



C-ITS SERVICE AND USE CASE DEFINITIONS

**EMERGENCY AND SERVICE VEHICLE
NOTIFICATIONS (ESVN)
[C-ROADS SUD11]**

VERSION 3.1.0

C-Roads Platform

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Publication History

Version	Date	Description, updates and changes	Status
3.1.0	01.11.2025	<p>Created the new service category Emergency and Service Vehicle Notifications (ESVN) with these use cases:</p> <ul style="list-style-type: none"> • ESVN-EPVA (was developed as HLN-EPVA before) • ESVN-ERVI (was developed as HLN-ERVI before) • ESVN-SMMV (new) • ESVN-WM (was developed as RWW-WM before) 	Final

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Introduction

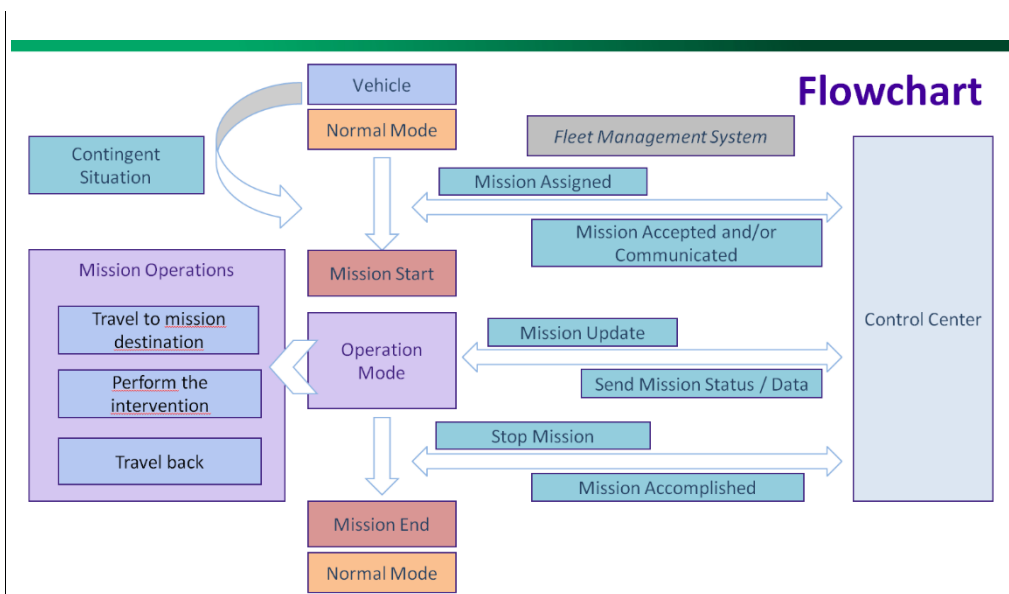
The document ‘Service and Use Case Descriptions 01 Intro Document’ [C-Roads SUD01] explains the structure of the service and use case descriptions harmonized in C-Roads. Also, it gives an overview of all harmonized service and use cases and in which document they are described. Each service and its use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

11. Emergency and Service Vehicle Notifications (ESVN)

11.1 ESVN: Service introduction

Service introduction	
Summary	<p>This service provides warnings to drivers about vehicles managed or contracted by road operators or authorities, such as winter service vehicles, emergency responders, or maintenance vehicles, that are operating on the road under the supervision, coordination, or control of the relevant authority.</p> <p>These vehicles may be stationary, slow-moving, or fast-moving, and can temporarily disrupt traffic flow or require priority passage. Their presence is typically communicated to road users visually through blue or amber lights, and, when necessary, acoustically through sirens.</p> <p>ESVN enhances road safety by promoting more attentive driving and supporting timely yielding to priority vehicles when necessary.</p>
Background	<p>Vehicles managed or contracted by road operators or authorities are regularly deployed to perform a special task or mission. These tasks may include incident response, emergency intervention, snow and ice removal, infrastructure inspections, breakdown assistance and recovery, roadworks setup or activities within roadwork zones, and the securing of hazardous areas.</p> <p>Such vehicles enter an operational mode either upon assignment of a task or mission by a TCC, emergency dispatch, or another competent authority, or in response to unforeseen or contingent events, such as accidents, urgent road maintenance, or environmental hazards.</p> <p>In the latter case, the vehicle may initiate the mission autonomously; however, the Control Centre is kept informed and continues to monitor and coordinate the operation, providing additional support if necessary.</p> <p>This operational mode clearly distinguishes the vehicle from ordinary traffic, both in its behaviour and, when applicable, in terms of road priority.</p> <p>Once the mission is completed, the vehicle exits operational mode and resumes normal traffic behaviour, no longer requiring special attention, elevated status, or coordination.</p>



Despite the use of visual and acoustic signals, these vehicles are not always easily detected by surrounding drivers, particularly in low-visibility conditions or complex traffic environments.

Their operational behaviour, ranging from fast response driving to slow or stop-and-go movement, can lead to unpredictable interactions with other road users.

These vehicles often operate without fixed road signage or formal lane closures, relying instead on vehicle-mounted signalling and/or remote coordination by a control centre. Consequently, current awareness and warning systems may fail to accurately reflect their real-time presence and status on the road.

Emergency and Service Vehicle Notifications addresses this gap by providing timely, context-specific awareness to drivers about these vehicles and their activities, enhancing the safety of both operational staff and surrounding traffic.

It can also support scenarios where exact tracking of vehicles is not feasible, ensuring drivers remain informed.

Objective

The purpose of the service is to enhance road safety and optimize traffic flow by providing drivers with timely warnings about the presence and activities of vehicles operating under the control of road authorities or emergency services.

ESVN supports drivers in adapting their behaviour when approaching or interacting with such vehicles, whether they are stationary, moving slowly, or traveling at high speed during active missions.

The service aims to:

- Increase driver awareness of operational vehicles that may be partially or fully occupying traffic lanes.
- Reduce the risk of collisions or abrupt maneuvers near vehicles performing road operations.
- Facilitate safe and effective yielding to priority vehicles, such as ambulances or police, when required.

