	Improve traffic safety via additional means of C-ITS messages by informing drivers in a more accurate way about adverse weather conditions and road status information.
Desired behaviour	<ul style="list-style-type: none"> • The vehicle drivers adapt their driving behaviour compliant to the applicable driving regulations and any advice or guidance provided. • In the future the information may be used by Advanced Driver Assistance Systems for supported and automated driving.
Expected benefits	<ul style="list-style-type: none"> • The primary expected impact is more attentive driving by providing actual and continuous (expected) information on road weather conditions (e.g., poor road traction conditions, visibility, wind, rainfall etc.), which improves traffic safety as it reduces (the numbers and the severity of) accidents.

	<ul style="list-style-type: none"> A topic of future day 2 C-ITS services can be to evaluate the applicability of this concept to Autonomous Driving functions.
Use case description	
Situation	WCW is expected to inform drivers of current and/or expected information related to precipitation or extreme weather conditions or low visibility ranges due to, for example, fog.
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> Road operator: Validates the warning and issues triggering information via different communication channels with one message ID. Service provider: Collects and ensures that the triggering information is correct, triggers an I2V warning, and/or aggregates information in cloud services. Weather information provider: Shares real-time information with the road operator, or TCC. End-User: Receives the warning via the on-board unit and/or receives notification that the automatic vehicle control is taking adverse weather conditions into account. Drivers: Are informed about dangerous weather conditions ahead in time to adapt the driving behaviour. Vulnerable road users: Vulnerable Road users or special vehicle categories (e.g., PTW) could receive adapted WCW messages. <p>Additional Information sources for the use case could be as follows:</p> <ul style="list-style-type: none"> Roadside sensors/weather forecasts provide weather data. C-ITS vehicles.
Use case scenario	<p>The operators in the TCC get informed about extreme weather conditions (and the consequences e.g., low visibility) on the road network.</p> <p>They put the information together, confirm it in their TCC and then distribute the WCW message via different communication channels and send it to the drivers.</p> <p>The vehicles receive the information and present it to the drivers, so that they can adapt their driving behaviour.</p> <p>Additional scenarios can be implemented as follows:</p> <p><u>Scenario 1:</u> Data is sent directly after the TCC has confirmed the data and the triggering conditions.</p> <div data-bbox="609 1718 1294 1906" data-label="Image">  </div> <p style="text-align: center;"><i>Figure 3:1 Scenario 1 HLN-WCW</i></p>

	<p><u>Scenario 2</u>: The vehicle receives the WCW message and asks the Service Provider (linked to TCC) for a confirmation of the data already on-board and displays the message in time to react.</p> <div data-bbox="611 371 1294 560" data-label="Image">  </div> <p><i>Figure 3:2 Scenario 2 HLN-WCW</i></p> <p>The event is cleared by the respective actors involved in each scenario by the end of lifetime with a next update.</p> <p>The sources of information for this use case are the following:</p> <ul style="list-style-type: none"> • [Study on the Deployment of C-ITS in Europe: Final Report] pp 158-160, includes references to the EU projects mentioned. • [ETSI TR 102 638], for Hazardous location notifications [ETSI TS 103 301].
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The user is provided with related information, presented on the dashboard. The layout is left to OEM-specific implementation. • The WCW message is presented early enough for the drivers to adjust their driving behaviour, and at the same time not too far away from the affected road segment. • The distribution of this warning message to end-users may extend beyond the single road segment or area affected. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<p>The document [ETSI TS 101 539 1] defines adverse weather condition specific functional requirements, as part of Road Hazard Signalling (RHS) in clause 6.3.6.</p> <p>It includes:</p> <ul style="list-style-type: none"> • DENM transmission conditions. • Event triggering condition. • Relevance area. • Event termination condition. • Use case specific data element values to be provided. • How the information is presented to the drivers is not part of the service description. • It is left to the provider of the in-vehicle information system with HMI how information is presented. • Information might be translated to the preferred language of the driver.
Link to other use cases	None

Interoperability requirements

Message profile requirements	<p>The DENM message for HLN – WCW is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP].</p> <ul style="list-style-type: none">For this use case, causeCode adverseWeatherCondition-ExtremeWeatherCondition17, adverseWeatherCondition-Visibility18, or adverseWeatherCondition-Precipitation19 shall be used. All respective subCauseCodes are applicable.stationType: 15 (also in case of a central C-ITS station)informationQuality shall be set according to the definition in [C-Roads MP].detectionZonesToEventPosition shall be provided as specified in [C-Roads MP].a single circular awareness area shall be provided. It shall be represented as:<ul style="list-style-type: none">eventPosition shall be set to the centre of the area subject to the event.awarenessDistance shall be provided using values 0 to 6.trafficDirection shall be set to allTrafficDirections (0).eventZone shall not be provided.<i>Legacy note: For highway scenarios, single linear awareness areas are allowed.</i> It shall be represented as:<ul style="list-style-type: none">eventPosition shall be set to the most upstream location of the event.awarenessDistance shall not be provided.trafficDirection shall be provided as specified in [C-Roads MP].eventZone shall be provided.Message management shall be done by either providing short validity durations or by actively terminating messages.												
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode adverseWeatherCondition-ExtremeWeatherCondition17, adverseWeatherCondition-Visibility18 or adverseWeatherCondition-Precipitation19 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><th></th><th colspan="2">SSP position</th></tr><tr><th>CauseCodeType / Container</th><th>Octet position</th><th>Bit position</th></tr><tr><td>adverseWeatherCondition-ExtremeWeatherCondition17</td><td>2</td><td>2</td></tr><tr><td>adverseWeatherCondition-Visibility18</td><td>2</td><td>3</td></tr></table>		SSP position		CauseCodeType / Container	Octet position	Bit position	adverseWeatherCondition-ExtremeWeatherCondition17	2	2	adverseWeatherCondition-Visibility18	2	3
	SSP position												
CauseCodeType / Container	Octet position	Bit position											
adverseWeatherCondition-ExtremeWeatherCondition17	2	2											
adverseWeatherCondition-Visibility18	2	3											

	<table><tr><td>adverseWeatherCondition-Precipitation19</td><td>2</td><td>4</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>	adverseWeatherCondition-Precipitation19	2	4
adverseWeatherCondition-Precipitation19	2	4		
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>			
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN – WCW• messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>			
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>			

3.2.5 HLN – Temporarily slippery road (HLN-TSR)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	A road operator knows that a section of a road (or a single lane or point) is temporarily slippery and sends this information to the drivers, and/or a vehicle detects that it is slipping and sends an alert message to other vehicles. The combination of these two information sources within a C-ITS system allows for much better information quality and accuracy compared to the two individual sources used so far.
Background	Today, information about slippery road sections is very limited, and this information is provided only by VMS. With C-ITS, the availability is better and the coverage and information quality can be greatly improved using I2V and V2V C-ITS systems that complement each other. This use case could reduce the risks of accidents by disseminating this information more widely and reaching the end-users in many more driving situations than today.
Objective	The objective of this use case is to increase the awareness of drivers about dangerous slippery sections so that they can adapt their speed and trajectory to the situation.
Desired behaviour	<ul style="list-style-type: none"> • Increased attention of the driver. • Adaptation of the driving speed. • Change of lanes (if needed). • Rerouting (e.g., for HGV or specific vehicle categories).
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accidents. • Improved traffic management.
Use case description	
Situation	<ul style="list-style-type: none"> • Depending on the cause of the slippery section, this use case can concern both directions of roads, even for dual carriageways. • Dealing with this information can be different for HGV and passenger vehicles since HGV might even adapt their itinerary completely. • Natural causes and/or spillage of various materials on the road are possible reasons for this risky situation and the generation of a warning message: <ul style="list-style-type: none"> ○ Oil, chemical fluids etc. ○ Rolling elements (e.g. bottles, golf balls, fruits,) ○ Black ice or water

	<p>Sources of this information can be:</p> <ul style="list-style-type: none"> • Cameras • Phone calls of a witness • Operating agents • C-ITS equipped vehicles with sensors which have detected the danger
Logic of transmission	I2V, V2V
Actors and relations	<p><u>I2V:</u></p> <ul style="list-style-type: none"> • Road operator: Generates the warning in the TCC and sends it to the C-ITS systems via various communication channels with one message ID. • Service provider: Forwards the warning messages to their users and contribute to the detection of slippery road segments. • Drivers: End-users are the drivers. For slippery segments detected by the vehicle sensors, drivers also act as data/information provider. <p><u>V2V:</u></p> <ul style="list-style-type: none"> • Sender is the vehicle detecting the slippery road. • End-users are all vehicles around or ahead of the slippery road segment.
Use case scenario	<ul style="list-style-type: none"> • The operators in the TCC get informed about a section that is slippery on the road network. • The TCC operators put the information into the TCC system, and the message is then disseminated to the drivers via the C-ITS systems and by various communication channels with one message ID. • The vehicles receive the information and present it to the drivers. • The drivers adapt their driving behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The drivers are provided with related information, presented on the dashboard. The layout is left to OEM-specific implementation. • The alert needs to be early enough for the drivers to adjust their driving speed without stress, but not too early so that the drivers do not forget about the alert. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • The vehicles might have to deal with two different sources of information for this use case: e.g., from other vehicles and from the TCC. Both sources of information could inform about a similar event, but not with exactly the same warning message, therefore the vehicle shall consider the priority between both messages. • For service providers the transmission speed and targeting accuracy for the drivers is a major dependency to implement this use case successfully, and to deliver high quality warning messages to the TCC. • Various sensors/procedures and their measurements/traffic detection are needed in the backend system of the road operators to generate the

	<p>information about all the slippery road segment locations for this use case. Therefore, restrictions of the service-availability could apply.</p> <ul style="list-style-type: none"> • The Information quality of this use case depends mainly on the detection of the event “temporarily slippery road” and the confirmation/maturity of the information. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Link to other use cases	IVS-TS: Sending the respective warning sign to the vehicles
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN-TSR is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • For this use case, causeCode adverseWeatherCondition-Adhesion6 and subCauseCode between 0 and 10 or causeCode hazardousLocation-SurfaceCondition9 with subCauseCode 0,1,4,5 or 7 shall be used. • eventSpeed shall not be provided. • In case of a linear event, a single linear awareness area shall be provided. It shall be represented as: <ul style="list-style-type: none"> ○ eventPosition shall be set to the most upstream location of the event. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall be provided. • In all other cases, a single circular awareness area shall be sent encoded as: <ul style="list-style-type: none"> ○ eventPosition shall be set to the centre of the area subject to the event. ○ awarenessDistance shall be provided using values 0 to 6. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be provided. • The alacarte container shall not be provided. • stationType: 10,15 (15 also in case of a central C-ITS station) • informationQuality shall be set according to the definition in [C-Roads MP]. • detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. • Message management shall be done by either providing short validity durations or by actively terminating messages.
Security and data protection requirements	Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].

