French C-ITS Deployment Coordination committee

C-ITS French use cases catalog functional descriptions

Deliverable 2.2

Activity 2: Studies

Sub Activity 2.2 > Use cases

Version 5.80, Approved

Publication Date: 06/02/2024

Co-financed by the Connecting Europe Facility of the European Union

Information on the document

Document: C-ITS French Use Cases Catalog – Functional descriptions

Date of publication: 01 february 2024

Responsible, Entity: Ministry for an Ecological Transition and Territorial Cohesion – Directorate General for Infrastructure, Transport and the Sea (DGITM)

Status: V 5.80

Distribution

Date	Version	Writer	Main modifications	Diffusion
05 May 2017	1.0	Thibaut Limon	First version of the catalog, without the use cases from the scoop project, to be approved by the COCSIC of May 12th, 2017. Use cases from the scoop project will be added in the next version.	COCSIC
02 August 2017	2	Thibaut Limon	Version 2 – Validated version. Scoop wave 2 and H use cases integrate remarks from partners and are now validated. Little modifications to various use cases.	
25 September 2017	3	Thibaut Limon	Version 3 – Validated version.	All
13 October 2017	4	Thibaut Limon	Version 4 – Validated version. Annex 1 modified	All
21 April 2020	5	Jérémy Diez	• New use cases in June 2018 : category K • Update of use cases in June 2018 : category J, B1b, C3 • New use cases related to the InDiD project added in December 2019 and February 2020 • Other minor changes • Global formatting • Annexes moved to a new document	Public
16 July 2020	5.10	Jérémy Diez	Use case E7 “Traffic jam ahead” added after validation of the COCSIC Etudes of 09-10th July 2020.	All
05 March 2021	5.20	Jérémy Diez	4 new use cases related to the InDiD project: A5, K5, K6, L5A and L5B, validated at the COCSIC Etudes.	All
23 April 2021	5.30	Jérémy Diez	3 new use cases related to the InDiD project: C8, F6, K7. GLOSA (G1) use case separated in two use cases.	All
22 July 2021	5.31	Jérémy Diez	Proposal for a better configuration of use cases for automated driving systems : • New paragraph in the introduction • B6 use case integrated into B1a use case • C6 use case integrated into C4 use case • H7 use case integrated into C2 use case • K7 use case integrated into K1 use case Proposal for a better configuration of the level crossing use cases (category K).	WG 2.2, COCSIC Etudes

05 October 2021	5.40	Jérémy Diez	Remarks from COCSIC integrated.	All
16 December 2022	5.50	Jamel Chakir	• 3 new use cases related to the InDiD projet : C9, G8, H9 • Update and improvement of use cases : F1, F5 • Other minor changes : G2, L3	All

11 July 2023	5.52	Jamel Chakir	• B4 use case update
			  ○ B4a : update of B4 use case
			  ○ B4b : new use case
			• 2 new use cases related to the InDiD projet : A6, C10
				COCSIC Études

21 July 2023	5.53	Jamel Chakir	Remarks from COCSIC integrated	COCSIC Etudes
21 July 2023	5.60	Thiwiza BELLACHE	Version approved following COCSIC-études of July	COCSIC Études
31 August 2023	5.61	Jamel Chakir	• 3 new use cases related to the InDiD projet : C10, F9, I1b • Minor improvements of D1 use case	COCSIC Études

03 October 2023	5.62	Jamel Chakir	Remarks from COCSIC integrated :
			• Renaming of use cases :
			  ○ B4a -> B4 & B4b -> C11
			  ○ C9 -> I6 & C10 -> I7
			  ○ I1a & I2b
			  ○ G8
			• Other minor changes
				COCSIC Etudes

09 October 2023	5.70	Thiwiza BELLACHE	Version approved following COCSIC-études of september	CE

04 December 2023	5.71	Jamel Chakir	Proposal for a better configuration of use cases in the catalog:
			• Renaming of use cases :(ticket 1693)
			  ○ D9a -> D9
			  ○ D9b -> E8
			• F1 use case update: (ticket 1680)
			  ○ Split in 2 uses cases: F1a & F1b
				COCSIC Etudes

31 January 2024	5.72	Jamel Chakir	• Remarks from COCSIC integrated. • Other minor changes Add CPM in CU G5/G6 (ticket 1643)	COCSIC Etudes
06 February 2024	5.80	Thiwiza BELLACHE	Use case name update: I7 (Cyclists -> Bicyle lane) Version approved following COCSIC-études of December	CE

Contributors

The numerous contributors to these functional descriptions come from the organizations involved in Scoop@F, C-Roads France, InterCor and InDiD projects.

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Purpose of the catalog

This catalog contains the functional descriptions of use cases considered in the four main french C-ITS projects: SCOOP@F (wave 1 and 2), C-Roads France, InterCor and InDiD.

The objective of a functional description is to describe the needs, independently of any technology: the functional descriptions are technology agnostic.

For each use case, the functional description is the main input in order to realize the technical specification, which is the answer to the use case needs.

Each functional description addresses the following topics:

- Type of road networks and type of vehicles relevant for the use case
- Added value of the use case compared to the current situation
- Objective of the use case
- Desired behaviour and expected benefits
- Situation where the use case is relevant
- Logic of transmission (independently of the technology)
- Actors and relationship
- Scenario
- Display principles and alert logic
- Possible standards pre-identified
- Main constraints and dependencies

The numerous use cases functionally described in this document will not necessarily be developed in one of the quoted projects. Moreover, the functional description has been done before any technical specifications.

The C-ITS use cases are categorized in 13 groups:

A – Probe vehicle data
B – Road Works Warning
C – Signage Applications
D – Hazardous Location Notifications
E – Traffic Information and Smart Routing
F – Parking, Park-and-Ride, Multimodality
G – Intersections
H – Traffic Management
I – Vulnerable Users
J – Multimodal Cargo Transport Optimization
K – Level Crossing
L – Law enforcement
M – Payment services

Each category includes several use cases. The logic of use cases numbering is the following:

- “Category Letter” + “incremental number” (and sometime, + “incremental letter” if a macro-use case has been divided in several sub- use cases).
- Moreover, some use cases have been described according to different logics of transmission (for example, the D11 use case “Alert end of queue” is described twice (I2V and V2V)). When this is the case, the use case number stays the same (e.g. D11), but there are two descriptions (e.g. D11 V2V and D11 I2V).
- Since the start of InDiD project, some use cases have been adapted in order to be used by an automated driving system and/or a human driver. When this is the case, the information is given in the “Type of vehicle” part. Some use cases have specifically been described in order to be used by automated systems only. When this is the case, the use case title specifies it with a mention such as “for automated vehicles” (e.g. C8).

The catalog encompasses different kinds of logic of transmission: I2V, V2V, V2I2V, V2P, etc.

