Common C-ITS Service Definitions

Hazardous Locations Notification (HLN)

C-Roads Platform

Working Group 2 Technical Aspects

Taskforce 2 Service Harmonisation

Publication History

Version	Date	Description, updates and changes	Status
0.1	15.10.2018	Started use case description for HLN group and use case Form Emergency Corridor, HLN – FeCOR,	Draft
0.2	17.12.2018	Input and comments included from C-Roads Belgium, Czech Republic, France, Portugal, Slovenia	Draft
0.3	20.12.2018	Input after Telco 17.12.18, use cases combined, and emergency vehicle approaching added, comments to Railway level crossing clarified	Draft
0.4	21.01.2019	Input received and included from France, Germany, Czech Republic, Portugal	Draft
0.5	25.01.2019	Changes incorporated according to the TF2 Subgroup telco discussions and the agreed changes.	Draft
0.6	06.02.2019	Changes included from AZD, Czechia, and HessenMobil, Germany, and minor text improvements.	Draft
0.75	14.02.2019	Open aspects from contributions and Telco clarified, and use case maintenance vehicle warning (HLN – MaVeW) added	Draft
0.8	15.02.2019	Removed use case maintenance vehicle warning after discussions, will be integrated in existing RWW use case, also indicated category A and B use cases in the header.	Draft

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1 Functional Description of Hazardous Locations Notification

1.1 Hazardous Locations Notification service introduction

Service introduction	
Summary	This C-ITS service describes an I2V warning message related to a series of potentially hazardous events on the road, where the approaching road users gets information and therefore warning 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 for road users potentially causing (more) accidents resulting in injuries/fatalities. This C-ITS service has the potential to directly inform the involved and relevant road users so they can adopt their driving behaviour accordingly.
Objective	Inform road users of hazardous locations on their way in order to enhance overall road safety by providing in-car information about these hazards, including the location and type of hazard, possibly also the remaining distance to the location, the duration of the events creating the hazard and lane and speed advice.
Expected benefits	More attentive driving while approaching and passing a hazardous location, or road section. Minimize risk to collisions/accidents resulting in less incidents / injuries / fatalities amongst road users and therefore to a harmonised traffic flow.
Use Cases	***Will be updated accordingly*** The events and therefore the Use Cases of the C-ITS service group HLN – Hazardous Location Notifications have been defined with the following warnings in C-Roads rel 1.3 as use cases: • Accident Zone, (Abbreviation: HLN – AZ) • Traffic Jam Ahead, (Abbreviation: HLN – TJA) • Stationary Vehicle, (Abbreviation: HLN –SV) • Weather Condition Warning, (Abbreviation: HLN – WCW) • Temporarily Slippery Road,(I2V), (Abbreviation: HLN – TSR) • Animal or Person on the Road (I2V), (Abbreviation: HLN – APR) • Obstacle on the Road (I2V), (Abbreviation: HLN – OR) Additionally in rel 1.4 hazardous events on the road (and therefore the UC scenarios of the C-ITS service) can generate the following warnings: • Form Emergency Corridor, (HLN – FEC), Emergency Vehicle Approaching (HLN-EVAP), Railway Level Crossing (HLN-RLX) • . . . The use case descriptions for Wrong Way Driver (HLN – WWD), or Truck Queues, (HLN – TQ), other UC´s are under investigation and might be added in next C-Roads releases.

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1.2 Use Case Form Emergency Corridor description (HLN-FEC)(A)