	<ul style="list-style-type: none"> • Enhance protection for personnel involved in roadside interventions or mobile operations. • Support the overall safety and efficiency of dynamic road management activities.
Expected benefits	<ul style="list-style-type: none"> • Enhanced road safety: By alerting drivers to the presence and operational status of managed vehicles, ESVN helps reduce collisions and near-misses involving these vehicles. • Improved traffic flow: Early warnings allow drivers to adjust speed and position smoothly, minimizing sudden braking or swerving that can cause congestion or secondary accidents. • Priority vehicle facilitation: ESVN supports timely yielding to emergency and priority vehicles, enabling faster response times and safer passage through traffic. • Increased protection for roadside workers: By raising driver awareness of slow-moving or stationary operational vehicles, the service contributes to safer working conditions for personnel on or near the road. • Operational efficiency: Road authorities and emergency services benefit from better coordination and reduced risk during interventions, helping maintain overall network performance.
Use Cases	<ul style="list-style-type: none"> • Emergency or Prioritised Vehicle Approaching (ESVN-EPVA) • Emergency, Rescue/Recovery or Maintenance Vehicle in Intervention (ESVN-ERVI) • Slow Moving Maintenance Vehicle (ESVN-SMMV) • Winter Maintenance (ESVN-WM) <p>Other Emergency and Service Vehicle Notifications-related use cases may be added in future releases.</p>

11.2 ESVN: Use Cases

11.2.1 ESVN – Emergency or Prioritised Vehicle Approaching (ESVN-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, or ESVN-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</p>

Desired behaviour	<p>emergency corridor in advance.</p> <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 ESVN-EPVA messages shall stop. • If the vehicle is stationary, then the sending of ESVN-EPVA messages shall stop. Instead, the use case for stationary special vehicles applies, see ESVN-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

	<ul style="list-style-type: none"> 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. <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 ESVN-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 ESVN-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 ESVN-ERVI are not satisfied.										
Logic of transmission	I2V, V _{EPV} 2V									
Actors and relations	<ul style="list-style-type: none"> Emergency or prioritised vehicle: Sends appropriate ESVN-EPVA messages to the vehicles in the vicinity of the emergency/prioritised vehicle or ESVN-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 ESVN-EPVA message based on the information received from the ECC and sends out the ESVN-EPVA message Drivers: Receive the ESVN-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_{EPV}2V or I2V.</p> <p><u>Case 1: Emergency Vehicle with absolute right of way</u></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>									

Intended Presentation/Alert principle	<p><u>Case 1a: V_{EPV2V}</u></p> <ul style="list-style-type: none"> The emergency vehicle sends appropriate ESVN-EPVA messages which can directly be used for communication to the vehicles in the vicinity of the emergency vehicle. The drivers receive this ESVN-EPVA message and can act according to the given circumstances. <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 ESVN-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_{EPV2V}</u></p> <ul style="list-style-type: none"> The prioritised vehicle sends appropriate ESVN-EPVA messages which can directly be used for communication to the vehicles in the vicinity of the prioritised vehicle. The drivers receive this ESVN-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 ESVN-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> <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>
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	The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<p>This use case has been described and harmonised with just limited input from 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 ESVN-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	This use case is functionally linked to ESVN-ERVI. When the vehicle arrives at the event location, this use case shall be terminated and ESVN-ERVI activated.
Interoperability requirements	
Message profile requirements	<p>The DENM message for ESVN-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 ESVN-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 ESVN-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, vehicle not stationary	2
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. 		

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

Message management	Setting
validityDuration	2 s
Termination	Not used

- 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.*

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 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 = ESVN-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>															

	Please be aware that the exact details of the specification are defined in chapter 3.3 of [C-ITS IP Based Interface Profile].
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>

11.2.2 ESVN – Emergency, Rescue/Recovery or Maintenance Vehicle in Intervention (ESVN-ERVI)

Use case introduction	
Type of road network	Motorways, Dual carriageways
Type of vehicle (receiver)	All
Use case introduction	
Summary	The intent of the emergency, rescue/recovery or maintenance 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, recovery and maintenance 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 or a maintenance vehicle in intervention safeguards the location of the accident or another

type of stationary hazard area where the emergency responders and/or rescuers or maintenance staff 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 “Stationary vehicle” use case HLN-SV (from document [C-ROADS SUD03]):

There is a difference to the regular stationary vehicle use case (HLN-SV). Basically, standing emergency, rescue/recovery or maintenance 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 ESVN-EPVA and ESVN-SMMV).

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, V_{RO}2V

Actors and relations	<ul style="list-style-type: none"> • Drivers: Receive information on their in-vehicle display about an emergency and/or rescue/recovery or maintenance vehicle activity on the road, its distance and the exact position. • Emergency, rescue/recovery or maintenance 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. They also send information about the distance, direction and lane position of the emergency or rescue/recovery vehicle(s). • Road operator: Provides information about the emergency, rescue/recovery or maintenance 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, rescue/recovery or maintenance 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"> • This use case scenario shall only be activated if the maintenance vehicle poses a potential danger for other vehicles (e.g. activated when parked on the hard shoulder, not activated when parked next to the hard shoulder) • The location information needs to be accurate on road and lane level and related to the physical location of the actual rescue or recovery or maintenance 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.

	<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. • 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 ESVN-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. • 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 ESVN-EPVA and ESVN-SMMV to ESVN-ERVI is of special interest since the emergency/rescue/recovery/maintenance 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} / V_{RO2V} 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. ○ NOTE: the GN destination area shall be set accordingly to 1000m. • eventZone shall not be provided. • Transmission Logic: V_{erv2V} / V_{RO2V} – message sent from the vehicle in intervention: <ul style="list-style-type: none"> ○ 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. ○ 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:

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 ESVN-EPVA and ESVN-SMMV).
- 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 ESVN-EPVA or ESVN-SMMV are met.

NOTE: Recovery vehicles without priority such as towing trucks will not use ESVN-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)”
- *NOTE: the use of vehicleRole: “emergency(6)” implies that SpecialVehicleContainer: EmergencyContainer is used*
- 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 ESVN-EPVA) change into this case when becoming stationary, while keeping the vehicleRole and container.

	<ul style="list-style-type: none">For this scenario, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 0 shall be used.CAM vehicleRole: "safetyCar(7)"NOTE: the use of vehicleRole: "safetyCar(7)" implies that SpecialVehicleContainer: SafetyCarContainer is usedIncidentIndication in the SafetyCarContainer shall be set to the causeCode/subCauseCode of this case. <p><u>Case 3: Recovery vehicle in intervention</u></p> <ul style="list-style-type: none">For this use case, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 0 shall be used.CAM vehicleRole: "rescue(5)"NOTE: the use of vehicleRole: "rescue(5)" implies that SpecialVehicleContainer: RescueContainer is usedNOTE: there is no IncidentIndication in the RescueContainer <p><u>Case 4: Maintenance vehicle in intervention</u></p> <p><i>NOTE: Slow moving maintenance vehicle (ESVN-SMMV) change into this case when becoming stationary, while keeping the vehicleRole and container.</i></p> <ul style="list-style-type: none">For this use case, causeCode rescueAndRecoveryWorkInProgress15 and subCauseCode 0 shall be used.CAM vehicleRole: "roadOperator(11)"CAM SpecialVehicleContainer: SafetyCarContainerNOTE: the use of SafetyCarContainer implies that lightBarSirenInUse is setIncidentIndication in the SafetyCarContainer shall be set to the causeCode/subCauseCode of this case.trafficRule in the SafetyCarContainer should be set (if applicable)									
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 rescueAndRecoveryWorkInProgress15 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>rescueAndRecoveryWorkInProgress15</td><td>2</td><td>1</td></tr></table>		SSP position		CauseCodeType / Container	Octet position	Bit position	rescueAndRecoveryWorkInProgress15	2	1
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
rescueAndRecoveryWorkInProgress15	2	1								