	<p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode adverseWeatherCondition-Adhesion6 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>adverseWeatherCondition-Adhesion6</td><td>1</td><td>3</td></tr><tr><td>hazardousLocation-SurfaceCondition9</td><td>1</td><td>4</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	adverseWeatherCondition-Adhesion6	1	3	hazardousLocation-SurfaceCondition9	1	4
	SSP position												
CauseCodeType / Container	Octet position	Bit position											
adverseWeatherCondition-Adhesion6	1	3											
hazardousLocation-SurfaceCondition9	1	4											
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>												
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-TSR• messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>												
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p>												

	The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].
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3.2.6 HLN – Animal or person on the road (HLN-APR)

Type of road network	Motorways, Dual carriageways
Type of vehicle (receiver)	All
Use case introduction	
Summary	A road operator knows that one or several animal(s) is(are) present on the road network and sends the information to drivers. Or a driver detects one or several animals on the road and signals that information via his HMI, sending a message to other drivers. Both situations and warnings could also be combined.
Background	Today, this information is typically provided only by VMS or radio. With C-ITS, the availability is better. The update of the information can also be improved (moving animal). Wandering animals are not easily detectable. Such a use case can be an added information for the drivers.
Objective	The objective of this use case is to alert drivers of a potential danger. Since there is usually no automatic detection and the animal can be moving quite fast, the accuracy of the localization is not very high. Note, drivers need to increase their attention while driving.
Desired behaviour	<ul style="list-style-type: none"> • Increased driver attention. • Adaptation of driving speed. • Change of itinerary (e.g., because of a flock of animals in mountains).
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accidents. • Improved traffic management.
Use case description	
Situation	<p>The starting point of this use case can be several situations like a vehicle breakdown, an accident or a person taking a call reporting that persons or also animals are on a part of the road network and their movements are a dangerous situation for all involved drivers in the area.</p> <p>The dangerous situations could be:</p> <ul style="list-style-type: none"> • persons present or • a flock, or group of animals need to be detected, and the warnings created and distributed to all possible road users involved.

	<p>According to the type of the road (and the speed limit consequently), the danger can be more or less important. A flock of animals in the mountains can be quite frequent for example.</p> <p>Sources of information can be:</p> <ul style="list-style-type: none"> • Cameras • Phone call of a witness • Operating agents • Other C-ITS equipped vehicles which have detected the danger with various – C-ITS messages as follows
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> • Road operator: Sender is a road operator in the TCC. • Drivers: End-receivers are the drivers.
Use case scenario	<ul style="list-style-type: none"> • The operators in the TCC get informed about the presence of one or several persons or animal(s) on the road network. • The TCC operator puts the information in the TCC systems, and the message is then sent by the C-ITS systems on various communication channels with one message ID to the drivers. • The vehicles receive the information and present it to the drivers. • The drivers adapt their driving behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The alert to the drivers needs to be early enough for them to adapt their speed or itinerary (in case of a flock for example). However, since the drivers should not forget about the alert, it could be repeated closer to the location. • The information could be presented differently according to the type of the road. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • For service providers, transmission speed and targeting accuracy for the drivers is a major dependency to implement this use case successfully. • Various sensors/procedures and their measurements/traffic detection are needed in the backend system of the road operators to generate the information about persons/animals detected on road segments for this use case. Therefore, restrictions of the service-availability could apply. • The Information quality of this use case depends mainly on the detection of the event “animals or persons on the road” and the confirmation/maturity of the information. • The localisation can be very imprecise. And the information cannot always be verified by the road operator. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system

	with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Link to other use cases	Note that HLN-APR use case is about the actual presence of animals on the road. And not the generic indication of an area prone to animals crossing the road. IVS-TS: Sending the respective warning sign to the vehicles.
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN-APR is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • In case of a linear event, a single linear awareness area shall be provided. It shall be represented as: <ul style="list-style-type: none"> ○ eventPosition shall be set to the beginning of the road segment where the animal or person was detected. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall be provided. • In all other cases, a single circular awareness area shall be provided. It shall be represented as: <ul style="list-style-type: none"> ○ eventPosition shall be set to the location where the animal or person was detected. ○ awarenessDistance shall be provided using values 0 to 6. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be provided. • For this use case, causeCode hazardousLocation-AnimalOnTheRoad11 or humanPresenceOnTheRoad12 shall be used. All respective subCauseCodes are applicable. • stationType: 15 (also in case of a central C-ITS station) • detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. • informationQuality shall be set according to the definition in [C-Roads MP]. • Message management shall be done by either providing short validity durations or by actively terminating messages. • NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications]</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p>

	<p>This use case is based on the causeCode hazardousLocation-AnimalOnTheRoad11 or humanPresenceOnTheRoad12 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <p>The here shall be for C-ITS used by operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>
<p>Communication technology requirements: ITS-G5</p> <p>Communication technology requirements: IP based</p>	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p> <p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none"> • serviceType = HLN-APR • messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>
<p>Test and validation requirements</p>	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>

3.2.7 HLN – Obstacle on the road (HLN-OR)

Type of road network	Motorways, Dual carriageways, Rural roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	A road operator knows that there is one or several obstacles on one or several lanes of the road network and sends this information to drivers. However, traffic can still pass the obstacles (not a blockage).
Background	Today, this information is typically provided only by VMS or radio. With C-ITS, the availability is better.
Objective	The objective of this use case is to alert drivers of a potential danger. Since there is no automatic detection, the accuracy of the localisation is not very high. Note, drivers need to increase their attention while driving.
Desired behaviour	<ul style="list-style-type: none"> • Increased attention. • Adaptation of the speed. • Change of lanes (if needed).
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accidents. • Improved traffic management for road operators.
Use case description	
Situation	<p>The obstacles can be small and not harmful, but still dangerous, since they can surprise drivers, who might brake or show unpredictable behaviour if not alerted. There can also be big obstacles, such as lost furniture for example from a HGV, etc., that could result in the blockage of a lane.</p> <p>Sources of information can be:</p> <ul style="list-style-type: none"> • Cameras • Phone call of a witness • Operating agents • Other vehicles which have detected the danger and sent out vehicle C-ITS messages as possible source of information
Logic of transmission	I2V, V2V
Actors and relations	<p>I2V:</p> <ul style="list-style-type: none"> • Road operator: Sender is the road operator in the TCC. • Drivers: End-receivers are the drivers.

	<p>V2V:</p> <ul style="list-style-type: none"> • Road operator agent: Source of the information and sender of the information from the road operator vehicle. • Drivers: End-Receiver are all other vehicles around.
Use case scenario	<p><u>I2V scenario:</u></p> <ul style="list-style-type: none"> • The operators in the TCC get informed about the presence of one or several obstacle(s) on the road network. • The TCC operator puts the information in the TCC system, and the message is then sent by the C-ITS systems on various communication channels with one message ID to the drivers. • The vehicles receive the information and present it to the driver. • The drivers adapt their driving behaviour. <p><u>V2V scenario:</u></p> <ul style="list-style-type: none"> • A road operator agent detects the presence of one or several obstacle(s) on the road. • The road operator agent signals it via the specific HMI: the message is then sent to the road users. • The other vehicles around receive the information and display it to their drivers. • The other drivers adapt their behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The warning presented to the drivers needs to be early enough for the drivers to adapt their speed or even their itinerary. However, since the driver should not forget about the alert, it could be repeated closer to the location. • The information could be presented differently according to the type of the road. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • For service providers, transmission speed and targeting accuracy for drivers is a major dependency to implement this use case successfully. • Various sensors/procedures and their measurements/traffic detection are needed in the backend system of the road operators to generate the information about persons/animals detected on road segment locations for this use case. Therefore, restrictions of the service-availability could apply. • The Information quality of this use case depends mainly on the detection of the event “animals or persons on the road” and the confirmation/maturity of the information. • Due to the dynamic event the localisation can be very imprecise. And the information cannot always be verified by the road operator. Moreover, for the V2V scenario, the precise localization of the obstacle from the road operator vehicle deserves the necessary attention How the information is

	presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Link to other use cases	HLN-ERVI: If an emergency or rescue or recovery vehicle arrives at the location of the obstacle on the road, the HLN-ERVI use case shall be triggered additionally.
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN-OR is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • In case of a point location, a point-based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the obstacle. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be provided. • In the case of multiple obstacles spread on the road, a single linear relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the most upstream obstacle. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall be provided as specified in the [C-Roads MP]. ○ <i>NOTE: Currently V2V implementations only use point locations</i> • For this use case, causeCode hazardousLocation-ObstacleOnTheRoad10 and subCauseCode between 0 and 5 shall be used. subCauseCodes 6 and 7 shall not be used. • stationType: <ul style="list-style-type: none"> ○ I2V scenario: 15 (also in case of a central C-ITS station) ○ V2V scenario: stationType shall be set according to [C-Roads MP] • detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. • informationQuality shall be set according to the definition in [C-Roads MP]. • Message management shall be done by either providing short validity durations or by actively terminating messages. • For V2V scenario: <ul style="list-style-type: none"> ○ trafficDirection: allTrafficDirections • <i>NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.</i>
Security and data protection requirements	Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].

	<p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode hazardousLocation-ObstacleOnTheRoad 10 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>hazardousLocation-ObstacleOnTheRoad10</td><td>1</td><td>5</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	hazardousLocation-ObstacleOnTheRoad10	1	5
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
hazardousLocation-ObstacleOnTheRoad10	1	5								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-OR• messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TV] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>									

3.2.8 HLN – Emergency or Rescue/Recovery Vehicle in Intervention (HLN-ERVI)

Type of road network	Motorways, Dual carriageways
Type of vehicle (receiver)	All
Use case introduction	
Summary	The intent of the emergency or rescue/recovery vehicle in intervention (ERVI) use case is to warn drivers about the location of the involved vehicle in intervention (e.g., a traffic accident, incident or rescue and recovery work) so the other drivers will be able to adjust their driving behaviour accordingly and in time. The equipped emergency or rescue/recovery vehicle is sending a warning message when the vehicle is stationary with an activated light bar and being stationary for more than the defined time period.
Background	The location of an accident, incident or another type of intervention and the involved vehicles could be unclear and could surprise or confuse drivers arriving to this section, which could complicate passing the intervention location. This could lead to another accident and pose a serious danger for the involved vehicles/persons at the intervention site. An alert sufficiently in advance would prevent this type of situation by adapting the behaviour of the approaching drivers.
Objective	<p>Ensure that drivers are informed in a timely manner through C-ITS messages about the place of intervention ahead, so it is possible for them to adjust their driving speed and distance to lower the risk of other complications or incidents/accidents.</p> <p>Ensure more attentive driving while approaching and passing the area of an accident by providing in-vehicle information and warnings about the type of rescue and recovery work.</p>
Desired behaviour	<ul style="list-style-type: none"> • Increased driver attention. • Adaptation of the driving speed. • Adaptation of the driving trajectory (e.g., lane changes if needed) by leaving space to the emergency vehicle.
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accidents with stationary emergency and rescue/recovery vehicles and thus increased safety for the involved crews. • Avoid follow-up accidents and possible additional confusion for drivers. • Increased driving comfort. • Increasing safety of operation for all participants.
Use case description	
Situation	A stationary emergency/prioritised vehicle or a rescue/recovery vehicle in intervention safeguards the location of the accident or another type of

stationary hazard area where the emergency responders and/or rescuers are working. This can also include a stop during a patrol tour to take a picture/fix equipment or intervening to protect drivers that might have stopped, either on the road or on the hard shoulder. When other drivers are approaching the place of intervention and are in the relevant zone, they are notified through an application installed in-vehicle or on a mobile device about the position and distance to the intervention. Drivers can adjust their driving speed and position on the road to pass by easily.

Differentiation with HLN-SV use case:

There is a difference to the regular stationary vehicle use case (HLN-SV). Basically, standing emergency or rescue/recovery vehicles could always send stationary vehicle warnings. However, this intervention use case means that an actual intervention is going on e.g., small backward and forward movements (towing truck), or reposition at the incident location might occur, and personnel might be on the road next to the vehicle in intervention. Vehicle extensions might be used that require more space (e.g., crane of a recovery service or ladder of a fire engine). Thus, “in intervention” could imply that there is work going on, which requires more space and more attention of other drivers than in the case of a “regular” stationary vehicle.