Use case introduction Form Emergency Corridor	
Summary	The road operator detects an event on its network where a traffic queue is forming up and broadcasts via a Roadside Station the information to the road users approaching it that they shal form an emergency corridor for emergency vehicles to be able to reach the traffic event in the fastest possible way.
Background	This Use Case is about forming the emergency corridor when a traffic jam builds up, during the phase when the vehicles are still moving via exchanging information between infrastructure and vehicles and describes the following scenario: 1. Sending traffic information from the TCC to the vehicles This scenario (TCC → 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 traffic queue information.
Objective	Warn road users of traffic events on their way and make them drive in the form of "an emergency corridor" in order to enhance overall road safety.
Desired behaviour	Precisely and correctly informed drivers adapt their driving behavior (i.e. drivers driving on the most left lane should drive on the left border of their current lane, drivers driving on the other lanes should drive on the right border of their current lane and reduce the speed according to the vehicle in front, drive more cautiously and/or concentrated...)  (The pictogramm is for illustration purposes only!) Hereby between the inner most lane and the one next to it (see picture above) an emergency corridor should remain, where police, ambulance or fire brigades can rapidly advance to the place of the traffic event and intervene swiftly.
Expected benefits	• Enhanced road safety for the society and lower numbers of persons killed or injured by traffic accidents and incidents, which are cleared faster. • Lighter injuries and lower numbers of secondary damages following a dangerous situation on the road for road operators and drivers. • Higher quality of traffic information services for service providers. • Faster formation of an emergency lane and therefore helping the emergency vehicles to pass queuing vehicles more rapidly. • More relaxed/comfortable driving for drivers.
Use case description	
Situation	A traffic event creating a danegrous situation on a road network, driving direction

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	dependent – and only downstream of the event with impact on the traffic flow on dual carriage way.
Logic of transmission	I2V broadcast, supported by V2V
Actors and relations	**Road operator:** provides information about the traffic event detected on its network mentioned in the use cases specifications and distributes respective warnings as C-ITS messages to all upstream drivers approaching the event in a lower than average driving speed. **Service provider:** distributes C-ITS messages actively and dynamically to the subscribers (end users) approaching the event. **Emergency responders:** Are informed about the HL with high quality of information and can better approach the vehicles involved in the accident/ incident. Because of the fast approach and clearance, the support to all persons involved is more efficient. **Road user**: The road user is informed about the traffic event ahead and the traffic queue area on his way by his selected channel of information. He adjust´s his driving speed and position on the road in order to let the public service vehicles pass and access the hazarduos location or accident.
Scenario	Sending traffic event information and traffic queuing area from the TCC to the vehicles - I2V broadcast The "traffic event" and the related queuing areas are detected and confirmed in the TCC, correct warning messages are coded according to the specified definition and send via the defined channels to R-ITS-S and web interface. The road user is informed ahead of the traffic event and the traffic queue.
Display / alert principle	Sending event information and traffic queuing areas from the TCC to the vehicles - I2V broadcast When the road user arrives near to the traffic event and queing area, he receives information to allow him to adjust his driving speed and position on the road to prevent dangerous situations. The information needs to be displayed on the HMI early enough, and is moderately intrusive (at the manufacturer's decision).
Functional Constraints / dependencies	For service providers the transmission speed and targeting accuracy for the road users 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 in order to generate the information about all the traffic events/hazardous locations for this use case. Therefore, restrictions of the service-availability could apply. The Information quality of this use case form emergency coridor depends mainly from the detection of the event location and "detailed network disturbances" and the confirmation/ maturity of this information.
Relation to C-Roads C-ITS Infrastructure Functions and Specifications	=> For the relation to TF3: Option 1: DENM message as a linear event with a dedicated CC/SCC (to be defined) Option 2 => through IVI message, because "form emergency corridor" is a traffic management measure, therefore IVI – merge to left, merge to right and for the emergency vehicle a message needs to be added as explanatory text "Form emergency corridor" (Also because no explicit pictogram, or traffic sign exists. Remark: There is a link of the HLN message to the Use Case Emergency vehicle approaching

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1.3 Emergency Vehicle Approaching (HLN – EVAP)(A)