	<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>
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 = ESVN-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>
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>

11.2.1 ESVN – Slow Moving Maintenance Vehicle (ESVN-SMMV)

Type of road network	Motorways, Dual carriageways
Type of vehicle	All
Use case introduction	
Summary	The slow-moving maintenance vehicle (SMMV), equipped with vehicle-to-vehicle (V2V) communication technology tailored for a road operator use (V _{RO2V}), transmits real-time alerts indicating it's in mission (operational task)—such as inspections of road surface inspections or objects on road. These notifications enable nearby drivers to adjust their driving behaviour proactively, enhancing safety and traffic flow
Background	Slow moving maintenance vehicles are much slower than the other road users. Then this use case can support the prevention of collisions between slow moving maintenance vehicles and road users.
Objective	The objective of this use case is to alert drivers that will encounter an operating slow moving maintenance vehicle so that they can adapt their driving behaviour accordingly.
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 accidents for drivers and maintenance crews. Improved efficiency of maintenance interventions.
Use case description	
Situation	<ul style="list-style-type: none"> The maintenance vehicle is slow-moving, and, on a task/mission, which is indicated by an active amber light bar. The sending of appropriate messages to the drivers nearby can be started automatically (automatically activated when the light bar is activated) or manually, based on the desire of the implementer. However, the activation of the light bar is a precondition to trigger (manually or automatically) this use case. As soon as the light bar is off, the sending of ESVN-SMMV messages shall stop. If the vehicle is stationary, then the sending of ESVN-SMMV messages shall stop. Instead, the use case for maintenance vehicle stationary vehicles applies, see ESVN-ERVI, as long as the light bar is still active. The drivers are arriving behind a slow moving maintenance vehicle. The drivers receive the information about the slow moving maintenance vehicle. The drivers can adapt their driving behaviour according to the information received in advance.

	<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 slow-moving when the speed is between 16.67 m/s (60 km/h) and 1.5 m/s (5.4 km/h) for a predefined duration of at least 30s. • <i>Note: the use-case, particularly the upper speed limit, applies only to motorways and dual carriageways</i> • <i>Note: the receiving vehicle shall determine whether the warning is relevant, i.e. if it is itself moving slowly in a traffic jam</i> <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 ESVN-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 ESVN-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 ESVN-ERVI are not satisfied.										
Logic of transmission	V _{RO2V}									
Actors and relations	<ul style="list-style-type: none"> • Maintenance vehicle: Sends appropriate ESVN-SMMV messages to the vehicles in the vicinity of the slow moving maintenance vehicle. • Drivers: Receive the ESVN-SMMV message sent by the slow moving maintenance vehicle. The drivers are informed about the situation and can act accordingly. 									
Scenario	<ul style="list-style-type: none"> • A slow moving maintenance vehicle is on the road and the light bar is switched on. If connected directly to the light bar or the beacon, the in-vehicle system sends a message to inform drivers of the slow moving maintenance vehicle. Otherwise, the activation can be done manually. • The drivers near the slow moving maintenance vehicle receive the message and the information is presented to the drivers when appropriate. 									
Display / 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 / dependencies	<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 with other Use Cases	This use case is functionally linked to ESVN-ERVI and the sub-use-case for maintenance vehicle. When the vehicle arrives at the event location, this use case shall be terminated and ESVN-ERVI with the sub-use-case for maintenance vehicle activated.												
Interoperability Requirements													
Message profile requirements	<ul style="list-style-type: none"> NOTE: This specification covers the V_{RO2V} – message only. An I2V implementation is not covered. The DENM message for ESVN-SMMV is profiled in chapters 4.2.1.1 and 4.2.1.4 of [C-Roads MP]. stationType shall be set according to [ETSI TS 102 894-2] 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: In case of separated carriageways: sameAsReferenceDirection-upstreamOfReferencePosition, in case of non-separated carriageways or unknown: allTrafficDirections. eventPositionHeading and eventSpeed shall be provided. For this use case, a vehicle is considered slow-moving when the speed is between 16.67 m/s (60 km/h) and 1.5 m/s (5.4 km/h) for a predefined duration of at least 30s. The causeCode shall be set to slowVehicle26 and subCauseCode to maintenanceVehicle (1). The vehicle shall send CAMs with associated vehicleRole and SpecialVehicleContainer (containing lightBarSirenInUse) as specified below <ul style="list-style-type: none"> CAM vehicleRole: roadOperator(11) CAM SpecialVehicleContainer: SafetyCarContainer NOTE: the use of SpecialVehicleContainer implies that lightBarSirenInUse is set IncidentIndication in the SafetyCarContainer shall be set to the causeCode/subCauseCode of this case. trafficRule in the SafetyCarContainer should be set (if applicable). informationQuality shall be set to 6 for the message is being sent out by the vehicle on the road. Message management shall be done providing short validity durations as follows: <table border="1" data-bbox="518 1601 1157 1832"> <thead> <tr> <th>Message management</th><th>Setting</th></tr> </thead> <tbody> <tr> <td>DENM update</td><td>every 250 ms</td></tr> <tr> <td>Repetition duration</td><td>no repetition</td></tr> <tr> <td>Repetition interval</td><td>no repetition</td></tr> <tr> <td>validityDuration</td><td>2 s</td></tr> <tr> <td>Termination</td><td>Not used</td></tr> </tbody> </table> The use case shall be terminated when the triggering conditions are no longer given, or when the triggering conditions of ESVN-ERVI sub-use-case “maintenance vehicle” are met. 	Message management	Setting	DENM update	every 250 ms	Repetition duration	no repetition	Repetition interval	no repetition	validityDuration	2 s	Termination	Not used
Message management	Setting												
DENM update	every 250 ms												
Repetition duration	no repetition												
Repetition interval	no repetition												
validityDuration	2 s												
Termination	Not 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 slowVehicle26 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>slowVehicle26</td><td>2</td><td>5</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.</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	slowVehicle26	2	5
	SSP position									
CauseCodeType / Container	Octet position	Bit position								
slowVehicle26	2	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 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 = ESVN-SMMV• messageType = DENM <p><u>Geographic area (Quadtree) for DENM message:</u></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>									