Triggering conditions:

This use case can be triggered manually or automatically as described below

Type of triggering	Triggering Condition
Automatic status detection	Light bar in use, vehicle stationary for 30s
	Light bar in use, engine relay (run lock) activated or ignition off
Human supervision and activation	Manual trigger

For this use case, a vehicle is considered stationary when the speed dropped below 1,5 m/s for a predefined duration of 30s, or if the engine is turned off, the run lock is activated, or the hand brake is activated (see also HLN-EPVA).

The use case shall be terminated, if the vehicle moves faster than 1.5 m/s and more than 40m from the position where the vehicle became stationary (i.e. where the timer has expired).

Logic of transmission

V_{erv}2V

Actors and relations

- **Drivers:** Receive information on their in-vehicle display about an emergency and/or rescue/recovery vehicle activity on the road, its distance and the exact position.
- **Emergency or rescue/recovery vehicle drivers:** Use the ERVI use case to warn other drivers about the place and position of the accident or another type of intervention on the road ahead when approaching this location.

	<p>They also send information about the distance, direction and lane position of the emergency or rescue/recovery vehicle(s).</p> <ul style="list-style-type: none"> • Road operator: Provides information about the emergency or rescue/recovery vehicle in intervention detected on its network mentioned in the use case specifications and distributes respective warnings as C-ITS messages to all vehicles approaching the respective road segments involved.
Use case scenario	<ul style="list-style-type: none"> • The equipped emergency/prioritised or rescue/recovery vehicle arrives at the incident. • The unit starts to automatically transmit the message when the light bars of the vehicle are activated, and the vehicle is stationary at least for a predefined time or the warning is activated manually via an HMI device. • Vehicles in the relevance zone receive the message and drivers adapt their driving behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • Vehicles approaching the intervention site receive the message, process it and present the information to the drivers. • When the drivers arrive near the intervention site, they receive an alert with possible instructions. • The warnings may include the type of dangers, distance to the emergency vehicle and lane position. • The alert needs to be presented on the HMI early enough and should be moderately intrusive (at the manufacturer's discretion). • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Functional constraints / dependencies	<ul style="list-style-type: none"> • The location information needs to be accurate on road and lane level and related to the physical location of the actual rescue or recovery work. • For road operators, the detection quality of the incident and the linked traffic conditions are of high importance to be able to warn precisely and generate a correct message for this use case. • For service providers, transmission speed and targeting accuracy for the drivers is a major dependency to implement this use case successfully. • The link of this use case with other C-ITS messages needs to be carefully taken into account when implementing the warning priorities for mobile units. E.g., on its way towards the location, the equipped emergency vehicle could use the HLN-EPVA use case. • Another message could be sent by the TCC providing information on the actual event protected by the operating vehicle (e.g., HLN-AZ). Two messages could then be sent. It should be advised to see if it is possible to link the events dynamically.

	<ul style="list-style-type: none">In case of a big accident/incident with a lot of intervention vehicles, a problem could be that a lot of messages would be sent.											
Link to other use cases	This use case can be triggered by or in addition to multiple others. The switch from HLN-EPVA to ERVI is of special interest since the emergency/rescue/recovery vehicle is first approaching before they reach their destination for the intervention.											
Interoperability requirements												
Message profile requirements	<p><i>NOTE: This specification covers the V_{erv2V} – message only. An I2V implementation is not covered.</i></p> <p>The DENM message for ERVI is profiled in chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP].</p> <ul style="list-style-type: none">a point-based relevance zone shall be sent. It shall be represented as:<ul style="list-style-type: none">The eventPosition shall always contain the current position of the emergency vehicle at the time the message is sent.awarenessDistance: less than 5km (5)trafficDirection: In case of separated carriageways: sameAsReferenceDirection-upstreamOfReferencePosition, in case of non-separated carriageways or unknown: allTrafficDirections.<p><i>NOTE: the GN destination area shall be set accordingly to 1000m.</i></p><ul style="list-style-type: none">eventZone shall not be provided.Transmission Logic: V_{erv2V} – message sent from the vehicle in intervention:<ul style="list-style-type: none">stationType shall be set according to [ETSI TS 102 894-2] <i>NOTE: the stationType of V-ITS-S should reflect the type of the vehicle, not the role of the vehicle. The special role of an emergency vehicle is reflected in the vehicleRole, while the stationType could be motorcycle, lightTruck, trailer etc as defined in TS 102 894-2. “specialVehicles(10)” should be used for special purpose vehicles, which refers to special construction according to UNECE regulation.</i>An instance of detectionZonesToEventPosition shall be provided based on the path history of the vehicle as specified in [C-Roads MSP] and [C-Roads MP].At least one of the following triggering conditions shall be met, and informationQuality shall be set as follows: <table><tr><th>Type of triggering</th><th>Triggering Condition</th><th>informationQuality</th></tr><tr><td rowspan="2">Automatic status detection</td><td>Light bar in use, vehicle stationary for 30s</td><td>2</td></tr><tr><td>Light bar in use, engine relay (run lock) activated or ignition off</td><td>4</td></tr><tr><td>Human supervision and activation</td><td>Manual trigger</td><td>6</td></tr></table>	Type of triggering	Triggering Condition	informationQuality	Automatic status detection	Light bar in use, vehicle stationary for 30s	2	Light bar in use, engine relay (run lock) activated or ignition off	4	Human supervision and activation	Manual trigger	6
Type of triggering	Triggering Condition	informationQuality										
Automatic status detection	Light bar in use, vehicle stationary for 30s	2										
	Light bar in use, engine relay (run lock) activated or ignition off	4										
Human supervision and activation	Manual trigger	6										

- For this use case, a vehicle is considered stationary when the speed dropped below 1,5 m/s for a predefined duration of at least 30s, or if the engine is turned off, the run lock is activated, or the hand brake is activated (see also HLN-EPVA).
- eventPositionHeading and eventSpeed shall be provided.
- Message management shall be done as follows:

Message management	Setting
DENM update	every second
Repetition	not used
validityDuration	30 s
Termination	Cancellation

- The use case shall be terminated when the triggering conditions are no longer given, or when the triggering conditions of HLN-EPVA are met.

NOTE: Recovery vehicles without priority such as towing trucks will not use HLN-EPVA. They could be considered for slow vehicle warnings when they depart from an incident location.

Case 1: Emergency vehicle in intervention

- For this case, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 1 (emergencyVehicles) shall be used.
- CAM vehicleRole: “emergency (6)”
- CAM SpecialVehicleContainer: EmergencyContainer
- IncidentIndication in the EmergencyContainer shall be set to the causeCode/subCauseCode of this case.

Case 2: Prioritised vehicle in intervention

NOTE: Prioritised approaching vehicles (Case 2 in HLN-EPVA) change into this case when becoming stationary, while keeping the vehicleRole and container.

- For this scenario, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 0 shall be used.
- CAM vehicleRole: “safetyCar(7)”
- CAM SpecialVehicleContainer: SafetyCarContainer
- IncidentIndication in the SafetyCarContainer shall be set to the causeCode/subCauseCode of this case.

Case 3: Recovery vehicle in intervention

- For this use case, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 0 shall be used.
- CAM vehicleRole: “rescue(5)”
- CAM SpecialVehicleContainer: RescueContainer
- NOTE: there is no IncidentIndication in the RescueContainer

Security and data
protection requirements

Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].

	<p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode rescueAndRecoveryWorkInProgress 15 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>rescueAndRecoveryWorkInProgress15</td><td>2</td><td>1</td></tr></table> <p>The here listed SSPs shall be granted only for C-ITS stations used by organisations which by national and/or regional regulations have absolute right of way or some other sort of priority (e.g. road operators or emergency services).</p> <p><i>NOTE: An alignment of the definition for emergency services with C2C-CC is outstanding.</i></p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	rescueAndRecoveryWorkInProgress15	2	1
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
rescueAndRecoveryWorkInProgress15	2	1								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-ERVI• messageType = DENM <p>Geographic area (Quadtree) for DENM message, see appendix A of [C-ITS IP Based Interface Profile]:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned.</p> <p>Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									

<p>Test and validation requirements</p>	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>
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3.2.9 HLN – Emergency or Prioritised Vehicle Approaching (HLN-EPVA)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	<p>The intention of this use case is to warn drivers about an approaching emergency or prioritised vehicle in order to facilitate free passage of such emergency or prioritised vehicle, when they are on a mission.</p> <p>There is a wide range of vehicles with a special role that participate in traffic and that need other drivers to give way or to facilitate their passage, when they are on a mission. In this use case, two categories of right-of-way are considered:</p> <ul style="list-style-type: none"> • Certain vehicles have the absolute right of way in many countries (e.g. ambulance, police, fire brigade), if they activate their emergency signals – usually a light bar, often used together with a siren. • In some countries, certain vehicles (e.g., road operator vehicles) can have a kind of priority that does not give them the absolute right of way, but other drivers must facilitate their passage or give way to the extent necessary that they can fulfil their mission. <p>The expected behaviour of drivers being in the vicinity of a vehicle with a special role might differ per special vehicle category but also per country. Therefore, in this use case there is a distinction by whether these vehicles have the right of way (absolute or in a “weaker” form) as described above.</p> <p><i>NOTE: Vehicles without any right of way or priority in their national traffic rules are not subject of this use case. They might fall into other use cases, e.g., RWW-RM, RWW-WM.</i></p>
Background	<p>Emergency vehicles and other prioritised special vehicles signal the urgency or importance of their journey to other drivers so that the drivers can potentially form an emergency corridor. However, when this information is noticed too late, these vehicles on their mission might be blocked by other vehicles. Additionally, a high driving speed difference between these vehicles and other drivers, without the latter being aware of the upcoming presence of these vehicles, increases the risk of accidents.</p>
Objective	<p>The objective is to warn drivers in time about an approaching emergency or prioritised vehicle, to ensure a free passage for the specific vehicle, and to reduce dangerous situations in connection with these vehicles.</p> <p>Also, increasing the safety of the emergency vehicle personnel and drivers. In addition, reducing the travel time for the emergency and prioritised vehicles by avoiding blockages and/or when necessary, by fostering the formation of an emergency corridor in advance.</p>

Desired behaviour	<p>In this use case two specific types of behaviour are distinguished.</p> <ul style="list-style-type: none"> • Give way to an emergency vehicle (e.g., pull over to the side of the road or clear an intersection). • Facilitate the passage of the special vehicle or facilitate its mission (e.g., ensure the passage of a road operator vehicle) if it has some kind of priority. <p>In all cases, it is desired that the drivers drive more attentively and where necessary adapt their driving behaviour accordingly.</p>
Expected benefits	<ul style="list-style-type: none"> • More attentive driving while an emergency or prioritised vehicle is approaching. • Minimise risks of collisions and accidents. • Faster formation of the emergency corridor and therefore reduced travel time for the emergency vehicles. • Avoidance of congestion. • Faster arrival to the incident/accident site to improve road safety of such zones. • Reduction of risks taken by road operating agents to reach those accident sites. • Improvement of traffic management
Use case description	
Situation	<ul style="list-style-type: none"> • The emergency or prioritised vehicle assumes a task/mission, which is indicated by an active light bar, a siren, or a combination of both based on the national regulations for priority. • The sending of appropriate messages to the drivers nearby can be started automatically (automatically activated when the light bar/siren is activated) or manually, based on the desire of the implementer. • However, the activation of the light bar, siren or both is a precondition to trigger (manually or automatically) this use case. • As soon as the siren and/or light bar is off, the sending of HLN-EPVA messages shall stop. • If the vehicle is stationary, then the sending of HLN-EPVA messages shall stop. Instead, the use case for stationary special vehicles applies, see HLN-ERVI, as long as the light bar is still active. • The drivers receive the information about the approaching vehicle. • The drivers adapt their driving behaviour accordingly by either ensuring a free passage of the approaching vehicle and/or driving more attentive knowing an emergency or prioritised vehicle in mission is in the vicinity. <p>Triggering conditions:</p> <ul style="list-style-type: none"> • This use case can be triggered manually or automatically as described below • For this use case, a vehicle is considered stationary when the speed dropped below 1,5 m/s for a predefined duration in the range of [15 – 60]s,