Use Case introduction Emergency Vehicle Approaching	
Summary	The emergency vehicle is equipped with the necessary technology for a vehicle-to-vehicle (V2V) communication to send appropriate messages and alert the road users in advance.
Background	Obstructions in connection with emergency vehicles often occur due to road users, which receive the information about an approaching emergency at very short notice. Limited visibility, for example due to bad weather conditions, reinforces the critical situation. Additionally, a high driving speed difference between the emergency vehicle and the road users while an emergency increases the risk of accidents.
Objective	The objective is to reduce the number of accidents in connection with emergency vehicles. Safety of the personnel and road users can be increased. Additionally, the travel time for the emergency vehicle can be reduced by fostering the formation of an emergency corridor in advance.
Desired behaviour	The informed road users adapt their driving behavior accordingly. The road user can adapt the vehicle speed and the usage of the lane conforming to the information.
Expected benefits	• More attentive driving while an emergency vehicle is approaching. • Minimize risks to collisions and accidents. • Faster formation of the emergency corridor and therefore reduced travel time for the emergency vehicle due to a proper emergency corridor. • Avoidance of congestions

Use case introduction	
Situation	• The emergency vehicle sends appropriate messages to the road users. • The road user is precisely informed about the emergency vehicle.
Logic of transmission	○ V2V
Actors and relations	• **Emergency vehicle**: sends appropriate messages to the environment for the road users to receive. • **Road user**: receives message sent by the emergency vehicle. The road user is informed about the situation and can act accordingly.
Scenarios	The emergency vehicle is sending appropriate messages to the road users nearby: (1) The road users receive the information about the approaching emergency vehicle from behind and can adapt their driving behavior accordingly. (2) The road users receive the information about an emergency vehicle in front and can adapt their driving behavior accordingly. (3) The road users receive an information about a stationary emergency vehicle, which. for example, guards against an accident, and adjusts their driving behavior and speed accordingly
Display / Alert logic	(1) The emergency vehicle sends appropriate messages to the road users nearby as soon as the light bar is active. As soon as the light bar is off the emergency vehicle stops sending DENMs. (2) If the hand break is pulled, the maintenance vehicle sends a DENM with the information that a stationary emergency vehicle is on the road. (3) (4) The road user receives the information about the approaching emergency vehicle. (5) The road user adapts their driving behavior accordingly.
Functional constraints /	• **Emergency Vehicle needs to be equipped with:**

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Dependencies	○ GPS receiver, ETSI G5 module to be able to send DENMs. • **Road User needs to be equipped with:** ○ ETSI G5 module to have the capability to receive and process V2V DENMs
Relation to C-Roads C-ITS Infrastructure Functions and Specifications	[not specified yet] • The most suitable type of C-ITS message for this use case (DENM and additionally from the mergency vehicle - CAM) still needs to be defined. Remark: CAM - additionally send out from the vehicle with the following elements: - vehicleRole is emergency (6) *(or safetyCar (7) to be discussed)* - EmergencyContainer *(or SafetyCarContainer to be discussed)* has the DE lightBarSirenInUse equal to [1,0] or to [1,1], which mean that the light bar is activated and the siren is activated or not. (=> Discuss this topic at WG2/ C2C CC)

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1.4 Railway Level Crossing (HLN-RLX)(A)

HLN – UC – RLX Railway Level Crossing (I2V unguarded & guarded additional)	
Type of road network	Road, urban road
Type of vehicle	All vehicles
Use case introduction	
Summary	The Railway inframanager or a Service provider informs the driver 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 drivers and the information provided is addressed, too.
Background	Very serious accidents, sometimes with a high number of fatalities, occur at railway level crossings. These accidents are often caused by a road vehicle driver 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-manoeuvre). Accidents are also frequent on railway crossings without any signalling protection systems. 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 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).
Objective	The driver gets warned about the presence of a railway level crossing to raise his/her attention when approaching it. Special warning is also shown to the driver when the signalling system (when available) detects approaching train. 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.
Desired behaviour	• Increased driver attention • Adaptation of the driving speed in the vicinity of railway crossing and when passing the crossing according to national speed limits • Stopping the vehicle in front of the crossing if the crossing is in a warning state • Waiting as long as the train has not passed the level crossing
Expected benefits	• 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	Vehicle is approaching a railway level crossing which may be equipped with a signalling system with warning lights and barriers, without barriers, or with a warning cross only. In due time and location the driver is informed about the presence of the railway crossing, and, if warning is active, about the current status of the crossing.
Logic of transmission	I2V broadcast • locally 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 • over the network to various communication channels

