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	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. 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. 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.
Background	While the C-ITS platform presents a single entry for this use case, ETSI TR 102 638 V1.1.1 [2] includes two distinct use cases: • Slow vehicle warning as a use case of cooperative awareness application, • Stationary vehicle as a use case of road hazard warning application. 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.). 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. 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.
Objective	Avoiding collisions (mostly rear-end) with stationary vehicles on the road and increasing road safety.
Desired behaviour	• The vehicle drivers adapt their driving behaviour by slowing down and/or changing lanes. • 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	• As reported in the Study of the Deployment of C-ITS in Europe [1], 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	The road operators' event management systems forward the necessary information to the C-ITS communication system. Sources of information can be: • Cameras (incident detection ones as well), • Operating agents/road operator equipped patrol vehicles, • Other C-ITS-equipped vehicles which have detected the danger. A Stationary Vehicle itself is expected to inform drivers in their vicinity about broken down vehicles as specified in the C2C-CC BSP [14].
Logic of transmission	I2V
Actors and relations	• **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	• 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	• 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	• 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 shall be triggered additionally.

<table>
<tr><th colspan="2">Interoperability requirements</th></tr>
<tr><td>Message profile requirements</td><td>

The DENM message for HLN – SV is profiled in chapters 4.2.1.1 and 4.2.1.3 of C-Roads, C-ITS Message Profiles [4].
For this use case, causeCode 94 (stationary vehicle) 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, C-ITS Message Profiles [4].
traces shall be provided as specified in C-Roads, C-ITS Message Profiles [4].
a point based relevance zone shall be sent. It shall be represented as:

The eventPosition shall be set to the location of the stationary/broken-down vehicle.
awarenessDistance shall not be provided.
awarenessTrafficDirection shall be provided as specified in C-Roads, C-ITS Message Profiles [4].
eventZone shall not be provided.

lanePosition 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.

NOTE: The position confidence depends on the detection system. If no precise value can be given, the value 4095 (unavailable) shall be used.
</td></tr>
<tr><td>Security and data protection requirements</td><td>
Security requirements and specifications of certificates are described in C-Roads, C-ITS Security Requirements and Specifications [2].

An overall introduction to the common European trust model is described in C-Roads, C-ITS Security and Governance [3] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.

This use case is based on the causeCode 94 and therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):
<table>
<tr><th></th><th colspan="2">SSP position</th><th colspan="5">SSP value per station type</th></tr>
<tr><th>CauseCodeType / Container</th><th>Octet position</th><th>Bit position</th><th>6 (bus)</th><th>9 (trailer)</th><th>10 (special vehicles)</th><th>11 (tram)</th><th>15 (road side unit)</th></tr>
<tr><td>stationaryVehicle(94)</td><td>3</td><td>2</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td></tr>
</table>
SSP value 1 means that an SSP for the specific causeCodeType/container is necessary for implementation of the use case when using a given stationType. SSP value '-' means that the SSP is not necessary, it does not mean that the SSP is forbidden. SSP value per station type is given only as guidance. There is no relation of SSP value and station type in the C-ITS message.
</td></tr>
<tr><td>Communication technology requirements: ITS-G5</td><td>
For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of C-Roads, C-ITS Roadside ITS G5 System Profile [6] shall apply.

For ITS-G5 based implementations of use cases where mobile stations are used, the requirements of C-Roads, C-ITS Mobile Roadside ITS G5 System Profile [5] shall apply.
</td></tr>
</table>

Communication technology requirements: IP based	For IP based implementations of use cases shared using backend communication, the requirements of C-Roads, C-ITS IP Based Interface Profile [7] shall apply. For use cases based on DENM the AMQP filtering tables specified in chapter 3.3 of [7] shall apply: • serviceType = HLN – SV • messageType = DENM Geographic area (Quadtree) for DENM: 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 [7].
Test and validation requirements	The document "C-ITS Cross-Border Testing and Validation Concept" [8] contains the generic applicable framework and process for interoperability testing. List of applicable generic test cases from C-Roads, C-ITS Test Plan [9]: • ITS-G5 only: ○ TC_CROADS_GENERIC_ITSG5_DENM_awarenessTrafficDirection_35_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5_DENM_CANCEL_04_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5_DENM_positionConfidenceEllipse_01_1_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5_DENM_TIMING_03_R2.0.8 TC_CROADS_GENERIC_ITSG5_DENM_Traces_02_R2.1.0 ○ TC_CROADS_GENERIC_ITSG5_DENM_UPDATE_04_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5-DENM_EventPosition_01_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5-DENM_informationQuality_65_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5-DENM_referenceDenms_36_R2.0.8 ○ TC_CROADS_GENERIC_ITSG5-DENM_StationType_66_R2.0.8 • IP based only: ○ TC_CROADS_GENERIC_HYBRID_DENM_awarenessTrafficDirection_35_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID_DENM_CANCEL_04_R2.0.8 ○ TC_CROADS_GENERIC_Hybrid_DENM_informationQuality_65_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID_DENM_positionConfidenceEllipse_01_1_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID_DENM_referenceDenms_36_R2.0.8 ○ TC_CROADS_GENERIC_Hybrid_DENM_stationType_66_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID_DENM_TIMING_03_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID_DENM_Traces_02_R2.1.0 ○ TC_CROADS_GENERIC_HYBRID_DENM_UPDATE_04_R2.0.8 ○ TC_CROADS_GENERIC_HYBRID-DENM_EventPosition_01_R2.0.8 List of applicable Specific Test Cases: • ITS-G5 only: ○ TC_CROADS_HLN-SV_ITSG5_DENM_awarenessArea_16-4_R2.0.8 ○ TC_CROADS_HLN-SV_ITSG5_DENM_awarenessTrafficDirection_8_R2.0.8 ○ TC_CROADS_HLN-SV_ITSG5_DENM_eventSpeed_16-2_R2.0.8 TC_CROADS_HLN-SV_ITSG5_DENM_lanePosition_16-8_R2.0.8

	• IP based only:
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_awarenessArea_16-4_R2.0.8
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_awarenessTrafficDirection_8_R2.0.8
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_CC-sCC_13_R2.0.8
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_eventSpeed_16-2_R2.0.8
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_lanePosition_16-8_R2.0.8
	  ○ TC_CROADS_HLN-SV_HYBRID_DENM_stationaryVehicle_16-5_R2.0.8