	<p>or if the engine is turned off, the run lock is activated, or the hand brake is activated.</p> <p>○</p> <table border="1"> <thead> <tr> <th>Type of triggering</th><th>Triggering Condition</th></tr> </thead> <tbody> <tr> <td rowspan="2">Automatic status detection</td><td>Light bar in use, vehicle motion status unknown*</td></tr> <tr> <td>Light bar in use, vehicle not stationary</td></tr> <tr> <td>Human supervision and activation</td><td>Manual trigger</td></tr> <tr> <td colspan="2">(*) This holds only if triggering conditions of HLN-ERVI are not satisfied.</td></tr> </tbody> </table>	Type of triggering	Triggering Condition	Automatic status detection	Light bar in use, vehicle motion status unknown*	Light bar in use, vehicle not stationary	Human supervision and activation	Manual trigger	(*) This holds only if triggering conditions of HLN-ERVI are not satisfied.	
Type of triggering	Triggering Condition									
Automatic status detection	Light bar in use, vehicle motion status unknown*									
	Light bar in use, vehicle not stationary									
Human supervision and activation	Manual trigger									
(*) This holds only if triggering conditions of HLN-ERVI are not satisfied.										
Logic of transmission	I2V, V _{EPV2V}									
Actors and relations	<ul style="list-style-type: none"> • Emergency or prioritised vehicle: Sends appropriate HLN-EPVA messages to the vehicles in the vicinity of the emergency/prioritised vehicle or HLN-EPVA information to the Emergency Control Centre. • Emergency Control Centre: Collects the necessary information (e.g., mission status, status of light bar/usage of siren) of the approaching emergency or prioritised vehicle and sends this information to the TCC. • Traffic Control Centre: Creates the HLN-EPVA message based on the information received from the ECC and sends out the HLN-EPVA message • Drivers: Receive the HLN-EPVA message sent by the emergency or prioritised vehicle or by the TCC. The drivers are informed about the situation and can act accordingly. 									
Use case scenario	<p>The below mentioned cases could have 2 types of implementations, either V_{EPV2V} or I2V.</p> <p><u>Case 1:</u> Emergency Vehicle with absolute right of way</p> <p>The vehicle is an emergency vehicle and assumes a task/mission giving them the absolute right of way according to applicable traffic rules. The vehicle is not stationary, and the light bar and possibly siren is active.</p> <p><i>NOTE: In most cases the light bar of an emergency vehicle is blue (fire brigade, ambulance, police), sometimes combined with other colours. Thus, the scenario does not depend on light colour, but on an active light bar that signals that the vehicle is on a mission and has right of way according to the applicable regulations of that country.</i></p> <p><u>Case 1a:</u> V_{EPV2V}</p> <ul style="list-style-type: none"> • The emergency vehicle sends appropriate HLN-EPVA messages which can directly be used for communication to the vehicles in the vicinity of the 									

	<p>emergency vehicle. The drivers receive this HLN-EPVA message and can act according to the given circumstances.</p> <p><u>Case 1b: I2V</u></p> <ul style="list-style-type: none"> The emergency vehicle sends frequently the necessary information about its status to the ECC. With respect to information on the position, position updates shall be retrieved at least every second. The ECC relays this information to the TCC. The TCC creates the appropriate HLN-EPVA messages and sends them to the vehicles in the vicinity of the emergency vehicle. <p>For both cases, the exact interoperability requirements can be found in the interoperability requirements section of this use case.</p> <p><u>Case 2: Prioritised vehicle with some kind of priority</u></p> <p>In this scenario the vehicle assumes a task/mission where other drivers must facilitate its passage according to applicable traffic rules. The vehicle is not stationary, and the light bar and possibly siren is active.</p> <p><u>Case 2a: V_{EPV}2V</u></p> <ul style="list-style-type: none"> The prioritised vehicle sends appropriate HLN-EPVA messages which can directly be used for communication to the vehicles in the vicinity of the prioritised vehicle. The drivers receive this HLN-EPVA message and can act according to the given circumstances. <p><u>Case 2b: I2V</u></p> <ul style="list-style-type: none"> The prioritised vehicle sends frequently the necessary information about its status to ECC. The ECC relays this information to the TCC. The TCC creates the appropriate HLN-EPVA messages and sends them to the vehicles in the vicinity of the prioritised vehicle. <p>For both cases, the exact interoperability requirements can be found in the interoperability requirements.</p> <p><i>NOTE: Traffic rules regarding right of way for emergency and prioritised vehicles differ internationally and are not always sharply distinguished. For Day-1 applications it is the corresponding implementing authority's responsibility to evaluate under which conditions to apply the scenarios according to the national traffic rules. Activation of a use case scenario with a resulting warning to the driver to give way, when the driver must not give way shall be avoided as it could cause dangerous traffic situations.</i></p>
Intended Presentation/Alert principle	<p>The drivers are provided with related information, to be presented on the dashboard. Layout and sequence of presentation is left to specific implementation.</p> <p>The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.</p>
Functional constraints /	<p>This use case has been described and harmonised with just limited input from</p>

dependencies	<p>the stakeholder group of e.g., emergency responders. Their representation in C-Roads is only very limited. A broader consultation on an EU level with these stakeholders could lead to improvements to this use case.</p> <p>How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.</p> <p>There are specific interoperability requirements with respect to the I2V implementation of this use case.</p> <p>In I2V implementations, the location, speed and light bar status of the emergency or prioritised vehicle shall be monitored and reported to the TCC while the vehicle is driving. The TCC then triggers the event and sends the HLN-EPVA message.</p> <p>The trigger for this use case is a confirmed mission status and the vehicle must be moving.</p> <p>I2V implementations are only recommended, if no V2V implementation exists and the vehicle is connected to a backend system via a non-ITS interface to avoid misalignment of information.</p>
Link to other use cases	<p>This use case is functionally linked to HLN-ERVI. When the vehicle arrives at the event location, this use case shall be terminated and HLN-ERVI activated.</p>
Interoperability requirements	
Message profile requirements	<p>The DENM message for HLN-EPVA is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP].</p> <p><u>All cases:</u></p> <ul style="list-style-type: none"> • An instance of detectionZonesToEventPosition shall be provided based on the path history of the vehicle as specified in [C-Roads MSP] and [C-Roads MP]. • trafficDirection shall be set to allTrafficDirections. • awarenessDistance should be used. If so, the awarenessDistance shall be set to lessThan1000. • <i>NOTE: the GN destination area shall be set accordingly to 1000m</i> • eventPositionHeading and eventSpeed shall be provided. • For this use case, a vehicle is considered stationary when the speed dropped below 1,5 m/s for a predefined duration in the range of [15 – 60]s, or if the engine is turned off, the run lock is activated, or the hand brake is activated.

Case 1a (V_{EPV2V}): Emergency Vehicle with absolute right of way

- The causeCode shall be set to emergencyVehicleApproaching95 and the subCauseCode to emergencyVehicleApproaching (1).
- The vehicle shall send CAMs with associated vehicleRole and SpecialVehicleContainer (containing lightBarSirenInUse) as specified below
 - CAM vehicleRole shall be set to emergency(6) .
 - CAM SpecialVehicleContainer shall be set to EmergencyContainer.
 - IncidentIndication in the SafetyContainer shall be set to the causeCode/subCauseCode of this case.

Case 1b (I2V): Emergency Vehicle with absolute right of way

- The causeCode is emergencyVehicleApproaching95 and the subCauseCode is “emergencyVehicleApproaching (1)”

Case 2a (V_{EPV2V}): Prioritised vehicle with some kind of priority

- The causeCode shall be set to emergencyVehicleApproaching95 and the subCauseCode to prioritisedVehicleApproaching (2).
- The vehicle shall send CAMs with associated vehicleRole and SpecialVehicleContainer (containing lightBarSirenInUse) as specified below
 - CAM vehicleRole shall be set to safetyCar(7).
 - CAM SpecialVehicleContainer shall be set to SafetyCarContainer.
 - IncidentIndication in the EmergencyContainer shall be set to the causeCode/subCauseCode of this case.

Case 2b (I2V): Prioritised vehicle with some kind of priority

- The causeCode shall be set to emergencyVehicleApproaching95 and the subCauseCode to prioritisedVehicleApproaching (2).

Case 1a and 2a (V_{EPV2V})

- a point-based relevance zone shall be sent. It shall be represented as:
 - The eventPosition shall always contain the current position of the emergency vehicle at the time the message is sent.
 - awarenessDistance as defined above.
 - trafficDirection as defined above.
 - eventZone shall not be provided.
- The stationType: shall be set according to [ETSI TS 102 894-2]
NOTE: the stationType of V-ITS-S should reflect the type of the vehicle, not the role of the vehicle. The special role of an emergency vehicle is reflected in the vehicleRole, while the stationType could be motorcycle, lightTruck, trailer, etc. as defined in TS 102 894-2. specialVehicles(10) should be used for special purpose vehicles, which refers to special construction according to UNECE regulation.
- At least one of the following triggering conditions shall be met, and informationQuality shall be set as follows:

Type of triggering	Triggering Condition	InformationQuality
Automatic status detection	Light bar in use, vehicle motion status unknown*	2
	Light bar in use, vehicle not stationary	4
Human supervision and activation	Manual trigger	6
(*) This holds only if triggering conditions of HLN-ERVI are not satisfied.		

- Message management shall be done providing short validity durations as follows:

Message management	Setting
DENM update	every 250 ms
Repetition duration	no repetition
Repetition interval	no repetition
validityDuration	2 s
Termination	Not used

- The use case shall be terminated when the triggering conditions are no longer given, or when the triggering conditions of HLN-ERVI are met.