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Actors and relations	• **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 inframanager** provides this information to TCC in order to be published to other users like Navigation information providers, etc.* • **Service provider** receives the warning messages from the Railway inframanager 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). • **End-user** receives the warnings in the vicinity of the railway crossing.
Scenario	**I2V** Basic warning: • 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 with one message ID to the road users. • Inclusion of optional information is dependent on the rules of the respective Railway inframanager • The vehicle receives the information and displays it to the driver. • The driver adapts his behaviour Approaching train: • If the approaching train is detected (by the signalling system), C-ITS system will automatically and continuously broadcast/distribute C-ITS message 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 road users. • Inclusion of optional information is dependent on the rules of the respective Railway inframanger • The vehicle receives the information and displays it to the driver. • The driver adapts his behaviour Railway crossing out of order: • If the railway crossing signalling system is malfunctioning or out of order and such event is detected by the signalling system itself or remotely by the Railway inframanager's means, or if fully closed for traffic, respective warning information is continuously sent out by the C-ITS system on various channels with one message ID to the road users. 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 driver may not comprehend precisely the meaning and react in a wrong way. • The vehicle receives the information and displays it to the driver. • The driver adapts his behaviour
Display / alert principle	• The warning to the driver needs to be displayed early enough and with adequate priority for him/her to adapt his driving. However, since he/she should not forget about the alert, it could be repeated closer to the location. • The user is provided with related information. Layout and sequence of presentation is left to OEM-specific implementation.
Functional Constraints / dependencies	Due to strict safety requirements on railway and the danger that the C-ITS system, which is not fail-safe, might, by its failure, send an information valid for another time instant, **no 'positive' information should be sent to the driver**

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	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/signalling system breakdown) and 'negative' (railway crossing closed/train is approaching) information should be given.
Relation to C-Roads C-ITS Infrastructure Functions and Specifications	The most suitable type of C-ITS message for this use case DENM part (SCC are unavailable (0), alert/closed doNotCross (1), longTermWarning, doNotCross (2) or fullClosure (3) Other usefull information should be sent along: level crossing national ID (useful for accident localisation), type of the railway level crossing, number of rail tracks, its length, width, height. Other optional information may be sent based on Inframanager rules: estimated time to the end of the warning state, direction of the approaching train(s) OBU manufacturer decides which information is displayed to the driver. It is recommended that at least those provided by traffic signs acc. to national rules are displayed. All the information may be sent in the HLN-RLX message or an IVI can be added to inform about length, width, height, weight irregular ground restrictions, limited available space behind the crossing if relevant. (DENM vs. IVI vs. SPAT/MAP) needs still to be done in TF3 A SPAT/MAP can be added relatively to a traffic light, if relevant e.g in urban area or at freight railway sidings. See remark in objective section.

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1.5 Public Transport Vehicle at Stop (HLN-PTVS)(B) – V2V and I2V

HLN – UC – PTVS Public Transport Vehicle at Stop (V2V)	
Type of road network	Road, urban road
Type of vehicle	All vehicles
Use case introduction	
Summary	Providing in-car information and warning about public transport vehicle at a stop.
Background	The public transport vehicles stopping in some types of stops create an obstacle on the road. These situations happen mainly in the stops on the road lane or stops where passengers get off directly on the road. In these locations, approaching vehicle 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.  
Objective	The driver gets warned about the presence of a public transport vehicle at the stop to raise his/her attention when approaching it by providing in-car information and warnings about this situation. During the getting on/off to public transport, the passengers often don't pay much attention. Due to the warning, the driver can be prepared for unexpected pedestrian behaviour.
Desired behaviour	• Increased driver attention • Adaptation of the driving speed in the vicinity of the stop (stopping the vehicle in front of stationary PT vehicle) • Readiness for unexpected pedestrian behaviour
Expected benefits	• 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	Vehicle is approaching a PT stop (e.g. stop on the road lane) where the PT vehicle is standing and passengers are getting on/off the vehicle in a hurry. The driver is informed about this situation.
Logic of transmission	V2V
Actors and relations	• **Public transport operator** is the origin of the information of the message. The direct source are OBUs in their vehicles. • **End-user** receives the warnings in the vicinity PT vehicle at a stop.
Scenario	• The PT vehicle stops at a stop. • Warning messages begin to be generated by the PT vehicle's OBU. • Transfer of information into vehicles equipped with OBU. • The vehicle receives the information and displays it to the driver. • The driver adapts his/her behaviour.
Display / alert principle	• The warning to the driver needs to be displayed early enough for