11.2.1 ESVN – Winter Maintenance (ESVN-WM)

Type of road network	All
Type of vehicle	All
Use case introduction	
Summary	<p>The intent of this use case is to warn drivers about the presence and activity of winter maintenance vehicles (e.g., salting, ploughing, de-icing, sand spreading) operating under the supervision or coordination of a road operator, or their contracted service providers. These vehicles may temporarily obstruct or slow traffic as they carry out their tasks.</p> <p>When these winter maintenance vehicles are in operational mode, often indicated by the activation of an amber light bar, a warning message is sent to nearby traffic. The amber light signals that the vehicle is engaged in a mission, though it may not always be actively applying treatment.</p> <p>The alerted drivers can adapt their driving behaviour accordingly, reducing collision risks and improving safety for both maintenance personnel and other road users.</p>
Background	<p>Winter maintenance vehicles typically operate at reduced speeds and may temporarily obstruct or slow traffic, especially during active treatment operations. In some countries, overtaking these vehicles while in operation is prohibited for safety reasons.</p> <p>On highways, winter maintenance is often performed by multiple vehicles driving in formation, sometimes across several lanes, to ensure consistent and efficient road treatment. This formation driving can create unexpected obstacles or lane restrictions, especially in low-visibility conditions such as snow, fog, or darkness. Although drivers generally reduce speed during winter conditions, poor visibility may prevent them from clearly seeing winter maintenance vehicles in time, increasing the risk of collisions or dangerous manoeuvres. This use case helps prevent such incidents by enhancing driver awareness of the location and operational status of winter maintenance vehicles. It can also provide information about salt spreading, which may be relevant for vehicles in the opposite direction on bi-directional roads or those approaching from behind, when passing is allowed.</p>
Objective	<p>The objective of this use case is to warn drivers approaching an operating winter maintenance vehicle, allowing them to adapt their driving behaviour in a timely and safe manner. This includes scenarios where vehicles are moving slowly, operating in formation across multiple lanes, or temporarily obstructing traffic.</p> <p>The use case also applies to drivers traveling in the opposite direction, particularly on bi-directional roads, where salting or snow removal operations may still affect road surface conditions or visibility.</p>

Desired behaviour	<ul style="list-style-type: none"> • Increased vigilance from drivers approaching winter maintenance operations • Adaptation of speed to reflect conditions and vehicle activity • Safe following distance behind maintenance vehicles or formations • Avoidance of unsafe overtaking • Cautious driving when encountering residual salt or snow on the road surface
Expected benefits	<ul style="list-style-type: none"> • Reduced risk of accidents for both drivers and winter maintenance personnel • Improved efficiency and continuity of winter maintenance operations • Enhanced situational awareness in low-visibility or high-risk environments • Better traffic flow, avoiding abrupt braking or erratic driver reactions

Use case description

Situation	<p>This use case addresses several typical situations involving winter maintenance vehicles operating under the supervision or coordination of a road operator or TCC, or their contracted service providers:</p> <p><u>Intervention Zone:</u> - This is a stationary event.</p> <p><i>Note: This event is classified as stationary because it is tied to a specific road section rather than individual vehicles, even though winter maintenance vehicles are moving through it.</i></p> <p>A designated road section is undergoing winter maintenance operations, indicating that road conditions are degraded due to snow, ice, or other related hazards.</p> <p>Although the exact position or activity of individual vehicles is not specified, and is generally not known with precision, winter maintenance vehicles are known to be present and operating with their amber lights activated. The intervention may involve multiple vehicles working simultaneously and can affect specific lanes or the entire carriageway over an extended segment, e.g. between toll stations. This scenario provides a high-level overview of the ongoing operation and enables identification of the lanes impacted by the maintenance activity.</p> <p><u>Active Treatment:</u> - This is a non-stationary event.</p> <p>A winter maintenance vehicle is actively performing road treatment, such as salting, de-icing, sand spreading or snow ploughing. This vehicle operates with the amber light bar activated, indicating it is in operational mode. The exact position and activity of the winter maintenance vehicle is known. Such activities may impact a broader area, displacing snow or spreading salt into adjacent or even oncoming lanes.</p> <p><u>Mission Underway:</u> - This is a non-stationary event.</p> <p>A winter maintenance vehicle is in circulation but not currently treating the road. The exact position of this vehicle is known. The presence of an active amber light bar indicates that the vehicle is in operational mode and may begin intervention at any moment. Although no immediate surface treatment is occurring, drivers should remain alert due to the vehicle's large dimensions and potential for sudden operational activity.</p> <p>In all scenarios, early warnings allow drivers to adapt their behaviour accordingly. This may include adjusting speed, increasing caution helping to ensure the safety of both</p>
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	<p>road users and maintenance personnel. Drivers should also pay particular attention to the large dimensions of winter maintenance vehicles and the fact that their activities can affect a wider area, including adjacent or oncoming lanes.</p> <p>On undivided (bi-directional) roads, winter maintenance operations may also pose risks to oncoming traffic due to salt dispersion, snow displacement, or limited visibility. Warnings issued to oncoming drivers help mitigate these risks, even when they are not directly following the maintenance vehicles.</p> <p>Each scenario may involve a single vehicle assigned to an individual mission or a fleet formation, where multiple vehicles (e.g., snowploughs and salt spreaders) operate in coordination along the same road segment.</p> <p>During winter maintenance operations, various temporary traffic regulations may be applied to ensure road safety and protect maintenance personnel. These include speed restrictions, overtaking bans and minimum distance requirement.</p> <p>Triggering Conditions:</p> <ul style="list-style-type: none"> • Activation of operational mode (e.g., light bar turned on, equipment activated) on the winter maintenance vehicle. • Manual triggering by the vehicle operator. • Remote triggering by the TCC, based on data received from the field, the vehicle operator, the vehicle system or the FMS. <p>Termination Conditions:</p> <ul style="list-style-type: none"> • Deactivation of operational mode (e.g., light bar turned off, equipment deactivated). • Manual termination by the vehicle operator. • Remote termination by the TCC, based on data received from the field, the vehicle operator, the vehicle system or the FMS.
Logic of transmission	V _{ro} 2V, I2V
Actors and relations	<ul style="list-style-type: none"> • Fleet Management System (FMS): Collects information from winter maintenance vehicles, such as mission status, light bar activation, and salting or ploughing activity, and forwards this data to the Traffic Control Centre (TCC). • Road Operator / Traffic Control Centre (TCC): Creates the message based on the information received from the FMS or their internal monitoring tool and sends out the message (I2V) • Winter Maintenance Vehicle: If equipped, it may directly generate and/or send messages to nearby vehicles (V2V). It can also provide operational data (e.g., mission status, light bar activation, salting/ploughing status) to the FMS or the TCC. • Drivers: The drivers approaching the area are the end-users of this service (receive the message).