Case 1b and 2b (I2V)

- a single linear relevance zone shall be sent. It shall be represented as:
 - The eventPosition shall be set to the most up to date position of the emergency vehicle at the time the message is sent.
 - awarenessDistance as above.
 - trafficDirection as above.
 - eventZone shall be provided for an estimation of the path, which the vehicle has covered since the last position update received from the vehicle until the current time, when the C-ITS message is generated.
NOTE: Position updates shall be retrieved at least every second in order to *match the DENM update requirements*.
- The eventZone shall be matched to a road topology.
 - stationType: roadsideUnit(15) (also in case of a central C-ITS station)
 - At least one of the following triggering conditions shall be met, and informationQuality shall be set as follows:

Type of triggering	Triggering Condition	InformationQuality
status detection by TCC	"mission status confirmed" by the driver,	2

		vehicle not stationary							
automatic status detection by tracking or fleet management device	Light bar in use (automatically detectable), vehicle not stationary		2 or 4, see Note 1 below.						
Human supervisor and activation	Manual trigger		2 or 4, see Note 1 and Note 2 below.						
<p>NOTE 1:</p> <ul style="list-style-type: none">InformationQuality 2, if the timestamped information is obtained by a trustworthy third-party organisation that provides reliable and high-quality information e.g., location information from fleet management with emergency status validated by an operator in the PSAP (emergency service dispatch centre).InformationQuality 4 applies if the event information and the generation of C-ITS messages is in the responsibility of the same organisation under the quality constraints of the informationQuality definition in the Message Profiles. <p>NOTE 2:</p> <ul style="list-style-type: none">Since it is unlikely that the vehicle and its position are continuously monitored via CCTV and validated by a human operator, informationQuality 6 shall not be used.									
	<ul style="list-style-type: none">Message management shall be done providing short validity durations as follows: <table><tr><th>Message management</th><th>Setting</th></tr><tr><td>validityDuration</td><td>2 s</td></tr><tr><td>Termination</td><td>Not used</td></tr></table> <ul style="list-style-type: none">The use case shall be terminated when the emergency vehicle has arrived at its destination.detectionTime shall refer to the time when the position of the vehicle has been recorded within the vehicle.NOTE: detectionTime is not the time when the event is reported in the backend or processed in the R-ITS-S, but the time when acquiring the vehicle location within the vehicle (e.g. GPS timestamp). It is different from the referenceTime.			Message management	Setting	validityDuration	2 s	Termination	Not used
Message management	Setting								
validityDuration	2 s								
Termination	Not used								
Security and data protection requirements	Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications]. An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards								

	<p>for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode emergencyVehicleApproaching95 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><th></th><th colspan="2">SSP position</th></tr><tr><th>CauseCodeType / Container</th><th>Octet position</th><th>Bit position</th></tr><tr><td>emergencyVehicleApproaching95</td><td>3</td><td>3</td></tr><tr><td>emergencyContainer</td><td>1</td><td>6</td></tr><tr><td>safetyCarContainer</td><td>1</td><td>7</td></tr></table> <p>The here listed SSPs shall be granted only for C-ITS stations used by organisations which by national and/or regional regulations have absolute right of way or some other sort of priority (e.g. road operators or emergency services).</p> <p><i>NOTE: An alignment of the definition for emergency services with C2C-CC is outstanding.</i></p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	emergencyVehicleApproaching95	3	3	emergencyContainer	1	6	safetyCarContainer	1	7
	SSP position															
CauseCodeType / Container	Octet position	Bit position														
emergencyVehicleApproaching95	3	3														
emergencyContainer	1	6														
safetyCarContainer	1	7														
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>															
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-EPVA• messageType = DENM <p>Geographic area (Quadtree) for DENM message, see appendix A of [C-ITS IP Based Interface Profile]:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned.</p> <p>Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>															

Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>
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3.2.10HLN – Railway Level Crossing (HLN-RLX)

Type of road network	Dual carriageways, Rural roads, Urban roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	The railway infrastructure manager or a service provider informs the drivers about the presence of a railway level crossing and its type/parameters/status. This use case covers both protected level crossings along with unprotected ones. The messaging to the drivers and the information provided is addressed, too.
Background	<p>Very serious accidents, sometimes with a high number of fatalities, occur at railway level crossings. These accidents are often caused by drivers overlooking the warning lights of the signalling system and failing to stop in front of the crossing. Even at level crossings with barriers, serious accidents occur due to reluctance of drivers to stop before the barriers are down and, in addition, tendencies of drivers to bypass half barriers during active warning (waiting) phase at a crossing (so called S-manoevre). Accidents are also frequent on railway crossings without any signalling protection systems.</p> <p>It needs to be noted that railway level crossings principally differ from road Intersections in that the train has always priority and cannot be stopped suddenly and that light warning principles of signalling systems on crossings differ from those on road intersections. Also, different legal bodies are responsible for road and railway in Europe (with a few exceptions).</p> <p>With respect to the type of railway crossings, two distinctions are made:</p> <ul style="list-style-type: none"> ○ ‘active level crossing’ means a level crossing where the crossing users are protected from or warned of the approaching train by devices activated when it is unsafe for the user to traverse the crossing. ○ ‘passive level crossing’ means a level crossing without any form of warning system or protection activated when it is unsafe for the user to traverse the crossing.
Objective	<p>The drivers get warned about the presence of a railway level crossing to raise their attention when approaching it. A special warning is also shown to the drivers in case of an active level crossing.</p> <p>Other use cases and scenarios of light railway crossings involving traffic lights in urban environments with equipment at the crossing can be part of the intersection safety use cases.</p>
Desired behaviour	<ul style="list-style-type: none"> ○ Increased driver attention. ○ Adaptation of the driving speed in the vicinity of railway crossing and when passing the crossing according to national speed limits.

Expected benefits	<ul style="list-style-type: none"> ○ Stopping the vehicle in front of the crossing if the crossing is in a warning state. ○ Waiting for the train to pass the level crossing. ○ Reducing the risk of accident between road and railway vehicles. ○ Reducing the risk of road vehicle accidents in the vicinity of railway level crossings. ○ Increased driving comfort.
Use case description	
Situation	A vehicle is approaching a railway level crossing which is 'active' (e.g. be equipped with a signalling system with warning lights and/or barriers, without barriers, or 'passive' (e.g. with a warning cross only). In due time and location, drivers are informed about the presence of the railway crossing, and, if the warning is active, about the current status of the crossing. The message is sent to both sides of the level crossing, covering all roads leading to the level crossing and denoting the boundaries or stopping points of the crossing.
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> ○ Railway infrastructure manager: Is responsible that the signalling system generates warnings locally at the railway crossing and distributes respective warnings directly (with low latency) as C-ITS messages to all drivers approaching the crossing or via alternate communication channels. In addition, the railway infrastructure manager provides this information to the TCC in order to be published by the road operator to other users like navigation information providers, etc. ○ Service provider: Receives the warning messages from the railway infrastructure manager and provides them to the end-users. He can also maintain (static) database of railway crossings and generate messages based on that (without the information about the state of the crossing). ○ Drivers: End-users receive the warnings in the vicinity of the railway crossing and adapt their behaviour if necessary.
Use case scenario	<p><u>Scenario 1: Presence of a railway crossing (Basic warning), active and passive</u></p> <ul style="list-style-type: none"> ○ Information about the location of the level crossing including the national ID, the type of the level crossing, the number of rail tracks, its length, width, height and other optional information like recommended/maximum passing speed for road vehicles, is available in the railway system. ○ The information is periodically sent out by the C-ITS system at the crossing directly on various communication channels to the drivers using one message ID. ○ Inclusion of optional information is dependent on the rules of the respective railway infrastructure manager.

- The information is received in the vehicle and presented to the driver.
- The driver should drive cautiously and adhere to possible regulations with respect to crossing the railway crossing.

Scenario 2: Train approaching (active level crossing)

- If the approaching train is detected (by the signalling system), the C-ITS system will automatically and continuously distribute C-ITS messages with a special warning about the warning state active at the crossing, including optional information like estimated time to the end of the warning state, direction of the approaching train(s), etc. directly or on alternate communication channels with one message ID to the drivers.
- Inclusion of optional information is dependent on the rules of the respective railway infrastructure manager.
- The information is received in the vehicle and presented to the driver.
- The driver shall safely come to a stop before the railway crossing or before any preceding stopped vehicles.

Scenario 3: Railway crossing out of order (active level crossing)

- If the railway crossing signalling system is malfunctioning or out of order and such an event is detected by the signalling system itself or remotely by the railway infrastructure manager's means, or if fully closed for traffic, respective warning information is continuously sent out by the C-ITS system on various communication channels with one message ID to the drivers. In case of malfunctioning, which can be demonstrated to the driver in several different ways, it is recommended to send only "long-term warning state" information as the drivers may not precisely comprehend the meaning and react in a wrong way.
- The information is received in the vehicle and presented to the driver.
- The driver shall adjust its behaviour according to national regulations with respect to this specific situation (e.g. shall not cross, recommended not to cross, cross with caution a.o.). A specific behaviour cannot be specified due to different regulations in the EU countries with respect to this situation.

Scenario 4: Status of active level crossing unknown

- There might be no information available on the status of the active railway crossing systems (e.g. red lights, barriers, train detection) due to e.g. power outage or communication failure.
- The information that no specific information is available on the active railway crossing is received in the vehicle and presented to the driver.
- The driver shall drive very cautiously and shall determine the driving behaviour only on the physical status of the red lights and barriers.

Intended Presentation/Alert principle	<p><u>Scenario 5: Detection of approaching trains based on positioning systems from the train</u></p> <ul style="list-style-type: none"> ○ The backend of the service provider is equipped with a system to detect trains approaching the level crossing based on GNSS information and/or other positioning systems from the trains. ○ The service provider distributes C-ITS messages with a special warning when a train approaching the level crossing is detected. The message may include optional information like estimated time to the end of the warning state, direction of the approaching train(s), etc. ○ The vehicle receives the information and presents it to the driver. ○ In case of an approaching train, the driver shall safely come to a stop before the railway crossing. ○ The warning needs to be presented early enough to the driver and with adequate priority for the driver to adapt his driving behaviour. However, since the driver should not forget about the alert, it could be repeated closer to the location. ○ The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility. ○ The user is provided with related information. Layout and sequence of presentation is left to OEM-specific implementation.
Functional constraints / dependencies	<p>Due to strict safety requirements on railway traffic and the risk that the C-ITS system, which is not fail-safe, might send information valid for another time instance, no 'positive' information should be sent to the driver and also should not be implemented in the OBU, i.e., informing that the railway crossing is open (no train approaching). Only neutral (railway crossing is ahead) and 'negative' (signalling system is broken down or railway crossing closed/train is approaching) information should be given.</p> <p>How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.</p>
Link to other use cases	None
Interoperability requirements	
Message profile requirements	<p>The most suitable type of C-ITS message for this use case is DENM for the status (opened, closed, breakdown, unguarded, ...) and IVIM for the restriction and other information (length, width, height, weight, irregular ground, etc.).</p> <p>In addition, a SPATEM/MAPEM can be added relatively to a traffic light, if relevant e.g., in urban area or at freight railway sidings. For the RLX status, currently only the scenario of a risk of collision can be handled by the DENM standard.</p>

- The DENM message for HLN-RLX is profiled in the chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP].
- causeCode: railwayLevelCrossing100

NOTE: Before the cause code railwayLevelCrossing100 was standardised specifically for railway level crossing, the more general causeCode collisionRisk97 and subCauseCode 2 (crossing collision risk) has been used. Collision risk is still used for public transport crossing HLN-PTVC.