A – Probe vehicle data

A1 – Traffic data collection

A1 – Traffic data collection	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is the automatic collection of road traffic data from the vehicle to the road manager.
Background / added values	Modern vehicles know at any time their own position, speed, direction and other internal data. This data could be used by the road operator to get a more comprehensive knowledge of its network (especially in areas not equipped with counting loops).
Objective	The objective of the service is to collect data from vehicles. This data can be used for real time traffic information and management, but also to build statistical information.
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible. • Data can be used by the road manager as input for monitoring and evaluation, as well as for I2V use cases.
Expected benefits	• Allow the road manager to know especially the average speed at each point of its network. • Characterize in a finer way the impact of events on traffic (development of congestion, end of queue evolution, etc.). • Identify more precisely the critical locations on the network. • Assist in the development and evaluation of traffic management strategies.
Use case description	
Situation	A driver is driving his vehicle along the road. The vehicle automaticaly sends messages, with a given frequency, related to the vehicle's traffic data (position, direction, speed, etc.).
Logic of transmission	V2I Broadcast
Actors and relations	• **The vehicle** is the source of the information, through its internal sensors or data. • **The vehicle driver**, possibly, needs to give its consent regarding automatic sharing of his vehicle's data. • **The road operator** collects the data from vehicles and can use the information derived from the data to provide information, warnings and advice. • **The end-users** of these data are the road operator and possibly service providers. • **Service provider:** uses the information derived from the data to provide warnings and advice. • **Others**: depending the car data considered, OEMs can act as a service provider, but also as an intermediate between the service providers and the end users.
Scenario	1. The vehicle regularly generates messages indicating its speed, position, direction and other data. 2. Messages from the vehicles are received by the road side units (RSUs). 3. The data elements are collected, crossed, aggregated, consolidated with messages possibles received from other vehicles according to different parameters defined by the road manager. 4. Data elements are accessible in the Traffic Management System (TMS) of the road manager who can then use them, either in real time of for statistical needs.
Display principle / Alert logic	This use case is totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI.

Possible standards	• CAM

Constraints / Dependencies	• **Technology of communication**:
	  ○ If the technology of communication used is the ITS-G5, data will be received by the road operator only if a RSU is surrounding the vehicle sending messages.
	  ○ A solution to handle this problem would be to equip vehicles with a function which stores the messages or the information they contain when the vehicle is not covered by an RSU around. RSU could send requests to vehicles when in communication range. Vehicles receiving this request could then send the stored messages/information. This solution could lead to privacy concerns. Moreover, not aligned with ETSI standards.
	• **Readiness of OEMs to broadcast data:**
	  ○ Road authorities are dependent on what information will be broadcasted from the C-ITS equipped cars.
	  ○ To a certain extent, it is up to OEMs what data will be broadcasted.
	• **Privacy** plays an important role. It is expected that car owners must answer a question whether they allow their data to be used for purposes as thought out by the road authorities (i.e. traffic jam detection, policy making, etc.). In France, an agreement with the CNIL has been done on this topic for the current C-ITS projects.
	• **Standardization:** The CAM standard has limitations in terms of data types. It would be particularly useful to extend it, for example to integrate the occupancy rate of the vehicle (see use case “H3 – Dynamic lane management”)
	• The user has to give his consent prior to use the data.

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A2 – Probe vehicle data on detected events

A2 – Probe vehicle data on detected event	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is an automatic collection of specific event information from the vehicles to the road manager.
Background / added values	• Thanks to their sensors / embedded technologies (windscreen wiper status, ABS, ESP, collision sensors, etc.), vehicles know specific events affecting the driving experience • This data could be used to enhance the road operator's knowledge of events, complementing cameras, patrol and other existing sources.
Objective	The objective of the service is the collection of event information on the road networks detected by the vehicles, for the road operator.
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible. • For the road operator, the collected data gives insight in the traffic situation and surroundings. These are used as input for monitoring & evaluation (e.g. for policy making) and other I2V use cases such as traffic condition warning, hazardous location notification and adverse weather condition.
Expected benefits	For the road manager, the service enables the detection and afterward a more precise and efficient qualification of road events on his network. The collected data proves as a basis for other I2V applications which are improved or possibly otherwise impossible.
Use case description	
Situation	A vehicle is driving along the road, automaticaly detects a specific event, and transmits automaticaly a message. Specific event are possibly: • Temporary slippery road (A2 – D1) • Stationary vehicle (A2-D4a) • Vehicle breakdown (A2-D4b) • Vehicle in accident (A2-D5) • Reduced visibility (A2-D6) • Emergency brake (A2-D10) • End of queue (A2-D11) • Extreme weather conditions (A2-E6) • Etc.
Logic of transmission	V2I Logic, Broadcast
Actors and relations	• **The vehicle** is the source of the information, through its sensors. • **The vehicle driver**, possibly, needs to give its consent regarding automatic sharing of his vehicle's data. • **The road operator** collects the data from vehicles and can use the information derived from the data to provide information, warnings and advice. • **The end-users** of these data are the road operator and possibly service providers. • **Service provider:** uses the information derived from the data to provide warnings and advice. • **Others**: OEMs can act as a service provider, but also as an intermediate between the service providers and the end users.

Scenario	1. A vehicle automaticaly detects an event and broadcasts a message signalling it. 2. The message is received by the road side units. 3. The data is collected, crossed, aggregated and consolidated with messages possibly received from other vehicles according to parameters defined by the road manager. 4. The data is then made available to the road manager on a dedicated database; It can access it from its TMS to assist in the operation of the network and / or automatic alerts directly to the occurrence of certain events. This will allow it, in return, to have this information back down to vehicles (I2V)
Display principle / Alert logic	This use case is totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI unless the HMI is programmed to display the events declared by the EGO vehicle (choice of the OEM).
Possible standards	• DENM
Constraints / Dependencies	• **Technology of communication**: ○ If the technology of communication used is the ITS-G5, data will be received by the road operator only if a RSU is surrounding the vehicle sending messages. ○ A solution to handle this problem, if the repetition of the message is not long enough, would be to equip vehicles with a function which stores the messages or the information they contain when the vehicle is not covered by an RSU around. RSU could send requests to vehicles when in communication range. Vehicles receiving this request could then send the stored messages/information. • **Readiness of OEMs to broadcast data:** ○ Road authorities are dependent on what information will be broadcasted from the C-ITS equipped cars. ○ To a certain extent, it is up to OEMs what data will be broadcasted. • **Privacy** plays an important role. It is expected that car owners must answer a question whether they allow their data to be used for purposes as thought out by the road authorities (i.e. traffic jam detection, policy making, etc.).

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A3 – Probe vehicle data on manually declared events