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	him/her to adapt his driving. • The user is provided with related information. Layout and sequence of presentation are left to OEM-specific implementation.
Functional Constraints / dependencies	-
Relation to C-Roads C-ITS Infrastructure Functions and Specifications	The DENM message for HLN-PTVS is profiled in chapter 3.1.1.1 and 3.1.1.3 of the C-ITS Infrastructure Functions and Specifications document. For this use-case, causeCode is 94 (stationary vehicle) and subCauseCode is 4 (publicTransportStop) For this use-case, causeCode is 94 (stationary vehicle) and subCauseCode is 4 (publicTransportStop) . validityDuration should be quite short and corresponding to the mean time of a stop. AND/OR the DENM shall be terminate when the public transport is leaving the stop. To be checked by TF3!

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1.6 Public Transport Vehicle Crossing (HLN-PTVC)(B) – V_PT2V and I2V

HLN – UC – PTVC Public Transport Vehicle Crossing (V2V)	
Type of road network	Road, urban road
Type of vehicle	All vehicles
Use case introduction	
Summary	Vehicle is approaching a location of a high risk of collision with PT vehicles. The driver is informed about this situation via in-car information and warning.
Background	Mainly in the cities, there are many places where tram tracks cross a road for other vehicles and these places are not equipped with traffic lights. Mainly during the turning manoeuvre, the driver doesn't expect to cross with tram tracks which often leads to the accident with trams.   Other dangerous locations are places where buses merge from a reserved lane with lanes for mixed traffic. Buses have priority, however, many drivers don't give way which often causes accidents. 
Objective	The driver gets warned about the presence of locations with a risk of collision with PT vehicle, i.e. where tram tracks cross a road (or in the connection from reserved lane). The aim of the service is raising the driver's attention and reminding him/her to "Give way!" when approaching the location.
Desired behaviour	• Increased driver attention • Adaptation of the driving speed
Expected benefits	• Reducing the risk of accident with PT vehicles • Increased driving comfort