- subCauseCode:
 - Scenario 1: Presence of a railway crossing (Basic warning), active and passive level crossing
 - If train approaching detection system is installed, sCC shall be set to 4 (nominal);
 - else sCC shall be set to 3 (unguarded)
 - Scenario 2: Train Approaching (active level crossing)
 - sCC shall be set to 2 (closed)
 - Scenario 3: Railway crossing out of order (active level crossing)
 - sCC shall be set to 1 (doNotCrossAbnormalSituation)
 - Scenario 4: status of active crossing unknown (active level crossing)
 - sCC shall be set to 0 (unknown)
 - Scenario 5: Detection of approaching trains based on positioning systems from the train (passive level crossing)
 - sCC shall be set to 5 (trainApproaching)
 - *NOTE 1: As defined, the sCC 0,1,2 and 4 all imply an active crossing, only sCC 3&5 would apply to a passive crossing*
 - *NOTE 2: Scenario 5 only applies to passive crossings as stated by the applicability of the sCC ('in case a train is approaching, and the railway is without barriers')*
- a single linear relevance zone shall be sent. It shall be represented as:
 - eventPosition shall be at the light/barrier of the level crossing for the direction concerned.
 - awarenessDistance shall not be provided.
 - trafficDirection shall be provided as specified in [C-Roads MP].
 - eventZone shall be provided.
 - eventZone shall end at the light/barrier of the opposite direction. So, at least two DENMs are needed to describe the event (one per direction).
- informationQuality shall be set to 4 or 6 for this use case, depending on the confidence the railway operator can have in his system (e.g., SIL4 systems could lead to a 6, while non-SIL4 systems could justify a 4).

	<ul style="list-style-type: none">○ For each affected driving direction, a separate DENM shall be send.○ stationType: 15 (also in case of a central C-ITS station)○ detectionZonesToEventPosition shall be provided as specified in [C-Roads MP].○ Message management shall be done by either providing short validity durations or by actively terminating messages.<ul style="list-style-type: none">○ It shall be used on the following situations: Train is approaching, or the signalling system is broken down.									
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>railwayLevelCrossing100</td><td>4</td><td>3</td></tr></table> <p>The here listed SSP shall be granted only for C-ITS stations used by road operators or any contractor on their behalf and railway operators.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	railwayLevelCrossing100	4	3
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
railwayLevelCrossing100	4	3								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">○ serviceType = HLN-RLX○ messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that</p>									

Test and validation requirements	<p>the exact details of specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p> <p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>
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3.2.11 HLN – Unsecured Blockage of a Road (HLN-UBR)

Type of road network	Motorways, Dual carriageways, Rural roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	An operator in the TCC gets the information that there is an unsecured blockage of a road. Till the time that operating agents arrive to the site to protect and manage it, the operator sends a warning message to the drivers. A blockage means that there is no traffic going through the road segment. The complete road is blocked (not an obstacle on one or more lanes).
Background	Today, this information is provided only by the VMS or the radio. With C-ITS, the availability of information is better. In mountainous regions for example, where there are a lot of kilometres to be driven before road operators reach a site, providing such warning information to drivers before the road operator arrives to the site can be essential.
Objective	<p>The objective of this use-case is two-fold:</p> <ul style="list-style-type: none"> ○ For vehicles that are very close to the blockage: to alert them about a danger ahead. ○ For vehicles much more upstream, to allow them to reroute early enough. <p>This use case concerns one whole road, or one direction of a dual carriage way.</p>
Desired behaviour	<ul style="list-style-type: none"> ○ Increased vigilance of the approaching drivers. ○ Adaptation of the speed. ○ Rerouting if blocked road is far away and rerouting possible for the targeted destination.
Expected benefits	<ul style="list-style-type: none"> ○ Reducing the risk of accidents. ○ Improved traffic management. ○ Reduce the number of drivers impacted by the road blockage.
Use case description	
Situation	<p>A vehicle close to the blockage is warned of the dangerous situation ahead. Or a more upstream vehicle is informed to adapt the driving route.</p> <p>Causes of blockage:</p> <ul style="list-style-type: none"> ○ Rocks falling, ○ Accidents of HGV, ○ Water flood,

<p>Logic of transmission</p>	<ul style="list-style-type: none"> ○ etc. <p>This use case does not include a single broken-down vehicle, or a vehicle blocking a single lane of a dual carriage way road.</p> <p>Sources of information can be:</p> <ul style="list-style-type: none"> ○ Other vehicles which have detected the danger, ○ Cameras, ○ Phone call of a witness, ○ etc. <p>I2V</p>
<p>Actors and relations</p> <p>Use case scenario</p>	<ul style="list-style-type: none"> ○ Road operator: Sender is an operator in the TCC. ○ Drivers: End-receivers are the drivers in the vehicles. <ul style="list-style-type: none"> ○ The operators in the TCC get informed about a section of road that is blocked. ○ The operator puts the information in the TCC, and the message is then sent to the drivers. ○ The vehicles receive the information and presents it to the driver. ○ The drivers adapt their behaviour, depending on the distance and driving situation compared to the location of the blockage. ○ When the operating agents arrive on site, the blockage becomes managed, and additional use cases activated. ○ This C-ITS message will be terminated and enhanced with more accurate information and use cases.
<p>Intended Presentation/Alert principle</p> <p>Functional constraints / dependencies</p>	<ul style="list-style-type: none"> ○ The warning to the drivers must be sent in time and the presentation to the drivers must be early enough for them to adapt their speed or even their itinerary. However, since the drivers should not forget about the alert, it could be repeated closer to the location. ○ The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility. The message of this use case should be enhanced when road operator vehicles get on the blocked road segment and terminated the warning message. ○ The information quality of this use case depends highly on the information source and the detection quality of the information, but as a first warning it is for sure useful to enhance aware driving. ○ How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.

Link to other use cases	<p>HLN-EPVA: when an unsecured blockage is detected, usually an emergency or rescue/recovery vehicle is dispatched to secure the location. For the approach, the HLN-EPVA shall be triggered.</p> <p>HLN-ERVI: Once the vehicle reaches the location, the HLN-ERVI use case shall be triggered.</p>
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> ○ The DENM message for HLN-UBR is profiled in chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. ○ For this use case, for now, causeCode impassability5 and subCauseCode 0 (unavailable) shall be used. NOTE: Current vehicle implementations do not support causeCode impassability5. If the impassability has a clear reason, consider using other causeCodes already supported in vehicles describing this reason instead, e.g. human presence on the road (humanPresenceOnTheRoad12/x), stationary / broken down vehicle (stationaryVehicle94/2), rescue and recovery work in progress (rescueAndRecoveryWorkInProgress15/0) and add linkedCause impassability5/0. ○ In case of a point location, a point-based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the blockage. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be used. ○ In multiple blockages on the road, a single linear relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the most upstream blockage ○ awarenessDistance shall not be provided ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall be provided as specified in [C-Roads MP] ○ stationType: 15 (also in case of a central C-ITS station) ○ detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. ○ informationQuality shall be set according to the definition in [C-Roads MP]. ○ Message management shall be done by either providing short validity durations or by actively terminating messages. ○ NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used. <p><i>NOTE: A C-Roads follow up action with ETSI is planned to provide a more adequate solution on the CC and sCC.</i></p>

Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode impassability5 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>impassability5</td><td>4</td><td>0</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	impassability5	4	0
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
impassability5	4	0								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">○ serviceType = HLN-UBR○ messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>									

3.2.12 HLN – Alert Wrong Way Driving (HLN-AWWD)

Type of road network	Motorways, Dual carriageways
Type of vehicle (receiver)	All
Use case introduction	
Summary	<p>This use case is intended to warn a driver that he could encounter a vehicle that is driving in the wrong way. It is not the primary aim of this use case to alert the wrong way driver that he is on the wrong way. This V2V use case could be added in the future to the warning sequence if detection quality and confirmed status of information is improved.</p> <p><i>NOTE: The following description is valid only for right lane driving countries, in e.g. UK the lane situation would be mirrored, but the resulting danger for all vehicles involved is similarly high.</i></p>
Background	<p>Today, information about a wrong way driver exists but is only received via radio and/or VMS. The detection rate, time and accuracy of information is initially low, even if the wrong way driver alert is activated. Because of the high relative vehicle speeds involved between the approaching vehicles on the same lane, this generates always a highly risky situation on the road motorway network.</p> <p>For these reasons the application of a collaborative C-ITS service where vehicles and infrastructure cooperate to quickly detect, and immediately warn nearby vehicles and drivers reaching the “warning zone” could be of high positive impact for road safety.</p> <p>As the wrong way drivers occur at varying network positions, including motorway entrances and exits, the main limitation of current technologies is the low quality and slow detection of the vehicle involved, this can be improved by applying C-ITS and combining I2V and V2V applications.</p>
Objective	<p>The objective is to encourage the drivers to adapt their driving lane, speed and behaviour in case of a wrong way driver to minimise risks.</p> <p>The aim is <u>not to alert wrong way drivers</u> that they are driving in the wrong direction. This can be an optional V2V message and possibly even an in-vehicle detection application in the future.</p> <p>This would increase road safety by reducing driving speeds and thus accidents on motorways, as the wrong-way driver would be detected more quickly and located more accurately, triggering a detailed warning sequence for all nearby and approaching drivers.</p>
Desired behaviour	<p>Vehicle drivers receiving this information:</p> <ul style="list-style-type: none"> ○ Can adapt their speed and/or trajectory by driving at the most right.

	<p><i>NOTE: This is valid only for right lane driving countries, in e.g. UK the lane situation would be mirrored.</i></p> <ul style="list-style-type: none"> ○ Can put themselves in a safe place (rest area, motorway interchange, etc). ○ Pay more attention to their direct traffic surroundings.
Expected benefits	<p>The added value of this use case is that potentially involved drivers are informed faster and more accurately. Moreover, the service aims to inform more drivers than currently (not all drivers listen to the radio).</p> <p>This leads to:</p> <ul style="list-style-type: none"> ○ Increased road safety by less accidents due to wrong way driving and less “horrible driving situations” for drivers involved in such a situation even without a direct accident. ○ Reduction of the number of follow up accidents by detecting high risk situations linked to wrong way drivers fast and efficiently and distributing the correct and precise warning sequence of messages to all drivers approaching the risky area.
Use case description	
Situation	<p>The wrong way driving alert could be triggered by several situations:</p> <ul style="list-style-type: none"> ○ On a motorway, a vehicle takes a slip road (entrance or exit segment) in the wrong way or turns back in the toll station/rest area and drives on the motorway in the wrong driving direction. ○ On a ring road with separate carriageways, the situation can be the same, but with slip roads/exits more regular. <p>Because the wrong way driver is entering the motorway* segment he mostly uses the most left lane**, which for the correct drivers is the lane with the highest travelling speed.</p> <p>For the wrong way driving alert, the following phases of the use case should be defined depending on the confirmed information status of the road operator. Possibly, the warning sequence in a single case can also consist of more than two linked use case phases as follows. Phase 1 and 3 always apply. The WWD alert could be extended with Phase 2 if more specific information becomes available.</p> <p><u>Phase 1</u>: Warning all drivers approaching the risky area or segment of the transport network that a wrong way driver present. The WWD alert informs drivers to drive carefully and slowly and only on the right lane** and not to overtake (and therefore use the most left lane of the motorway**) on both directions of the motorway.</p> <p><u>Phase 2</u>: If the wrong way driver position, heading and lane is confirmed, all drivers approaching this respective road segment are alerted to drive carefully and switch lanes to drive on the right lanes**. And at the same time alert drivers on the opposite driving direction of the motorway that the WWD alert has been clarified and regular traffic conditions have been resumed.</p>



	<p><u>Phase 3</u>: After clearance of the complete warning case, all involved drivers are informed that regular traffic conditions have been resumed.</p> <p><i>*In the urban environment, the use case is currently not regularly reported even if evidence shows that it could also be relevant but is rarely detected. (Urban use case could be added in the future).</i></p> <p><i>**This described traffic situation is valid only for right lane driving countries, in e.g. UK the lane situation would be mirrored, but the resulting danger for all vehicles involved similarly high.</i></p>
Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> ○ Drivers: The end-users of this service are drivers in their vehicle, exposed to the wrong way driving vehicle in their direction and in the opposite direction of driving at the beginning of the WWD-alert. Following the confirmation of WWD position, heading and driving direction including the lane only the vehicle drivers on the carriageway approaching the RWW are informed, the other driving direction gets a de-escalation or warning cancellation. ○ Road operator: the sender of the message is the operator in the TCC, using various detection sources of the wrong way driving vehicle e.g.: <ul style="list-style-type: none"> ○ Automated wrong-way detector ○ Camera's ○ Phone call (field operator, police, drivers, radio). ○ Other C-ITS equipped vehicles ○ Service providers: Providing the message to the involved drivers and contributing the fast and precise detection of WWD cases by sending their WWD cases from vehicles to the involved road operators/public.
Use case scenario	<ul style="list-style-type: none"> ○ An operator in the TCC is alerted of the presence of a wrong way driving vehicle on a motorway segment. ○ Phase 1: The TCC sends the information for the relevant road segments for both directions. The subject of the message is "wrong way driver on your way". No detailed recommendations will be given initially. It informs drivers only to drive slowly and not to overtake. ○ Vehicles receive the information. ○ If the information is relevant for a vehicle (driver), the information is presented to the driver with a high priority. ○ Phase 2: Wrong way driver details (driving position, speed, heading, driving lane) are confirmed by a second source of information to the road operator in the TCC. ○ Vehicles involved receive the driving direction dependent updated information. ○ Updated information (for same traffic event and message) is presented to the driver with a high priority. ○ A message cancellation is transmitted after clearance of the WWD alert.