A3 – Probe vehicle data on manually declared events	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is a manual reporting by the road user of specific events to the road manager.
Background / added values	Thanks to their sensors / embedded technologies, vehicles know specific events affecting the driving experience (windscreen wiper status, ABS, ESP, collision sensors, etc.). But some events cannot be detected automaticaly by the vehicle itself (e.g. Animal on the road, unsecured blockage of a road, etc.) Therefore, the driver himself could be a source of information to detect some specific events and to warn the road operator. These data could be used by the road operator to enhance his knowledge of events, complementing cameras, patrol and other existing sources. However, compared to automaticaly detected events, the declared information could be less precise, especially in terms of localisation.
Objective	The objective of the service is the collection of event information on the road networks detected by the road users, for the road operator.
Desired behaviour	• Road user: needs to pull up information quickly, without putting himself in danger. The information may be declared after the event. • Road operator: the collected data gives insight in the traffic situation and surroundings. These are used as input for monitoring & evaluation (e.g. for policy making) and other I2V use cases such as traffic condition warning, hazardous location notification and adverse weather condition ; however, since this information depends on the driver, and the way he declares on the HMI (and the traffic conditions when he does), the road operator will need to proceed to a thorough check of these data elements.
Expected benefits	For the road manager, the service enables the detection and afterward a more precise and efficient qualification being a new source of information of road events on his network. The collected data proves as a basis for other I2V applications which are improved or possibly otherwise impossible.
Use case description	
Situation	A vehicle is driving along the road. The driver detects a specific event and decides to warn the road manager. Specific events are possibly: • Animal on the road (A3 – D2a) • People on the road (A3-D2b) • Obstacle on the road (A3 – D3) • Accident (A3 – D5) • Unsecured blockage of a road (A3-D8)
Logic of transmission	V2I Broadcast
Actors and relations	• **The vehicle driver** can declare manually some specific events via the HMI of his vehicle. • **The road operator** collects the data from vehicles and can use the information derived from the data to provide information, warnings and advice. • **The end-users** of these data are the road operator and possibly service providers. • **Service provider:** uses the information derived from the data to provide warnings and advice. • **Others**: OEMs can act as a service provider, but also as an intermediate between the service providers and the end users.
Scenario	1. The driver observes an event and informs about it via the HMI of his vehicle.

	2. The vehicle then sends a message in broadcast. 3. The message is received by the road side units. 4. The data is collected, crossed, aggregated and consolidated with messages possibly received from other vehicles according to parameters defined by the road manager. 5. The data is then made available to the road manager on a dedicated database; It can access it from its TMS to assist in the operation of the network and / or automatic alerts directly to the occurrence of certain events. This will allow it, in return, to have this information back down to vehicles (I2V)
Display principle / Alert logic	The driver manually informs on his HMI specific events. There are no alerts / information displayed on the vehicle's HMI unless the HMI is programmed to display the events declared by the EGO vehicle (choice of the OEM).
Possible standards	• DENM
Constraints / Dependencies	• **The driver** can be distracted when he reports the event on the HMI. • **Technology of communication**: ○ If the technology of communication used is the ITS-G5, data will be received by the road operator only if a RSU is surrounding the vehicle sending messages. ○ A solution to handle this problem, if the repetition of the message is not enough, would be to equip vehicles with a function which stores the messages or the information they contain when the vehicle is not covered by an RSU around. RSU could send requests to vehicles when in communication range. Vehicles receiving this request could then send the stored messages/information. • **Readiness of OEMs to broadcast data:** ○ Road authorities are dependent on what information will be broadcasted from the C-ITS equipped cars. ○ To a certain extent, it is up to OEMs what data will be broadcasted. • **Privacy** plays an important role. It is expected that car owners must answer a question whether they allow their data to be used for purposes as thought out by the road authorities (i.e. traffic jam detection, policy making, etc.).

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A4 – Detection of a vehicle in distress in a critical area

A4 – Detection of a vehicle in distress in a critical area	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	This use case permits an automatic detection of the presence of a vehicle in distress in a critical area. The critical area, previously determined by the infrastructure operator, can be a bridge, a tunnel, or any other.
Background / added values	• Today, the road operator can only get the information of the presence of a vehicle in distress on the road manually and this use case aims to automate the process. • The added value of this use case is to provide information in advance and automaticaly.
Objective	• The objective is to alert the infrastructure manager that a vehicle is stationed in a critical area.
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible.
Expected benefits	• For the infrastructure manager, the service enables the detection of a vehicle in distress in a critical area. • The collected data is a basis for other I2V applications which are improved or possibly otherwise impossible.
Use case description	
Situation	• Stationary vehicle in a tunnel. • Stationary vehicle on a bridge. • Stationary vehicle in any other critical area.
Logic of transmission	V2I Logic, broadcast

Actors and relations	• **The vehicle** is the source of the information
	• **The infrastructure operator:**
	  ○ Determines precisely the critical areas of its networks
	  ○ Is the end user of the service, and collects the data from vehicles. It can use the data to provide information, to warn or to advise.

Scenario	1. The infrastructure operator defines precisely the critical areas of its network. 2. A vehicle gets stuck on a critical area. 3. The vehicle sends a D4 event (Alert stationary vehicle / breakdown). 4. This information, coupled with the presence of the vehicle in a critical area, triggers a specific message to the infrastructure operator on the presence of a distress vehicle in a critical area.
Display principle / Alert logic	• This use case is totally invisible for the road user
Possible standards	• CAM • DENM
Constraints / Dependencies	Functional constraint: • The precision information of vehicle to avoid sending false alarms Dependencies: • D4 – Alert stationary vehicle / breakdown • D5 – Alert accident area • K4 – Detection of vehicle in distress on a level crossing

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A5 – Wrong way users detection

A5 – Wrong way users detection	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	The road manager detects a road user taking a dual carriageway in the wrong way.
Background	• Today, the information of wrong-way users is difficult to get with enough precision and efficiency by road managers. • By reducing the duration of wrong way user's detection, the other road users will be warned earlier.
Objective	The objective of the service is to detect a wrong way user on a dual carriageway. This information can be used to send a warning to the wrong way user and other road users to adapt their speed (see use case "D7 – Alert Wrong Way Driving").
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible. • The road manager analyses the information received to determine that there is a wrong way driver.
Expected benefits	• Faster detection of a wrong way driver • Road safety
Use case description	
Situation	A vehicle is driving along the dual carriageway in the wrong way. It automaticaly sends necessary information for the road manager to detect the wrong way user.
Logic of transmission	V2I Logic, Broadcast
Actors and relations	• **The vehicle** is the source of the information, through its sensors. • **The vehicle driver**, possibly, needs to give its consent regarding automatic sharing of his vehicle's data. • **The road operator** collects the data from vehicles and uses the information to detect a wrong way user and to provide information and warnings. • **The end-user** of the service is the road operator.
Scenario	1. A vehicle is driving in the wrong way of a dual carriageway. 2. The vehicle automaticaly sends necessary information for the road manager to detect that it is driving in the wrong way. 3. The messages are received by the road side units. 4. The information is received by the road manager. 5. Depending on the type of message, the road manager may need to aggregate and consolidate the information with messages possibly received from other vehicles according to different parameters. 6. The road manager detects the wrong way user. He can then use this information in real time and for statistical needs.
Display / alert principle	• This use case is totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI. • The road manager receives an alert in case there is a wrong way user detected.
Possible standards	• CAM • DENM
Constraints /	**Constraints:**

Dependencies	• If the technology of communication used is short-range, data will be received by the road operator only if a RSU is surrounding the vehicle sending messages. • The user may need to give his consent prior to use the data. **Dependencies:** • This use case is a way for the road operator to detect a wrong way user, but to be used as a warning to other road users the use case “D7 – Alert Wrong Way Driving” needs to be deployed.