Use case scenario	<p>This use case applies to winter maintenance activities performed by road operators or by their contracted service providers, typically involving salting, sand spreading, de-icing, or snow removal.</p> <p><u>Intervention Types</u></p> <p>Two main intervention types are distinguished:</p> <ul style="list-style-type: none"> • Pre-emptive Action: Initiated proactively based on weather forecasts predicting snow, ice, or freezing conditions. • Reactive Intervention: Triggered in response to deteriorating road conditions or ongoing precipitation. <p>Depending on the nature of the intervention, different types of treatments may be applied:</p> <ul style="list-style-type: none"> • Salting: Spreading of solid or pre-wetted salt. • Sand spreading: Spreading of sand to decrease slipperiness in icy conditions • De-icing: Application of liquid chemicals to break the bond between ice and road surface. • Snow removal: Mechanical clearance of snow using ploughs. It may be combined with salting or de-icing depending on the road condition and the vehicle type. <p><u>Planning and Deployment</u></p> <p>The process begins when the TCC or relevant road authority, or their contracted service providers receives weather alerts, forecast data, or observes deteriorating road conditions.</p> <p>Based on this input, winter maintenance interventions are planned and assigned to specific vehicles, which are then dispatched to targeted road segments.</p> <p>These operations are always pre-planned and/or actively supervised. Winter maintenance vehicles, even when operated by private companies, do not act autonomously; they are deployed under explicit instructions from the TCC, a road authority, or the service provider. Each vehicle follows a defined mission within a designated area, based on the required treatment type. Even if not all vehicles are tracked in real time, their deployment is coordinated.</p> <p>The TCC typically registers the intervention zone on their traffic management system (TMS), including the planned start time. The positional information can be dynamically updated based on operational feedback. The confirmation of mission start or completion, received via any available communication channel (e.g., FMS, field reports, acts as the trigger and termination condition for the Intervention Zone scenario.</p> <p>Variable Message Signs (VMS) can be used to inform drivers of the intervention.</p> <p>From the vehicle's perspective, the mission begins when operational mode is activated, indicated by the amber light bar or beacon. The activation or deactivation of the amber light bar, or confirmation thereof, serves as the trigger and termination condition for the Winter Maintenance Vehicles in Operational Mode scenario.</p> <p>The vehicle then proceeds toward the designated intervention zone.</p>
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Upon arrival, it begins the assigned treatment activity, such as salting, sand spreading, de-icing, or snow ploughing. The activation or deactivation of the winter treatment equipment (e.g., spreader, plough), or confirmation thereof, serves as the trigger and termination condition for the Active Winter Treatment in Progress scenario.

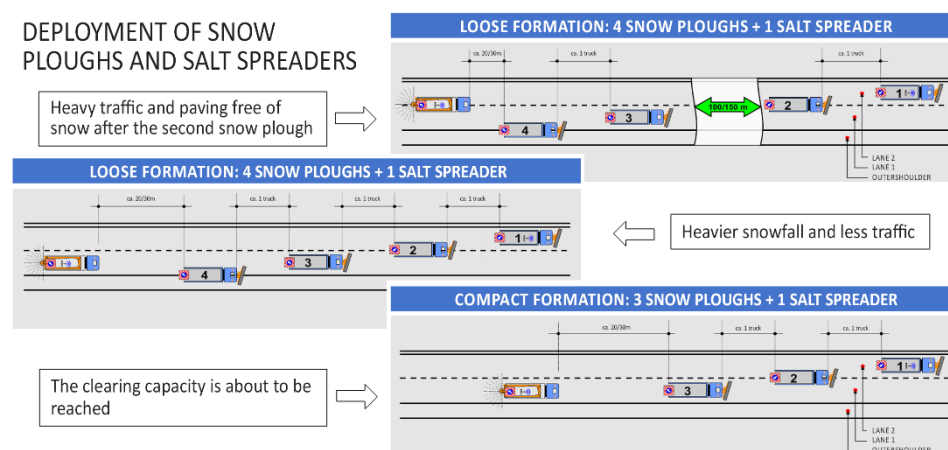
Note: On motorways, interventions often occur within predefined sections (e.g., between toll stations or highway safety centres).

Winter Maintenance Configurations

Winter maintenance may be carried out in two main configurations:

- **Single vehicle:** A vehicle independently executes a mission on a specific segment of the network. Multiple single vehicles may be deployed in parallel across different areas.
- **Fleet formation:** Multiple vehicles (e.g., ploughs, spreaders) work in a coordinated formation to cover wider road surfaces efficiently. Formations can be:
 - *Compact formation:* Vehicles operate closely together across lanes, often preventing overtaking physically and legally.
 - *Loose formation:* Vehicles are spaced further apart; overtaking may be legally permitted but discouraged due to safety concerns.

Fleet behaviour is dynamically adapted based on road geometry, weather, and traffic conditions. In certain situations, vehicles within the formation may temporarily shift to the hard shoulder to allow traffic to pass, depending on traffic density, weather severity, and available road space.



Winter Maintenance Signages

Winter maintenance vehicles can display rear signage, which in some cases is legally required. The signage is configured based on the vehicle's road position and formation within the fleet.



States and Operational Flow

Winter maintenance vehicles operate through distinct states during their missions, reflecting their current activity and operational status:

- **Idle/Standby:** The vehicle is not in operational mode. It may be parked or traveling without an assigned mission, awaiting deployment.
- **Operational mode:** This includes two main sub-states.
 - **Transit/Warning state:** The vehicle is traveling to the intervention zone with its *amber light bar or beacon activated* to warn surrounding traffic.
 - **Active operation:** Upon arrival, the vehicle begins performing one or more winter maintenance treatments, which may occur sequentially or simultaneously.
 - **Salting:** The salting system activated.
 - **Sand spreading:** The sand spreading system activated
 - **De-Icing:** The de-icing system activated.
 - **Snow removal:** The snow removal process is activated.
- **Return to Idle / Standby:** After completing the mission, the vehicle deactivates operational mode and either returns to base or prepares for the next assignment.

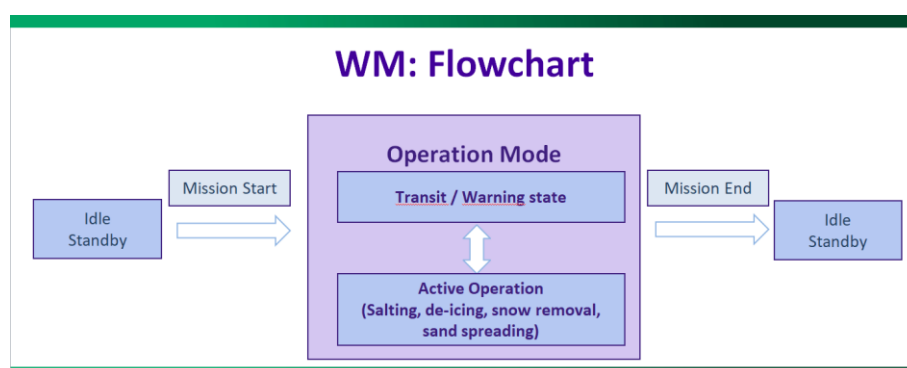
Flow Transition Rules

The Idle / Standby state can transition directly to either:

- Transit / Warning State, or
- Active Operation (e.g., in case of an immediate local task).