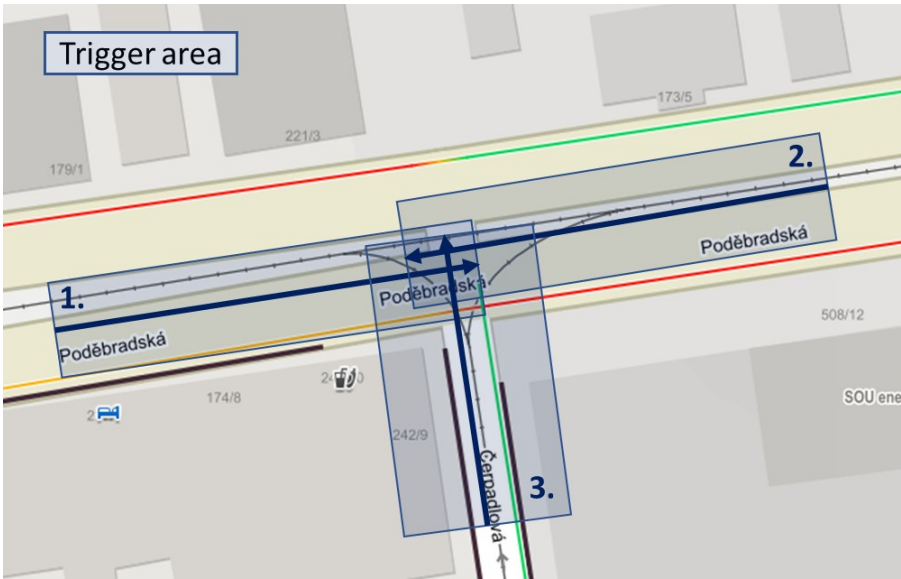
	<p><i>NOTE: If the detailed information does not become available, steps 5-7 will not be applicable.</i></p> <p>This use case could in the future also be extended in urban road networks, where drivers are driving against the allowed driving direction of a single direction road, which is also mainly a V2V use case.</p> <p>In a later stage of C-ITS deployment this could be enhanced by (an advanced vehicle detection application) warning the wrong way driver to stop immediately at the safe border of his current driving lane (and not try to turn, deviate or perform other driving actions).</p>
Intended Presentation/Alert principle	<p>There are two main presentation possibilities:</p> <ul style="list-style-type: none"> ○ A moderately intrusive alert to encourage the drivers to adapt their driving behaviour (change lane to right as precaution) without risk of an overreaction (this can be related to phase 1). ○ An intrusive alert to encourage the drivers to adapt their driving behaviour in case of urgency (this can be related to phase 2). <p>In both cases, the alert should be given early enough to give the drivers the time to adapt their driving behaviour, possibly reduce vehicle speed and follow a lane advice. The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.</p>
Functional constraints / dependencies	<ul style="list-style-type: none"> ○ For this particular use case, the validity duration, dissemination area, status and information quality will need to be determined and ascertained in the TCC for every phase of the use case. ○ The information will not be precise enough to manage an imminent emergency. <p>This use case would benefit from a future extension with V2V messages between vehicles and of an in-vehicle application for all C-ITS vehicles involved (also ego vehicle detection).</p> <p>This use case would benefit a lot if all C-ITS vehicles would have a robust WWD-Detection logic on board for the ego vehicle and for other vehicles in the surrounding traffic environment.</p> <p>Additionally, if the WWD use case is active, a specific V2V message forwarding in the opposite direction of the WWD would enhance the message distribution to the correct driver's group (approaching the risky situation with the WWD).</p> <p>How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.</p>
Link to other use cases	None
Interoperability requirements	

<p>Message profile requirements</p>	<ul style="list-style-type: none"> ○ The DENM message for HLN use-cases is profiled in chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. ○ For this use-case, causeCode wrongWayDriving14 and subCauseCode 2 (wrongDirection) shall be used. ○ stationType: 15 (also in case of a central C-ITS station) ○ detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. ○ informationQuality shall be set according to the definition in [C-Roads MP]. ○ Message management shall be done by either providing short validity durations or by actively terminating messages. ○ A single linear awareness area shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ eventPosition shall be set to a position upstream of the position where the wrong way driver was last detected. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall be provided. <p>The relevance zone of the event is a linear which starts upstream of the last known position of the WW driving vehicle and ends downstream this last know position. Upstream and downstream have to be understood as the correct driving direction for the infrastructure concerned (and not in reference to the driving direction of the WW driver). This linear of relevance is the eventZone of the DENM. This results in the WW driving vehicle being somewhere along the eventZone, between the eventPosition and the last point of the eventZone. In case the WW driver position is well known, the eventZone can be shortened by the road operator. To be on the safe side, the start of this linear event (i.e eventPosition) could be extended by the road operator to a position upstream of a suitable road junction or motorway exit, so that receiver-vehicles can choose to leave the carriageway to avoid any risk of accident with the WW driver.</p> ○ NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.
<p>Security and data protection requirements</p>	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the causeCode wrongWayDriving14 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p>

	<table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>wrongWayDriving14</td><td>2</td><td>0</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf.</p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	wrongWayDriving14	2	0
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
wrongWayDriving14	2	0								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-AWWD• messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>									

3.2.13 HLN – Public Transport Vehicle Crossing (HLN-PTVC)

Type of road network	Urban roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	The intent of this use case is to inform drivers that they are approaching a location with a high risk of collision with PT vehicles via in-vehicle information and warning.
Background	<p>The use case applies mainly in cities, as there are many places where tram tracks cross a road with other vehicles and these places are not equipped with traffic lights. Mainly during turning manoeuvres, drivers don't expect to cross tram tracks, which often can lead to accidents with trams.</p>  <p><i>Figure 3:3 Example of HLN-PTVC</i></p> <p>Other dangerous situations include situations where buses merge from bus priority lanes into mixed traffic lanes. Most drivers are unaware that they have to give priority to buses, which can also lead to conflicts and accidents.</p>  <p><i>Figure 3:4 Example of PTVC situation</i></p>
Objective	The drivers get warned about the presence of locations with a risk of collision

	with PT vehicles, i.e. where tram tracks cross a road (or in the connection with reserved lanes). The aim of this use case is to raise the driver's attention and to remind them to "Give priority!" when approaching the location.
Desired behaviour	<ul style="list-style-type: none"> • Increased driver attention. • Adaptation of the driving speed.
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accident with PT vehicles. • Increased driving comfort.
Use case description	
Situation	<p>A vehicle is approaching a location with a high risk of collision with PT vehicles. All these dangerous locations are known, pre-selected and saved in the database. At the same time, the PT vehicle enters the trigger area in the appropriate direction and begins to generate and transmit specific warning message. The database of the dangerous locations and their trigger areas are saved in the PT vehicle's OBU; for IP-based, they may also be deployed in the backend.</p> <p>The dangerous locations (and its trigger areas) are usually chosen by road operators or public transport companies who know where the spots of frequent accidents with PT vehicles (trams and buses) are. The type of locations is quite varied and always depends on the specific topology of the specific intersection.</p>  <p style="text-align: center;"><i>Figure 3:5 Example 1 of trigger area HLN-PTVC</i></p>