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A6 – Road signs detection

A6 - Road signs detection	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The vehicle detects and interprets the roadside signs, records them and transmits their position to the other ITS-station. This service could be used to collect data to complete HD MAP.
Background / added values	• Help the road operator to improve driver safety • Help the road operator to improve the knowledge of his infrastructure by detection of the alteration of the road sign panel • Share and update the HD MAP to the other C-ITS station
Objective	• The objective of the service is to transmit information in “pictogram” in order to update the map. • The information collected could be used to notifty the road operator of damaged or displaced signs
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible • The road manager analyses the information about damaged or displaced signs to determine if an intervention is needed.
Expected benefits	• Optimize the reliability of the panel position • Improve the safety of the infrastructure • Improve sign maintenance • Update a database of roadside signs • Improve the knowledge of the infrastructure
Use case description	
Situation	• The vehicle detects road sign alteration: fallen, mismatched, missing and damaged road sign, etc… • The vehicle interprets the issue and shares the information to the road operator and other C-ITS stations
Logic of transmission	V2I logic Broadcast
Actors and relations	• **The vehicle** detects and interprets the roadside signs, records them and transmits their position to the other ITS-station • **End-Receivers**: the road operator and other C-ITS station
Scenario	If the road sign is presents: 1. the vehicle detects it 2. The vehicle checks if the sign is present in the roads sign data base 3. The vehicle checks if the traffic sign is present and placed as expected in the map 4. If the road sign is not conformed with the map, the vehicle sends an IVI to inform the road operator If the road sign is absent or has fallen: 1. The map informs the vehicle that it has not detected the expected road sign 2. The vehicle confirms that no road sign was detected at this position 3. The vehicle sends the IVI 9-98 to the road operator
Display principle / Alert logic	• This use case is totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI

	• The vehicle detects and interprets the roadside signs, records them and transmits their position to the other ITS-station.
Possible standards	• ISO TS 14823 • IVI
Constraints / Dependencies	**Constraints** • The vehicle must be equipped with a camera or sensor able to recognize the road sign and must be able to assign a value to the road sign • The vehicle must be connected to an interactive map/data base with road sign to process the information detected along the road (check if the road sign detected is well compliant with the database) • The precision information of vehicle to avoid sending wrong information **Dependencies** • There are some dependencies with the use case G7 “HD cartography extended services” • Link to be done with AV systems (autonomous vehicle)

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B – Road works warning

B1a – Alert closure of part of a lane, whole lane or several lanes

B1a – Alert closure of part of a lane, whole lane or several lanes	
Type of road network	**All for human drivers, motorways only for automated driving systems**
Type of vehicle	**All, adapted for automated driving systems**
Use case introduction	
Summary	The vehicle receives information about the neutralization of part of a lane or a lane closure (but without road closure). The neutralization can be due to a static road works site, but also to an accident. In this use case, alternate mode and road closure are excluded. In addition, the use case also specifies additional information necessary for an automated system to understand precisely the roadworks site topology.

Background / added values	• Currently, many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims. An alert sufficiently in advance would prevent this type of situation by adapting the behaviour of the driver.
	• The same risks exist in accident sites, even when they are secured with warning beacons.
	• Interpreting properly a zone with road works signalization is a difficulty for a vehicle with a delegated driving system. For example:
	  ○ Signalization cones are not always recognized by AVs or are recognized but can be interpreted as an object on the road.
	  ○ FLR may be understood as a stopped vehicle (“end of queue”) so AVs may stop just behind, waiting for the resumption of the traffic congestion.
	  ○ The interruptions of the central road divider may not be understood by AVs.
	• A roadworks site or a specific securization of an accident alter the topology of the road. An automated system needs to update its map with the cartography of the altered zone, which can be retrieved from the roadworks site information.

Objective	• For human drivers, the objective is to allow them to anticipate the neutralization of a lane and to adapt their speed and position on the road.
	• For automated system, the objective is to receive the roadworks topology information in advance in order to:
	  1. Determine whether the new road topology is compliant with its operational design domain;
	  2. Decide whether the system gives back the control to the driver, stops in a secure way or navigate through the altered zone while associating the elements detected by its sensors with the elements of the new map
	• The objective is not to signal a road closure and therefore no alternative route will be transmitted.

Desired behaviour	• Increased vigilance of the human drivers • Adaptation of the speed • Change of lanes (if needed) • Finding the way through the road works in automated mode, or informing and giving back the control to the driver, at the right moment and in safe conditions.
Expected benefits	• Reduce the risk of accidents (for users, road agents, emergency services in case of an accident...) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering) • Improved traffic management
Use case description	
Situation	• Roadworks equipped with warning beacons / temporary road signs, on a road with separate carriageways or on a dual carriageway. • Accidents occurring on a lane without closing the flow direction (no alternate, no

	closure). The area has been equipped by road operators with warning beacons / temporary road signs. • Carriageway crossover.
Logic of transmission	I2V Logic Broadcast

Actors and relations	• **The Road operator** is the sender of the message**.**
	• **The driver or the automated driving system of the vehicle** approaching the area is the end-user of this service.
	• **Information provider:**
	  ○ In case of roadworks: the road works planner of the road operator.
	  ○ In case of accidents: can be the emergency services, the road operator through its cameras, etc.

Scenario	1. a. Neutralization due to roadworks: If the neutralization is due to a roadworks, the road manager programs a static and planned roadworks and reports it in the Traffic Management System (TMS). b. Neutralization due to an accident: An accident occurs on the road. Road operators go there and secure the accident area with portable posting. They alert the TCC. Then, the road manager programs an incident area in the TMS. 2. The information contains all the elements that can be used to precisely describe the work site (start / end position of the worksite, duration) or the accident area. Additional information can be added, such as the speed limit of each neutralized portion. To be used by an automated driving system, the message must contain an indication of the road beaconing geometry or the geometry of the remaining authorized paths. 3. The message is then broadcasted to the road users. 4. The vehicle receives the information and processes it. 5. The vehicle displays the message to the driver if necessary (especially if there is only a human driver) and the driver or the automated system takes the appropriate actions to prepare to go through the zone.
Display principle / Alert logic	• When planning his journey, the user is informed of road portions with lane neutralization. • When approaching the site, the user receives an alert to allow it to adjust its speed and position on the pavement. The alert needs to be received early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• DENM • IVI / IVS • MAP

Constraints / Dependencies	**Constraints**:
	• Prior the standards decision, the following check would be necessary:
	  ○ Update of the Message Set and Triggering Conditions for Road Works Warning Service.
	• A major constraint is the potential presence of gaps between the message sent to automated driving systems and the real road marking on the ground, which seems to be irresolvable.
	• For example, such gaps can come from:
	  ○ the status of the *Manual of the site supervisor* (which is simply a guide);
	  ○ possible displacements of elements (cones, panels, etc.);
	  ○ the precision of the installation site signage, which is not centimetric but metric, and that of the decree which is of the order of a hundred meters;
	  ○ constraints of the site that could shift the start or end of the work site in relation to the decree and therefore the forecast information that could feed the RSU if the correction is not made.
	• Automated vehicles will thus have to merge the data from the C-ITS messages

	with that supplied by their sensors. **Dependencies:** • Dependencies with the G7 use case (“HD cartography: extended services”). The MAP message specified in the B1a and G7 use cases should be technically specified and developed in the same way. • Dependencies with the C2 use case (“In-vehicle dynamic speed limit information (adapted for automated driving systems)”). The IVI message specified in the B1a and C2 use cases should be technically specified and developed in the same way.