During a mission, the vehicle may alternate multiple times between Transit / Warning State and Active Operation (e.g., when moving between road segments).

The vehicle transitions back to Idle / Standby from either Transit / Warning State or Active Operation, depending on mission completion.



TCC - Vehicle Position and Mission Status Tracking

The ability of the TCC or relevant road authority to monitor the status and location of winter maintenance vehicles depends on the available communication infrastructure.

The following tracking modalities may apply:

- **No Tracking:** The TCC receives only basic status updates (mission start and end) from the road operator or fleet supervisor. The intervention zone remains static on the TMS.
- **Intermittent Tracking:** The TCC receives occasional progress updates, enabling partial revision of the intervention zone on the TMS and on the VMS. Accuracy and responsiveness depend on update frequency.
- **Fleet Management System (FMS)-based Tracking:** The vehicle's location and operational status are transmitted at regular intervals via the FMS. The TCC uses this data to dynamically update messages and intervention zone positioning. Accuracy and responsiveness depend on update frequency.
- **Direct Vehicle-based:** The vehicle transmits position and status information directly to the TCC, typically through an OBU or a dedicated device. This allows for real-time updates to message positioning and scenario status.

Vehicle – OBU System Integration

Winter maintenance vehicles may be equipped with OBUs offering varying levels of integration:

- *Direct System Integration:* the OBU is directly connected to vehicle systems such as salting, ploughing, and the amber beacon. This setup allows for automatic status detection and message generation without operator input.
- *No Direct System Integration:* in this case, operational status (e.g., beacon activation or equipment usage) must be manually or remotely confirmed by the operator, the FMS or TCC. Messages may still be automatically generated based on this confirmation.

Intended
Presentation/Alert
principle

- The information presented to the driver shall align with applicable traffic rules, such as overtaking restrictions or temporary speed limits related to winter maintenance activities.
- Alerts should be tailored to the vehicle's relative position (following, approaching, or oncoming) and consider the type of operation (e.g., salting, ploughing), presence of formations, and affected lanes.

	<ul style="list-style-type: none"> Information shall be shown early enough and in the correct road segment to allow for timely driver response, but not so early that it risks being ignored. Repetition may be used when nearing the event. In area-wide interventions, general alerts may be used even when no specific vehicle position is known. The HMI presentation logic and timing remain under the responsibility of the vehicle manufacturer and/or service provider.
Functional constraints/dependencies	<ul style="list-style-type: none"> This scenario may be complemented by messages issued by TCC signalling a zone of winter maintenance (using VMS for example). This scenario may be complemented by road restriction information (e.g., speed limits, minimum distance, or overtaking restrictions) activated by the TCC as part of the winter maintenance operation. Accurate vehicle positioning is essential for reliable operation. In GNSS-denied environments, such as tunnels or urban canyons, position tracking may be degraded, limiting the effectiveness of this scenario. The correct activation and termination of the scenario rely on timely access to the vehicle's light bar or beacon status. The applicability and effectiveness of this scenario are constrained by the position update frequency. 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	<ul style="list-style-type: none"> HLN-WCW: Used for snow or winter condition warnings. HLN-TSR: Relevant in cases of icy road surfaces or salt application. HLN-OR: May apply when snowbanks or ploughed snow obstruct road edges. IVS-FT: Variable Message Signs (VMS) to provide dynamic updates on maintenance activities. IVS-TS: Traffic signs, such as overtaking bans or speed limits, minimum distance gap, to warn approaching drivers, even in the absence of physical roadside signs. AVG-VDI / AVG-VSI: minimum distance gap and speed limits
Interoperability Requirements	
Message profile requirements	<ul style="list-style-type: none"> The DENM message for ESVN-WM is profiled in chapters 4.2.1.1 and 4.2.1.3 of [C-Roads MP]. Road operators may choose to inform drivers about winter maintenance using VMS; in such cases, the IVS-FT use case applies. <p><u>Intervention Zone: - I2V</u></p> <p>This implementation may be combined with the other approaches, as it represents an overview of the winter maintenance intervention. It also reflects the standard method currently used on some motorways. The designated intervention zone, along with the affected lanes, is explicitly indicated.</p>

Note: Only the road operator is authorized to plan and initiate winter service interventions on the motorway.

- For this use case, causeCode roadworks3 and subCauseCode winterService(6) shall be used.

Note: The use of roadworks(3) and winterService(6) will be deprecated and no longer used in the next update of the ETSI CDD, so its use is temporary here.

- C-Roads will provide another causeCode and subCauseCode in a later release.
- detectionZonesToEventPosition shall be provided as specified in [C-Roads MP].
- stationType: roadsideUnit(15) (also in case of a central C-ITS station)
- trafficDirection shall be set;
 - if this information is unknown or cannot be set uniformly for the whole extension of the event, allTrafficDirections shall be used; otherwise,
 - shall be set according to the road topology
- validityDuration should not exceed 12 minutes,
- 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 provided. It shall be represented as:
 - eventPosition shall be set to the beginning of the zone, where the winter maintenance is planned or the last update from the field is received.
 - eventZone shall be specified to indicate the zone where the winter maintenance operation is planned or the road extension interested.

Note: eventPosition and eventZone should be updated as frequently as possible.

- In the case of an augmented scenario, data from the involved vehicles can be used to dynamically update the single linear awareness area.
- lanePositions shall be provided to specify the lanes affected by the intervention.
- occupiedLanes should be provided to specify the lanes currently occupied during the intervention.
- trafficFlowRule should be set, with value according to the national regulation, and the affected lanes in the planned intervention.
 - In case an overtaking ban applies, it shall be set either to noPassing(0) or noPassingForTrucks(1), according to the overtaking ban
 - In the case of a single vehicle, the value should match the indication given by the rear signage, if present.
 - In case of fleet formation it should be set according to formation
- lightBarSirenInUse should be set.
- speedLimit shall be set, if uniform speed restrictions are active within the intervention zone across all lanes.

Active Treatment: / Mission Underway: - I2V

This implementation requires accurate vehicle tracking, via FMS or direct vehicle-based data. Its effectiveness depends heavily on the frequency of position and status updates.

- For this use case, causeCode slowVehicle26 or roadworks3 shall be used.
- Appropriate subCauseCodes for causeCode slowVehicle26 are:

- saltingVehicles(8), in case of an winter maintenance vehicle with the *salting or sand system activated*.
- *Note: It is also used for sand spreading, as there is no specific subCauseCode. Since it involves spreading a granular material, from a driver's perspective it poses the same level of risk.*
- deicing(7), in case of an winter maintenance vehicle with the *deicing system activated*.
- snowplough(6) in case of an winter maintenance vehicle with *snow removal process is activated*.
- unavailable(0), in case of an winter maintenance vehicle with *light bar or beacon activated*.