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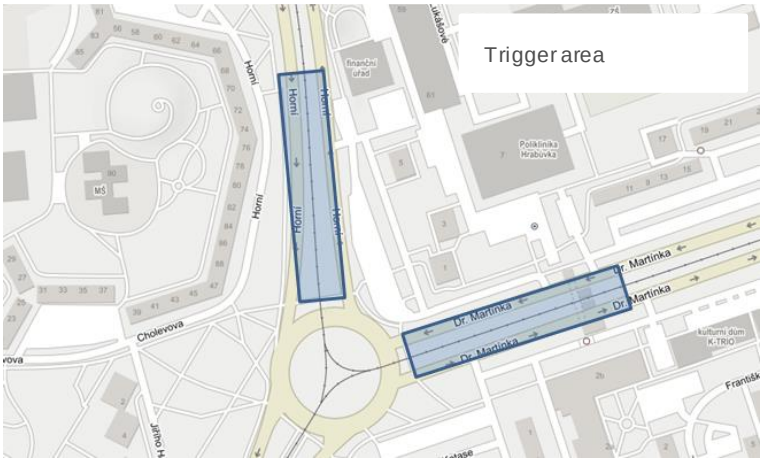
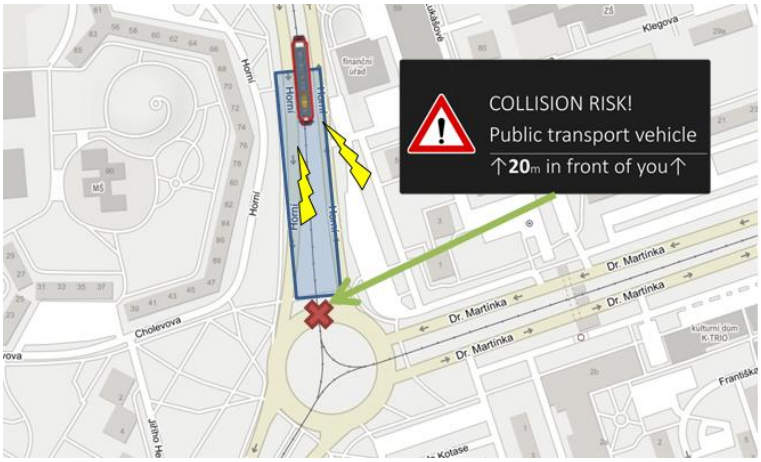
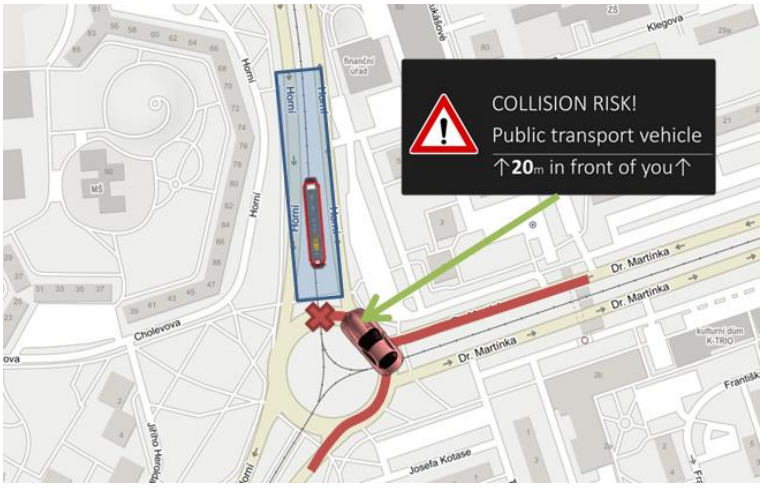
Use case description	
Situation	Vehicle is approaching a location with a high risk of collision with PT vehicles. All these dangerous locations are known, pre-selected and saved in the database. In the same time, the PT vehicle enters the trigger area of this location and begins to generate and transmit prepared warning message. The database of the dangerous locations and related pre-prepared warning messages are saved in the vehicle's OBU.   

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Logic of transmission	V2V
Actors and relations	• **Public transport operator** is the origin of the information of the message. The direct source are OBUs in their vehicles. • **End-user** receives the warnings in the vicinity PT vehicle crossing.
Scenario	• The PT vehicle enters a trigger area of a dangerous location. • Warning message about a potential collision is generated and transmitted by an OBU in the PT vehicle. • Transfer of information into vehicles equipped with an OBU. • The vehicle receives the information and displays it to the driver. • The driver adapts his/her behaviour.
Display / alert principle	• The warning to the driver needs to be displayed early enough for him/her to adapt his driving. However, since he/she should not forget about the alert, it could be repeated closer to the location.
Functional Constraints / dependencies	-
Relation to C-Roads C-ITS Infrastructure Functions and Specifications	The DENM message for HLN-PTVC is profiled in chapter 3.1.1.1 and 3.1.1.3 of the C-ITS Infrastructure Functions and Specifications document. For this use-case, causeCode is 97 (collision risk) and subCauseCode is 2 (crossing collision risk) + stationType is 6 (bus) or 11 (tram) □ indicator of PT vehicles OR use of MAPem and SPATem? Or new CC and SCC? CAM ? for Public Transport Vehicle, formulate a proposal and forward to TF3/WG2?

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