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B1b – Alert planned closure of a road or a carriageway

B1b – Alert planned closure of a road or a carriageway	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives information about a road closure due to a planned static roadworks. If possible, are routing information is also given to the driver.
Background / added values	• When road users are stuck without being informed on the situation, they can become anxious and they may do dangerous U-turns or use an inappropriate lane. Providing that kind of information can prevent these situations, bringing more safety and comfort to road users.
Objective	• To allow the driver to anticipate the closure of a road so he can choose an alternate route. • This anticipation can be geographical or temporal.
Desired behaviour	• The driver adapts his route.
Expected benefits	• Safety (avoid dangerous behaviour, e.g U-turns) • Improved traffic management • Improved comfort for road users
Use case description	
Situation	• On a dual carriageway: one direction is closed, without carriageway crossover. • On a two-way carriageway: the whole road is closed (therefore without alternate). • Rail works on a level crossing with a traffic closure • In all cases: a deviation is indicated near the closure.
Logic of transmission	I2V Logic Broadcast
Actors and relations	• **The Road operator** is the sender of the message. Can be in contact with the other road managers in order to implement a smart deviation itinerary. • **The Vehicle driver** is the end-user of the service (receiver of the closure information). • **The information provider** is the infrastructure operator (road operator, railway operator). • **Other**: The authorization of the road works is given following the issuance of an order.
Scenario	1. The road manager programs a static and planned road works and reports it in his Traffic Management System (TMS). 2. This information contains all the elements that can be used to precisely describe the worksite (start / end position of the closure, duration). 3. The message is then broadcasted to the road users so that users can adapt their itinerary. 4. The vehicle receives the information and displays it to the driver.
Display principle / Alert logic	• When planning his journey, the user is informed of road closures. • Little intrusive alert in the case of a significant temporal anticipation; a little more intrusive in case of a shorter anticipation time.
Possible standards	• DENM • IVI / IVS • MAP
Constraints / Dependencies	• Management of planned events to be sent to road users.

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B1c – Alert planned road works – mobile

I2V use case

B1c – Alert mobile road work site (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives information about a zone on the road that contains, at some point, the neutralization of part of a lane or a lane closure (but without road closure) due to a planned mobile work site.
Background / added values	Currently, many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims. An alert sufficiently in advance would prevent this type of situation by adapting the behaviour of the driver. The risk is even more important with mobile work site that are “lighter” in terms of protection and signaling, since moving.
Objective	The objective of this use case is to inform a road user of a mobile work zone where he will encounter operating agents in the zone. However, the operating agents as well as markings. will not be present on the whole section. This use-case does not include mobile bottleneck operations.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reduce the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering) • Improved traffic management
Use case description	
Situation	• mowing • road markings • fixing restraint systems • phyto-sanitary treatments • sweeping, road cleaning, • etc
Logic of transmission	I2V Broadcast
Actors and relations	• **The Road operator** is the sender of the message**.** • **The vehicle driver** approaching the area is the end-user of this service (receives the message). • **Information provider:** the road works planner of the road operator.
Scenario	1. The road manager programs a mobile and planned roadworks and reports it in his Traffic Management System (TMS). 2. The information contains all the elements that can be used to precisely describe the work zone (start / end position of the work zone, duration). This zone will not be entirely used by the operating agents; they will set markings around the actual work site within this zone. 3. Additional information can be added, such as the speed limit of each neutralized portion. 4. The message is then broadcasted to the road users. 5. The vehicle receives the information, processes it, and displays it to the driver.
Display principle /	• When he arrives near the possible work zone, he receives an alert to allow him

Alert logic	to adjust his speed and position on the pavement. The alert needs to be displayed on the HMI early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• DENM • IVI / IVS • MAP
Constraints / Dependencies	• The road operator vehicle on site, if equipped, might broadcast a message signaling a mobile worksite as well. The HMI might need to handle those two messages. The priority shall be given to the information given by the vehicle on site.

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Vg2V use case

B1c – Alert mobile road works (Vg2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives information about the neutralization of part of a lane or a lane closure (but without road closure), along with working operating agents due to a mobile work site.
Background / added values	Currently, many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims. An alert sufficiently in advance would prevent this type of situation by adapting the behaviour of the driver. The risk is even more important with mobile work site that are “lighter” in terms of protection and signaling, since moving.
Objective	The objective of this use case is to inform a road user of mobile road works, directly from the vehicle that protects the operating agents doing the works. This use-case does not include mobile bottleneck operations.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering) • Improved traffic management
Use case description	
Situation	• mowing • road markings • fixing restraint systems • phyto-sanitary treatments • sweeping, road cleaning, • etc
Logic of transmission	Vg2V logic Broadcast
Actors and relations	• The sender is an operating agent in his vehicle, the first vehicle that protects the work site. Usually, it will be a trailer. • End – receivers are drivers approaching the road works site in their vehicles. The source of information is the operating agent in his vehicle.
Scenario	1. While setting the markings to define the mobile roadworks on site, the road operator’s vehicle or trailer protecting the mobile road works sends a message in

	V2V indicating its position. Possibly, a contextual speed is attached. The triggering conditions are manual, if the warning arrows are not connected, automatic if connected. 2. The roadworks starts and are moving along at a speed depending on the nature of the roadworks. The first vehicle or trailer follows them from an appropriate distance to make sure it is still seen by road users, either continuously or by short hope. It keeps sending the message, updating its position. 3. Vehicles approaching the mobile road works receive the message, process it and displays the information to the driver.
Display principle / Alert logic	When the road user arrives near the work site, he receives an alert to allow him to adjust his speed and position on the pavement. The alert needs to be displayed on the HMI early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• DENM
Constraints / Dependencies	An RSU message might also be broadcasted signaling a mobile work zone as well. The HMI might need to handle those two messages. The priority shall be given to the information given by the vehicle on site. Another constraint would also be if different vehicles on the work site sends the same information as well.

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B2a – Alert operator vehicle approaching

B2a – Alert operator vehicle approaching	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operating agent in its intervention vehicle needs to access urgently an incident area to protect it. He requests to drivers that they facilitate its way on the road, broadcasting a message.
Background / added values	Road operators' vehicles are not emergency vehicles and are not as equipped as police or firemen vehicles for example. Thus, they are not always visible by the drivers when they try to go through a bottleneck for example. Such a use case can make sure the driver is alerted by their presence and facilitates its progression.
Objective	The objective is to alert a road user that a road operator intervention vehicle is trying to go through so that he facilitates its way.
Desired behaviour	When the road user receives the alert, the desired behaviour is that he checks where the road operator vehicle is and makes sure the road operator can overtake him easily. The road user can then change lanes, move aside, or else
Expected benefits	• Faster reach of incident/accidents 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	• situation of bottleneck: the road operating vehicle can either be circulating on the hard shoulder, or between lanes • free flow traffic
Logic of transmission	Vg2V Broadcast
Actors and relations	• The sender is an operating agent in his vehicle. • The End – receivers are drivers that he is trying to overtake in their vehicles. • The operator in his vehicle is the source of information
Scenario	1. The operating agent needs to go and protect an incident / accident zone on the road network 2. While he is on the network trying to reach his destination, he broadcasts a message to road users that he is trying to overtake 3. The road users' vehicles receive the information and alerts the drivers. 4. The road users' vehicles facilitate the way of the road operator vehicle.
Display principle / Alert logic	This use-case is one that needs to alert the driver from an event that is happening behind him. The alert logic should make sure that he gets the message without interfering with his driving. It is at the OEM discretion: can be a display on the HMI, a sound, or a flash on the mirrors for example.
Possible standards	• DENM • CAM
Constraints / Dependencies	This use case being a message from behind the driver, the main constraint will be to alert the driver without interfering with his driving.