Note: The aim of C-ROADS is to move toward a generic subCauseCode for winter maintenance.

- If multiple events happen in parallel, the major incident should be alerted, measured by its impact on road users (e.g. snow plough uses more space and moves snow and ice to the side which can collide with following or overtaking cars. deicing spills liquid on the road and does not impact the road users as much).
 - The priority order for alerting is as follows: snowplough(6) > saltingVehicles(8) > deicing(7) > unavailable(0)
 - Appropriate subCauseCodes for causeCode roadworks3 is:
 - winterService(6): in case the exact treatment type underway is unknown.
- Note: The use of roadworks(3) and winterService(6) will be deprecated and no longer used in the next update of the ETSI CDD, so its use is temporary here. C-Roads will provide another causeCode and subCauseCode in a later release.*
- 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].
 - stationType: roadsideUnit(15) (also in case of a central C-ITS station)
 - trafficDirection shall be set;
 - if this information is unknown or cannot be set uniformly for the whole length of the event, allTrafficDirections shall be used; otherwise,
 - shall be set according to the road topology
 - informationQuality shall be set as follows:

Type of triggering	Trigger condition	InformationQuality
status detection by TCC	Light bar in use, treatment type, mission status confirmed by the driver	2 or 4, see Note 1 below
automatic status detection by tracking or fleet management device	Light bar in use, treatment type, mission status	4 or 6 see Note 2 below.
Human supervisor and activation	Manual trigger	6

Note 1: InformationQuality 4 applies if the event information and the generation of C-ITS messages is in the responsibility of the same organisation.

Note 2: InformationQuality 6 applies if the event information and the generation of C-ITS messages is in the responsibility of the same organisation.

- eventPositionHeading shall be provided
- eventSpeed shall reflect the vehicle's latest speed estimate, obtained directly or calculated from position changes over the update interval.
- lanePositions shall be provided to indicate the lanes affected by the vehicle, if the information is available and reliable
- occupiedLanes should be provided to specify the lanes currently occupied by the vehicle, if the information is available and reliable
- trafficFlowRule should be set, with value according to the national regulation, according to the signage present on the rear of the vehicle.
 - In case an overtaking ban applies, it shall be set either to noPassing(0) or noPassingForTrucks(1), according to the overtaking ban.
 - In case of formation should be set according to formation.
- lightBarSirenInUse shall be set.
- linkedDenms should be used, if the aim is to indicate that vehicles are operating in a coordinated fleet formation.
- *Note: if the winter maintenance vehicles drive in formation, the only way of conveying this information is by using linkedDenms.*
- Message management should be done as follows:

Message management	Recommended
DENM update	1s
validityDuration	2s
Termination	Not used

The values above are NOT intended to cover all operational configurations and apply to ideal conditions.

In general, update frequency and message validity can be dynamically adjusted as a function of:

- Operational scenario (e.g., urban vs. motorway, snowplough vs. salter)
- Formation type (single vehicle or coordinated fleet formation)
- Latency of the information transmission to the TCC
- Scenario lifecycle shall be done as follows:
 - When a vehicle switches between different operational states (e.g., Transit/Warning or Active Operation), a DENM update shall be sent with the corresponding causeCode and subCauseCode.
 - Once the vehicle finishes its operation *and the light bar is off*, it shall stop sending DENM messages, so no explicit termination message is required.

- eventPosition shall always contain the most up to date position of the vehicle at the time the message is sent.
 - Either a circular or a single linear awareness area shall be provided
 - In case of a circular awareness area::
 - awarenessDistance shall be used; The maximum allowed value is lessThan500m(3);The choice between values depends on the vehicle's speed, frequency of position updates and latency of the information in the TCC
 - In case of a single linear awareness area::
 - eventZone shall be provided;
 - it shall cover the vehicle's estimated path travelled since the last position update until the current time, when the C-ITS message is generated.
 - it can cover the vehicle's predicted path over the update interval.
- Note: the length of eventZone shall also be kept as short as possible, depending on vehicle speed, frequency of position updates and latency of the information in the TCC.*
- The eventZone shall be matched to a road topology.

Active Treatment / Mission Underway: - V2V

- For this use case, causeCode slowVehicle26 or roadworks3 shall be used.
 - Appropriate subCauseCodes for causeCode slowVehicle26 are:
 - saltingVehicles(8), in case of an winter maintenance vehicle with the *salting or sand system activated*.
 - *Note: It is also used for sand spreading, as there is no specific subCauseCode. Since it involves spreading a granular material, from a driver's perspective it poses the same level of risk.*
 - deicing(7), in case of an winter maintenance vehicle with the *deicing system activated*.
 - snowplough(6) in case of an winter maintenance vehicle with *snow removal process is activated*.
 - unavailable(0), in case of an winter maintenance vehicle with *light bar or beacon activated*.
- Note: The aim of C-ROADS is to move toward a generic subCauseCode for winter maintenance.*
- If multiple events happen in parallel, e.g., gritting and snow ploughing, the major incident should be alerted, measured by impact on road users (e.g. snow plough usually uses more space and moves snow and ice to the side which can collide with following or overtaking cars. De-icing spills liquid on the road and does not impact the road users as much)
- The priority order for alerting is as follows: snowplough(6) > saltingVehicles(8) > deicing(7) > unavailable(0)
 - Appropriate subCauseCodes for causeCode roadworks3 is:

- winterService(6): in case the exact treatment type underway is unknown.,
Note: The use of roadworks(3) and winterService(6) will be deprecated and no longer used in the next update of the ETSI CDD, so its use is temporary here. C-Roads will provide another causeCode and subCauseCode in a later release..
- 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].
- stationType: specialVehicles(10)
- trafficDirection shall be set;
 - if this information is unknown or cannot be set uniformly for the whole length of the event, allTrafficDirections shall be used; otherwise,
 - shall be set according to the road topology
- informationQuality shall be set to 6
- eventPositionHeading shall be provided
- eventSpeed shall be provided; the current speed of the vehicle at the time the message is sent
- lanePositions shall be provided to indicate the lanes affected by the vehicle, if the information is available and reliable
- occupiedLanes should be provided to specify the lanes currently occupied by the vehicle, if the information is available and reliable
- trafficFlowRule should be set, with value according to the national regulation, according to the signage present on the rear of the vehicle.
 - In case an overtaking ban applies, it should be set either to noPassing(0) or or noPassingForTrucks(1), according to the overtaking ban.
 - In case of formation should be set according to formation.
- lightBarSirenInUse shall be set if the information is available and reliable or if the integration with the lightbar and/or siren equipment is active.
- linkedDenms should be set if the aim is to indicate that vehicles are operating in a coordinated fleet formation.
- *Note: if the winter maintenance vehicles drive in formation, the only way of conveying this information is by using linkedDenms.*
- A point-based relevance zone shall be sent. It shall be represented as:
 - eventPosition shall always contain the current position of the vehicle at the time the message is sent.
- . Message management shall be done as follows:

Message management	Setting
DENM update	Every 250ms
Repetition Interval	No repetition
Repetition Duration	No repetition
validityDuration	2s
Termination	Not used
- Scenario lifecycle shall be done as follows:
 - When a vehicle switches between different operational states (e.g., Transit/Warning or Active Operation), a DENM update shall be sent with the corresponding causeCode and subCauseCode.