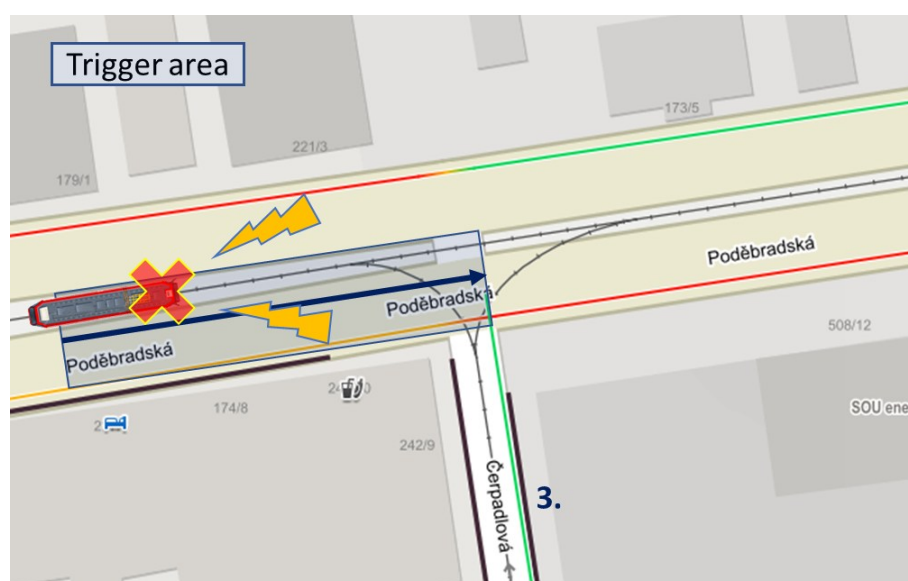


Figure 3:6 Example 2 of trigger area HLN-PTVC

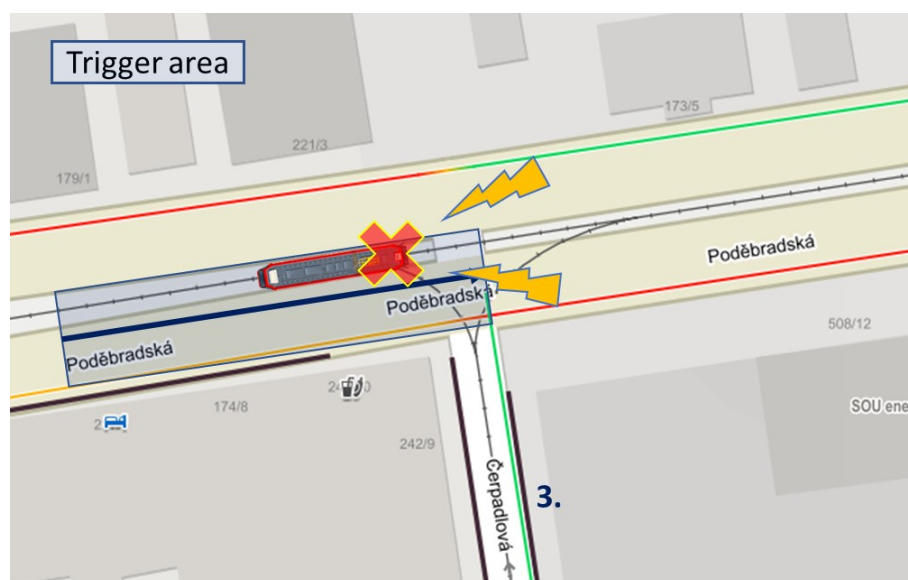


Figure 3:7 Example 3 of trigger area HLN-PTVC

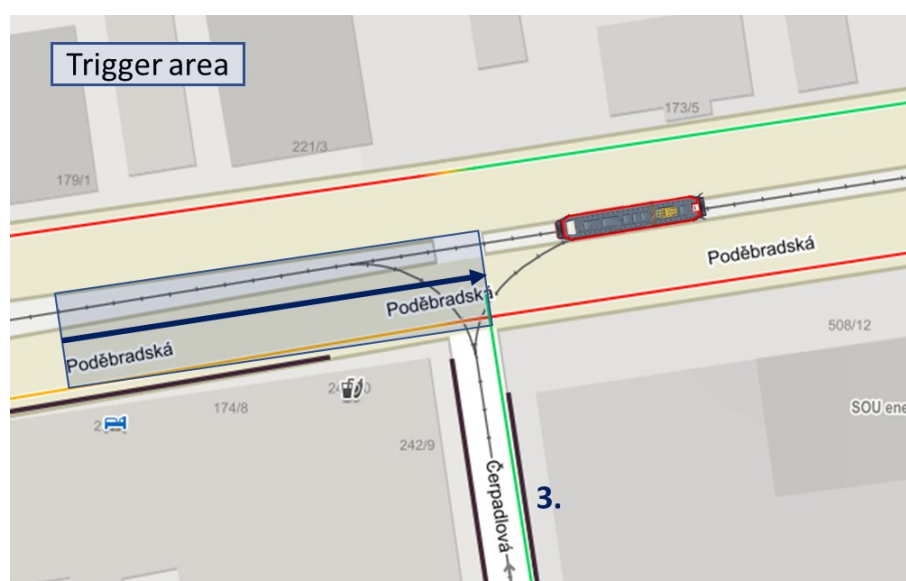


Figure 3:8 Example 4 of trigger area HLN-PTVC

Logic of transmission	V _{PT} 2V
Actors and relations	<ul style="list-style-type: none"> • Public transport operator: Is the origin of the information of the message. The direct source are OBUs in their vehicles. • Road user: End-users in the vicinity of the PT vehicle crossing receive the warnings.
Use case scenario	<ul style="list-style-type: none"> • The PT vehicle enters a trigger area of a dangerous location in the appropriate direction. • A warning message about a potential collision is generated and transmitted by an OBU in the PT vehicle containing its actual position (within eventPosition DE). • The information is sent to vehicles equipped with an OBU. • The vehicle receives the information and presents it to the driver. • The drivers adapt their driving behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The warning to the drivers needs to be presented early enough for them to adapt their driving behaviour. However, since they should not forget about the alert, it could be repeated closer to the location. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • This use case should be implemented only in locations without traffic light control (or when it is disabled). • For buses, it is expected to be used in locations where dedicated bus lanes cross regular traffic. • The (location) information of the trigger area should be accurate, detailed and up to date.

	<ul style="list-style-type: none"> • The trigger area shall be defined at least by 2 points which also defines the direction to avoid that the area activates a transmitting of DENM even though the PT vehicle just left the dangerous location. • The settings of the trigger areas shall consider the length of PT vehicle, GNSS antenna placement and an adequate amount of time between first transmission and reaching the PT vehicle. • The approaching PT vehicle should transmit its position with a certain accuracy and in a timely manner. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Link to other use cases	None
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN-PTVC is profiled in chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • For this use-case, causeCode collisionRisk97 and subCauseCode 2 (crossing collision risk) shall be used. • A point-based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the PT vehicle. ○ awarenessDistance shall not be provided. ○ trafficDirection shall be provided as specified in [C-Roads MP]. ○ eventZone shall not be provided. • stationType shall be set to 6 (bus) or 11 (tram) indicator of PT vehicles. • detectionZonesToEventPosition shall be provided as specified in [C-Roads MP]. • informationQuality shall be set according to the definition in [C-Roads MP]. • Message management shall be done by either providing short validity durations or by actively terminating messages. • NOTE: The position confidence depends on the accuracy of the localisation method. If no precise value can be given, the value 4095 (unavailable) shall be used. <p>In addition to the DENM, a CAM shall be sent.</p> <ul style="list-style-type: none"> • CAM vehicleRole shall be set to publicTransport (1). • CAM SpecialVehicleContainer: publicTransportContainer
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI</p>

	<p>standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the collisionRisk97 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><td></td><td colspan="2">SSP position</td></tr><tr><td>CauseCodeType / Container</td><td>Octet position</td><td>Bit position</td></tr><tr><td>collisionRisk97</td><td>3</td><td>5</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf and public transport operators.</p> <p><i>NOTE: C-Roads investigates the necessity to restrict this UC. If it is necessary, it is proposed to request a separate cC for PT use cases and restrict the usage of this new cC.</i></p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	collisionRisk97	3	5
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
collisionRisk97	3	5								
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p> <p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p>									
Communication technology requirements: IP based	<p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none">• serviceType = HLN-PTVC• messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>									
Test and validation requirements	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p>									

The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].
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3.2.14 HLN – Public Transport Vehicle at a Stop (HLN-PTVS)

Type of road network	Urban roads
Type of vehicle (receiver)	All
Use case introduction	
Summary	The intention of this use case is to provide in-vehicle information and warnings about public transport vehicles at a stop.
Background	<p>Public transport vehicles stopping at some types of stops create an obstacle on the road. These situations happen mainly at stops on lanes or stops where passengers get off directly on the road. At these locations, approaching vehicles could collide with the stationary public transport vehicle or even the passengers. These locations can be very dangerous mainly in combination with bad weather conditions.</p> <div data-bbox="477 956 1286 1234" data-label="Image">  </div> <p><i>Figure 3:9 Example of HLN-PTVS</i></p>
Objective	<p>The drivers get warned about the presence of a public transport vehicle at the stop to raise their attention when approaching it by providing in-vehicle information and warnings about this situation.</p> <p>During getting on and off public transport, passengers often don't pay much attention. Due to the warning, the driver can be prepared for unexpected pedestrian behaviour.</p>
Desired behaviour	<ul style="list-style-type: none"> • Increased driver attention. • Adaptation of the driving speed in the vicinity of the stop (stopping the vehicle behind the stationary PT vehicle). • Readiness for unexpected pedestrian behaviour.
Expected benefits	<ul style="list-style-type: none"> • Reducing the risk of accident with PT vehicles. • Reducing the risk of road vehicle accidents in the vicinity of PT stops. • Increased driving comfort.

Use case description	
Situation	<p>A vehicle is approaching a PT stop (e.g., stop on a lane), where a PT vehicle is standing, and passengers are getting on/off the vehicle in a hurry.</p> <p>The driver is informed about this situation.</p>
Logic of transmission	V _{PT} 2V
Actors and relations	<ul style="list-style-type: none"> • Public transport operator: Is the origin of the information of the message. The direct source are OBUs in their vehicles. • Drivers: End-users receive the warnings in the vicinity of the PT vehicle at a stop.
Use case scenario	<ul style="list-style-type: none"> • The PT vehicle stops at a stop. • Warning messages begin to be generated by the PT vehicle's OBU. • Information is sent to vehicles equipped with OBU. • The vehicle receives the information and presents it to the driver. • The drivers adapt their driving behaviour.
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • The warning to the drivers needs to be presented early enough for them to adapt their driving behaviour. • The user is provided with related information. Layout and sequence of presentation are left to OEM-specific implementation. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • The sent position of the PT vehicle and the exact lane it is located should be sufficiently accurate. • The sent info that the PT vehicle is coming to a stop should be communicated early enough to leave time for surrounding vehicles to be aware and react. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. Information might e.g., be translated to the preferred language of the driver.
Link to other use cases	None
Interoperability requirements	
Message profile requirements	<ul style="list-style-type: none"> • The DENM message for HLN-PTVS is profiled in chapter 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. • For this use-case, stationaryVehicle94 and subCauseCode 4 (publicTransportStop) shall be used. • A point-based relevance zone shall be sent. It shall be represented as: <ul style="list-style-type: none"> ○ The eventPosition shall be set to the location of the PT vehicle. ○ awarenessDistance shall not be provided.

	<ul style="list-style-type: none"><ul style="list-style-type: none">○ trafficDirection shall be provided as specified in [C-Roads MP].○ eventZone shall not be provided.• stationType shall be set to 6 (bus) or 11 (tram) to clearly indicate public transport vehicles.• detectionZonesToEventPosition shall be provided as specified in [C-Roads MP].• informationQuality shall be set according to the definition in [C-Roads MP].• Message management shall be done by either providing short validity durations or by actively terminating messages. validityDuration should be short, corresponding to the mean time of a stop.• NOTE: The position confidence depends on whether the PTV uses GPS. If no precise value can be given, the value 4095 (unavailable) shall be used. <p>In addition to the DENM, a CAM shall be sent.</p> <ul style="list-style-type: none">• CAM vehicleRole shall be set to publicTransport (1)• CAM SpecialVehicleContainer shall be set to publicTransportContainer									
Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the stationaryVehicle94 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):</p> <table><tr><th></th><th colspan="2">SSP position</th></tr><tr><th>CauseCodeType / Container</th><th>Octet position</th><th>Bit position</th></tr><tr><td>stationaryVehicle94</td><td>3</td><td>2</td></tr></table> <p>The here listed SSP shall be granted for C-ITS stations used by road operators or any contractor on their behalf and public transport operators.</p> <p><i>NOTE: C-Roads investigates the necessity to restrict this UC. If it's necessary, it is proposed to request a separate cC for PT use cases and restrict the usage of this new cC.</i></p> <p><i>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</i></p>		SSP position		CauseCodeType / Container	Octet position	Bit position	stationaryVehicle94	3	2
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
stationaryVehicle94	3	2								
Communication technology requirements: ITS-G5	For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.									

<p>Communication technology requirements: IP based</p>	<p>For ITS-G5 based implementations of use cases where mobile stations are allowed and used, the requirements of C-Roads, [C-Roads MSP] shall apply.</p> <p>For IP based implementations of use cases shared using backend communication, the requirements of [C-ITS IP Based Interface Profile] shall apply.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [C-ITS IP Based Interface Profile] shall apply:</p> <ul style="list-style-type: none"> • serviceType = HLN-PTVS • messageType = DENM <p>Geographic area (Quadtree) for DENM message:</p> <p>The event is characterised by its referencePosition, detectionZone(s), relevanceZone(s) and DestinationArea. These fields draw a geographic area and C-ITS actors shall publish in a set of tiles corresponding to the maximum set of tiles containing all the geographic indication mentioned. Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].</p>
<p>Test and validation requirements</p>	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [C-Roads_TVC] contains the generic applicable framework and process for interoperability testing.</p> <p>The applicable message and service generic and use case specific test cases are listed in the document “C-ITS Test Plan” [C-Roads_TP].</p>