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B2b – Alert operator vehicle in intervention

B2b – Alert operator vehicle in intervention	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	An operating agent in his vehicle stops in front of an accident/incident to protect the obstacles or is currently setting the equipment (lane delineation) to protect a site (in case of roadworks for example).
Background / added values	Currently, many road users strike the protection equipment's of road works or incident/accident sites, sometimes causing victims. An alert sufficiently in advance would prevent this type of situation by adapting the behaviour of the driver. The risk is even more important with accidents that drivers usually stop to look at.
Objective	The objective of this use-case is to alert a road user that an operating agent is intervening on a site so that the driver can adapt his behaviour. This can be either a stop during a patrol tour to take a picture/fix an equipment, or actual intervening to protect road users that might stopped, either on the road or on the hard shoulder.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering) • Improved traffic management
Use case description	
Situation	• accident • incident (stopped vehicle on the road, obstacle) • stop during a patrol tour • lane delineation • etc.
Logic of transmission	Vg2V Broadcast
Actors and relations	• The sender is an operating agent in his vehicle, or the vehicle itself (if automatic detection) • The End – receivers are drivers around the event. • The operator in his vehicle is the source of information
Scenario	1. a) <u>Intervention in case of accident/incident:</u> An operator detects/gets alerted of an accident/incident on the road and asks the operating agents (via their hierarchy) that there is a need to go and protects the site. b) <u>Intervention while patrolling:</u> While patrolling, an operating agent detects an event on the road (pothole, obstacle, broken restraint system, etc.) and needs to protect the site or correct the situation. c) <u>Intervention in case of lane delineation:</u> A roadworks is planned and lane delineation needs to be done (or removed). 2. The operator agent in his vehicle stops to protect the event and/or starts delineating and sends a message in V2V indicating its position. The triggering conditions are manual, if the warning arrows are not connected, automatic if

	connected. 3. Vehicles approaching the intervention site receive the message, process it and display the information to the driver.
Display principle / Alert logic	When the road user arrives near the intervention site, he receives an alert to allow him to adjust his speed and position on the pavement. The alert needs to be displayed on the HMI early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• DENM
Constraints / Dependencies	Another message could be sent by the TCC providing information on the actual event protected by the operating event. Two messages could be then sent. See if it is possible to link dynamically the events.

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B2c – Alert operator vehicle in patrol

B2c – Alert operator vehicle in patrol	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator vehicle that is patrolling sends out a message alerting road users that he might be currently driving slower than the flow.
Background / added values	The road users are currently not aware that there are patrolling vehicles on the road. Even if, depending on traffic, they might be circulating at the flow speed, they also could be driving slower than the flow, to be able to properly detect events on the road. This use-case can bring vigilance to road users for this kind of operation.
Objective	The objective of this use-case is to alert road users that an operating agent is currently circulating on the road at a speed that could be slower than the flow speed, since patrolling, so that the driver can adapt his behaviour.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering) • Improved traffic management
Use case description	
Situation	A patrolling vehicle is circulating on the road network.
Logic of transmission	Vg2V Broadcast
Actors and relations	• The sender is an operating agent in his vehicle, or the vehicle itself (if automatic detection) • The End – receivers are drivers around the vehicle • The operator in his vehicle is the source of information
Scenario	1. An operating agent or a team of operating agents go on a patrolling mission on the road (consisting in checking the state of the road, road equipments, road infrastructure, etc.). 2. While patrolling, the vehicle might go at a limited speed to be able to properly notice events on the road. If so, either manually, or automaticaly, the vehicle sends out a message signaling its presence. 3. Vehicles around the patrolling vehicle receive the message, process it and display the information to the driver.
Display principle / Alert logic	Since it is to alert the presence of a moving vehicle, even if slow, the alert does not need to be too intrusive.
Possible standards	• DENM
Constraints / Dependencies	The DENM standard does not have a patrolling cause code.

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B2d – Alert end of queue by a road operator vehicle

B2d – Alert end of queue by a road operator vehicle	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator is signaling sufficiently in advance a dangerous end of queue with his vehicle.
Background / added values	Signalling end of queues directly from vehicles might be quite dangerous for operating agents on site, since they are the signal themselves. Sending a message upstream could allow to also be protected. Another obvious added value is also a better signalling of the end of queue itself.
Objective	The objective of this use-case is to alert road users that an end of queue is near. However, the use-case will signal the position of the vehicle signaling the end of queue, and not the end of queue itself.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	• Reducing the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down or stopping) • Improved traffic management
Use case description	
Situation	A road operator vehicle signals the end of queue that is downstream of it, a few hundred meters away. Depending on the traffic and the site, he might be going backwards on the hard shoulder if the bottleneck is growing.
Logic of transmission	Vg2V Broadcast
Actors and relations	• The sender is an operating agent in his vehicle • The End – receivers are drivers around the vehicle • The operator in his vehicle is the source of information
Scenario	1. A bottleneck is forming on the road network, with a dangerous end of queue. 2. Operating agents are sent on site to signal this dangerous end of queue. They stop a few hundred meters upstream and send out a message, with their position. 3. Vehicles around the vehicle receive the message, process it and display the information to the driver.
Display principle / Alert logic	The alert logic might need to be different than the V2V message between two road user's vehicle that signal the actual position of the end of queue, since here the position is of the vehicle signaling the end of queue. It can then be moderately intrusive.
Possible standards	• DENM
Constraints / Dependencies	The difficulty could be for the HMI to properly interpret this message compared to the V2V message; and deal with both messages if it happens. Another difficulty could be if the road operator vehicle is going backwards.

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B3a – Winter maintenance – Salting in process

B3a – Winter maintenance – Salting in progress	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Operating agents (or one, depending on the road operator) are in a winter maintenance vehicle currently salting the road and sending a message signaling their activity.
Background / added values	Salting vehicles are much slower and cannot be overtaken. Even if the road might not be easily used because of the snow, and the vehicles might not go very fast, they usually don't know exactly where the winter maintenance activities are happening. This use-case can then prevent collisions between winter maintenance vehicles and vehicles. It can also help sending information about a possible spill of salt for vehicles circulating on the other side of the road.
Objective	The objective of this use-case is to alert a road user that he will encounter a winter maintenance vehicle salting the road, so that he can adapts his driving behaviour. This use-case is also interesting for people on the other direction because there could be an impact of this salting on their direction.
Desired behaviour	• Increased vigilance • Alert of an imminent risk • Adaptation of speed
Expected benefits	• Reducing the risk of accidents (for users, road agents) during a winter maintenance intervention • Improved winter maintenance interventions efficiency
Use case description	
Situation	• A vehicle is arriving behind a salting vehicle in intervention • A vehicle is driving on the other side of a dual carriageway
Logic of transmission	Vg2V Logic Broadcast
Actors and relations	• Sender is the operator in his vehicle or the vehicle automaticaly (if connected to the salting equipment) • End-receivers are drivers in both directions of the road. • The source of information is the road operator.
Scenario	1. The operating agent(s) start salting the road while circulating on the road. 2. If connected directly to the salting equipment, the OBU sends a message to inform users of the salting; otherwise, the signaling can be made manually on the HMI. 3. The road users' vehicles around the winter maintenance vehicle receive the message and display it to the drivers.
Display principle / Alert logic	The display logic might be different if the message is received by a vehicle behind the winter maintenance vehicle (maybe a reminder that it cannot overtake?) or a vehicle on the other side of the road (shards).
Possible standards	• DENM
Constraints / Dependencies	This message could be also accompanied by a message sent by the TCC signaling a zone of winter maintenance (using VMS for example). The vehicle will have to deal with the priority or redundancy of both messages.