- Once the vehicle finishes its operation *and the light bar is off*, it shall stop sending DENM messages, so no explicit termination message is required.

If a “Intervention Zone” event is present, then for the “ActiveTreatment / Mission Underway: (both I2V and V2V):

- linkedCause may be set to causeCode roadworks3 and subCauseCode winterService(6).
- linkedDenms; the *Intervention Zone* event may be linked.

CAM Profile

In a V2V setting, CAM messages are generated and appropriately profiled.

- The CAM message for ESVN-WM is profiled in chapters 4.2.5 of [C-Roads MP].
 - vehicleRole shall be set to roadOperator(11);
- SpecialVehicleContainer shall be set to SafetyCarContainer, except if the integration with the lightbar and/or siren equipment is not possible:
 - NOTE: the use of SafetyCarContainer implies that lightBarSirenInUse is set
 - incidentIndication:
 - shall be set to the causeCode/subCauseCode of the current scenario when the vehicle is on operational mode;
 - shall not be set when the vehicle is not on operational mode;
 - trafficRule should be set, with value according to the national regulation, according to the signage present on the rear of the vehicle.
 - In case an overtaking ban applies, it should be set either to noPassing(0) or noPassingForTrucks(1), according to the overtaking ban. In case of formation should be set according to formation.

Road Restrictions:

In the context of winter maintenance activities, certain traffic restrictions may apply, whether mandated by law, resulting from the presence of a vehicle formation, or introduced as a safety measure by the TCC.

In this case, the corresponding IVS-TS (or equivalent AVG-VSI/VDI) message should be sent.

Among the possible restrictions:

- “Overtaking ban”, either for all vehicle or only for heavy vehicles
 - serviceCategoryCode: regulatory
 - pictogramCategoryCode:
 - nature: 5
 - serialNumber: 42 or 44
- “Speed restrictions”:
 - serviceCategoryCode: regulatory
 - pictogramCategoryCode:
 - nature: 5
 - serialNumber: 57



- **“Minimum distance requirement”**

- serviceCategoryCode: regulatory
- pictogramCategoryCode:
 - nature: 5
 - serialNumber: 15



These restrictions can be applied alongside either the Intervention Zone or vehicle-based scenarios (e.g., Active Treatment/ Mission Underway). The choice between these is exclusive and depends on the implementer’s strategy and system capabilities. Each scenario may involve different restriction parameters.

Both I2V and V2V implementations using the IVIM message are supported, and this choice is independent of how the corresponding DENM is generated.

Road Restrictions & Intervention Zone

IVIM message is generated by the TCC

- linkedIvims should be referenced in the associated DENM messages.
- connectedDenms shall be used;
- Relevance zone: (giv.relevanceZonelds/avc.relevanceZonelds)
 - shall cover at least the area of intervention of the DENM (eventZone)
 - shall be updated to match DENM position and extension updates
- Active termination is required

For safety reasons, the restriction may start before and extend beyond the duration of the winter maintenance activities. During these time windows, the general IVIM rules apply, and the intervention zone can be used for relevance definition.

Road Restrictions & Active Treatment / Mission Underway:

Note: This specification addresses only the I2V IVIM message generation. A V2V IVIM implementation is not covered. The DENM message can be I2V or V2V.

- linkedIvims should be referenced in the associated DENM messages.
- connectedDenms should be used;
- Relevance zone: (giv.relevanceZonelds/avc.relevanceZonelds)
 - shall start at least 50m before rear-most vehicle of the formation
 - shall extend at least 100m after the front-most vehicle.
 - shall be updated to match position and extension updates

Note: This buffer compensates for latency, keeps the fleet within the restricted zone, and covers the operational impact area beyond the vehicle’s footprint.

In urban settings these values can be scaled down due to lower speeds and shorter reaction times.

IVS-TS: Pass To left – Pass to Right

Note: This specification addresses I2V and V2V IVIM message generation.

This corresponding IVS-TS message can be sent, if all the following conditions are met:

- The vehicle displays the appropriate rear-mounted traffic sign.
- The vehicle is not part of an active situation (e.g., fleet formation) where a DENM message defines a conflicting trafficFlowRule.

Note: Contradictions between IVIM content should be avoided, e.g., an overtaking ban present at the vehicle's current position

If any of these conditions are no longer satisfied, a termination message shall be sent.

Moreover the following rules apply to the IVS-TS:

- linkedIvims may be referenced in the associated DENM messages.
- ISO 14823 option "Pass this side" shall be used
 - serviceCategoryCode: regulatory
 - pictogramCategoryCode:
 - nature: 7
 - serialNumber: 18, 19 or 23



The choice shall be aligned with the signage displayed on the rear of the vehicle

- Relevance zone: (IviStructure.optional.giv.relevanceZonelds)
 - shall start at the current position of the vehicle at the time the message is sent
 - shall be updated to match the position of the vehicle
 - No requirement on the extension.
- connectedDenms should be used.

Security and data protection requirements

Security requirements and specifications of certificates are described in C-ITS Security Requirements and Specifications [2].

An overall introduction to the common European trust model is described in 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 roadworks3 and slowVehicle26 therefore requires appropriate DENM permission (SSP) in the certificate to be used (AT):

CauseCodeType / Container	SSP position	
	Octect position	Bit position
roadworks3	1	2
slowVehicle26	2	5

The here listed SSP shall be granted only for C-ITS stations used by road operators or any contractor on their behalf.

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.

Communication technology requirements: ITS-G5

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.

<p>Communication technology requirements: IP-Based</p>	<p>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.</p> <p>For use cases based on DENM messages the AMQP filtering tables specified in chapter 3.3 of [7] shall apply :</p> <ul style="list-style-type: none"> • serviceType = ESVN-WM • messageType = DENM <p>Geographic area (Quadtree) for DENM message, see appendix A of C-Roads, C-ITS IP Based Interface Profile [7]:</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>For use cases based on CAM messages the AMQP filtering tables specified in chapter 3.3 of [7] shall apply:</p> <ul style="list-style-type: none"> • serviceType = ESVN-WM • messageType = CAM <p>Please be aware that the exact details of the specification are defined in chapter 3.3 of [7].</p>
<p>Test and validation requirements</p>	<p>The document “C-ITS Cross-Border Testing and Validation Concept” [8] contains the generic applicable framework and process for interoperability testing.</p> <p>List of applicable generic test cases from C-Roads, C-ITS Test Plan [9]</p>