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B3b – Winter maintenance – Snow removal in process

B3b – Winter maintenance – Snow removal in process	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Operating agents (or one, depending on the road operator) are in a winter maintenance vehicle currently de-snowing the road and sending a message signaling their activity.
Background / added values	De-snowing vehicles are much slower and cannot be overtaken. Even if the road might not be easily used because of the snow, and the vehicles might not go very fast, they usually don't know exactly where the winter maintenance activities are happening. This use-case can then prevent collisions between winter maintenance vehicles and vehicles. It can also help sending information about a possible spill for vehicles circulating on the other side of the road (bi-directional roads).
Objective	The objective of this use-case is to alert a road user that he will encounter a winter maintenance vehicle de-snowing the road, so that he can adapts his driving behaviour.
Desired behaviour	• Increased vigilance • Alert of an imminent risk • Adaptation of speed
Expected benefits	• Reducing the risk of accidents (for users, road agents) during a winter maintenance intervention • Improved winter maintenance interventions efficiency
Use case description	
Situation	• A vehicle is arriving behind a de-snowing vehicle in intervention, cannot overtake • the de-snowing can only be on a few lanes on a dual carriageway • for a bi-directional road, snow could be removed and spill on the other lane
Logic of transmission	Vg2V Logic Broadcast
Actors and relations	• Sender is the operator in his vehicle or the vehicle automaticaly (if connected to the de-snowing equipment) • End-receivers are drivers • The source of information is the road operator.
Scenario	1. The operating agent(s) start de-snowing the road while circulating on the road. 2. If connected directly to the de-snowing equipment, the OBU sends a message to inform users of the de-snowing ; otherwise, the signaling can be made manually on the HMI. 3. The road users' vehicles around the winter maintenance vehicle receive the message and display it to the drivers.
Display principle / Alert logic	The display logic might be different if the message is received by a vehicle behind the winter maintenance vehicle (maybe a reminder that it cannot overtake?) or a vehicle on the other side of the road.
Possible standards	• DENM
Constraints / Dependencies	This message could be also accompanied by a message sent by the TCC signaling a zone of winter maintenance (using VMS for example). The vehicle will have to deal with the priority or redundancy of both messages.

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B3c – Winter maintenance – Alert vehicle moving

B3c – Winter-maintenance – Alert vehicle moving	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Operating agents are sent to salt or remove snow or a particular section or come back from their intervention and are circulating in their winter maintenance vehicle, larger than a regular vehicle, from or to their center.
Background / added values	The winter maintenance vehicle (usually trucks with blade snow ploughs) are larger than the usual vehicles (even than a lane). An alert of their presence, even if they are doing any activity, can be interesting for road users.
Objective	The objective of this use-case is to alert a road user that he will encounter a winter maintenance vehicle that is larger than a usual vehicle, so that he can adapts his driving behaviour.
Desired behaviour	• Increased vigilance • Alert of an imminent risk • Adaptation of speed, change of lanes
Expected benefits	• Reducing the risk of accidents (for users, road agents) during a winter maintenance intervention • Improved winter maintenance interventions efficiency
Use case description	
Situation	• a vehicle is driving behind a winter maintenance vehicle circulating, might need to overtake
Logic of transmission	Vg2V Logic Broadcast
Actors and relations	• Sender is the operator in his vehicle or the vehicle automaticaly (if connected to the orange revolving light) • End-Receivers are vehicle around. • The source of information is the road operator.
Scenario	1. The operating agent(s) use a winter maintenance vehicle equipped with a blade snow plough but are not doing any de-snowing or salting. 2. If connected directly to the orange revolving light, the OBU sends a message to inform users of the presence of the vehicle; otherwise, the signaling can be made manually on the HMI. 3. The road users' vehicles around the winter maintenance vehicle receive the message and display it to the drivers.
Display principle / Alert logic	Since such a vehicle can be going slower than other vehicles, the alert can be moderately intrusive to signal a danger.
Possible standards	• DENM
Constraints / Dependencies	This message could be also accompanied by a message sent by the TCC signaling a zone of winter maintenance (using VMS for example). The vehicle will have to deal with the priority or redundancy of both messages.

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B4 – Dangerous Vehicle Approaching a Road Works: Warning to the Dangerous Vehicle

B4 – Dangerous Vehicle Approaching a road works – Warning to the Dangerous Vehicle	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	When a vehicle is approaching with an inappropriate and a dangerous trajectory an ITS station in a light arrow trailer upstream a road works, a warning is sent to the dangerous vehicle by the ITS station.
Background	• Vehicles are only warned of the presence of workers and anyone else in and around a road work through a dynamic temporary sign such as light arrow trailer for roadworks. • Many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims. • So far, no external and connected system, such as an ITS station, warns vehicles of a dangerous behaviour.
Objective	• To enhance the safety of road workers, drivers and anyone else being in the road works area, by sending a warning to dangerous vehicle driver in order to let him adapt his trajectory / speed.
Desired behaviour	• When receiving the warning, drivers adapt their behaviour by taking care of outside elements associated to the road works. For example, they will adapt their speed or correct their trajectory.
Expected benefits	• Safety for road works workers, as a result of the warning sent to to the dangerous vehicle • Safety for drivers • To reduce number and severity of corporal and material accidents.
Use case description	
Situation	• On a dual carriageway, one or more lanes are closed due to a road works (temporary or not). • The site is equipped with a system able to detect a dangerous vehicle approaching and connected (e.g. illuminated arrows linked with and OBUg; connected beacon...). • Workers are operating inside the road-marking zone.
Logic of transmission	Vg2V or I2V logic, Unicast

Actors and relations	• **The sender is an ITS station**, which is an OBU in a trailer or on a deported beacon, named Vg.
	• **The driver of the dangerous vehicle** approaching is the end-user of the service.
	• **Road agents** equip their roadworks with an equipped trailer in front of their work site.
	• **Sources of information** could be:
	  ○ Messages from vehicles (CAM) received by the ITS station
	  ○ An infrared camera mounted at the top of the trailer
	  ○ Others (radar, other camera...)

Scenario	1. An ITS Station is installed in a trailer. 2. The trailer is positioned at the beginning of a road works area. 3. The ITS station computes the trajectories of the vehicles in front of the road works. 4. A vehicle is approaching too close from the roadwork area with an inappropriate and

	dangerous trajectory and/or speed. 5. ITS station detects that the vehicle is going inside a “dangerous zone”, meaning that it is becoming dangerous for the roadworks site. 6. A warning is immediately sent to the dangerous vehicle. 7. The driver is alerted (if it is still relevant), and he can adapt his behaviour (trajectory, speed).
Display / alert principle	• The warning message is displayed with a very high priority on the HMI of the dangerous vehicle.
Possible standards	• CAM (e.g. to calculate the position, trajectory and speed of the approaching vehicles) • DENM (e.g. to send messages to the dangerous vehicles) • MAP (e.g. to get a detailed description of the roadworks)
Constraints / Dependencies	**Constraints:** • There are very low latency requirements. Therefore some message types might be too heavy. • Wrong detection from the camera • The relevance of the signal **Dependencies:** • To extend the study on the SCOOP use case “Road Work Warning” which is developed with the DENM standard, ITS station could use CAM messages. However other sources to detect a dangerous vehicle approaching are possible (e.g. cameras, radar, etc.). • There are some dependencies with use case C11 “Dangerous vehicle Approaching a Road Works: Safety Recommendation to the Dangerous Vehicle”. • Dependencies with the Yellow project. One of the following systems could be used: ○ an illuminated arrow linked with a OBUg and including the Yellow system phase 1 plus 2 could be used. ○ a connected beacon with an OBU and linked with an illuminated arrow indicating a track shift equipped with the Yellow system.

B5 – Dangerous Vehicle Approaching a Road Works: Warning to workers

B5 – Dangerous Vehicle Approaching a road works – Warning to workers	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	When a vehicle is approaching with an inappropriate and dangerous trajectory an ITS station in a light arrow trailer upstream a road works, a warning is sent to the workers present in and around the road works area.
Background	• So far, no external and connected system such as an ITS station warns the road workers or anyone else in and around the road works of a dangerous vehicle approaching. • Many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims.
Objective	• To enhance the safety of workers and anyone else being in the road works area by sending to them a strong alert of a dangerous vehicle approaching with a risk of collision.
Desired behaviour	When hearing the signal, workers and pedestrians adapt their behaviour according to the safety measures carried out (in order to keep themselves safe)
Expected benefits	• Safety • To reduce stress for workers as they know a system protect them more. • To reduce number and severity of corporal and material accidents.
Use case description	
Situation	• On a dual carriageway, one or more lanes are closed due to a road works (temporary or not). • The site is equipped with a system able to detect a dangerous vehicle approaching and connected (e.g. illuminated arrows linked with and OBUg; connected beacon...). • Workers are operating inside the road-marking zone. Other people such as pedestrians, or workers in a vehicle, are also concerned.
Logic of transmission	Vg2P Logic, Broadcast

Actors and relations	• **The sender is an ITS station** (illuminated arrows or deported beacon equipped with an OBU), named Vg, detecting the danger.
	• **The workers of the roadworks,** and other pedestrians in and around a roadwork equipped with a personal and / or collective alert system, are the end-users of the service.
	• **Road agents** equip their roadworks with an equipped trailer in front of their work site.
	• **Sources of information** could be:
	  ○ Messages from vehicles (CAM) received by the ITS station
	  ○ An infrared camera mounted at the top of the trailer
	  ○ Others (radar, other camera...)

Scenario	1. An ITS Station is installed in a trailer. 2. The trailer is positioned at the beginning of a road works area. 3. The ITS station computes the trajectories of the approaching vehicles in front of the road works (e.g., by using the CAMs of the vehicles). 4. A vehicle is approaching too close from the road work area with an inappropriate and a dangerous trajectory 5. ITS station detects it since it is coming in the dangerous zone, meaning that it is becoming dangerous for the roadworks site. 6. A warning is immediately sent to all the equipped workers so that they keep

	themselves safe (for example, by going outside the safety barrier).
Display / alert principle	• An alert system is needed. It can be personal (e.g. connected jackets, connected helmet, vibrating bracelet) and / or collective (strong alarm). • The alert needs to be distinctive and clearly understandable.
Possible standards	• CAM (e.g. to calculate the position, trajectory and speed of the approaching vehicles) • DENM or IVI or IVS (e.g. to send messages to the road workers)
Constraints / Dependencies	**Constraints:** • Acceptance of the alert system by the road workers • Relevance signal • Wrong warning collective (such as launching of an alarm not expected) • Wrong detection from the camera **Dependencies**: • Dependencies with the Yellow project. One of the following systems could be used: ○ an illuminated arrow linked with a OBUg and including the Yellow system phase 1 plus 2 could be used. ○ a connected beacon with an OBU and linked with an illuminated arrow indicating a track shift equipped with the Yellow system.

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B7 – In-vehicle signage (embedded mobile VMS)

B7 – In-vehicle signage (embedded mobile VMS)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	• The service is to display to the user an information of type "free text ". The information can reproduce what displays a physical mobile VMS (on a maintenance vehicle for example). • This service is a “tool” that can be used to develop other use cases.
Background / added values	• Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance its visibility by enabling it to last longer than the moment he can see the mobile VMS. • Another benefit would be to enable the information to be displayed in the driver’s own language. • Unlike a physical mobile VMS, an embedded VMS enables a more important coverage, and the display is directly inside the vehicle, allowing the driver or the passenger to have enough time to read the message. • Relative to DENM message, it is possible to display free contents. • Comparing to the C3 use case, this use case gives the possibility to send the message from the road operator’s vehicle.
Objective	• Transmit to road user’s information in “free text” that is not provided by other in-vehicle signage use cases. • Add details to an already transmitted message (e.g. DENM) in order to provide a more precise and readable information to the road users to achieve the expected behaviour.
Desired behaviour	The desired behaviour depends on the message.
Expected benefits	• Traffic management: this use case allows to improve the traffic management (regulation, smart routing, etc.), because information can be broadcast on the scale of the complete network, beyond the limited cover of the physical mobile VMS • Comfort: this use case allows a persistence of the information comparing to the physical mobile VMS.
Use case description	
Situation	• Road works • Road operator vehicle on intervention • Accident area • Rerouting • Special events (sports, demonstration...) • Travel time information • Speed advice • Etc. The information may already be displayed on a physical mobile VMS or other means of signalization on the road.
Logic of transmission	Vg2V logic Broadcast

Actors and relations	• **The Road operator,** from its vehicle, is the sender of the message.
	• **The vehicle driver** is the end user of the service.
	• **Information provider**:
	  ○ The road operator for information concerning traffic management, events, etc.
	  ○ Other road operators during coordinated traffic management.
	  ○ Public or transport authorities for all information concerning pollution,

	kidnap alert, etc. ○ Other partners for all information concerning demonstrations, sport events, services in highway parking areas, etc
Scenario	1. The road operator agent in its vehicle wants to send an information to road users. The information may already be displayed on a physical mobile VMS. 2. The vehicle broadcasts the information to other road users in a defined area. 3. Vehicles within the defined area receive the information, and display it to the drivers, at the moment and in the location defined by the road operator.
Display principle / Alert logic	• There are two main display principles: ○ Copy the contents of the message to be displayed as it is ○ Other displays may be envisaged, such as a drop-down text, etc. • The display time is chosen by the road operator agent.
Possible standards	• DENM • MAPEM • ISO TS 17425 or ISO TS 19321 • ISO TS 14823 (Graphic data dictionary)
Constraints / Dependencies	**Constraints** • The French regulations (IISR part 9) does not specify the number of lines or characters and follows the recommendations of Geneva's agreements (RES2) of 7 words at most. • If road managers do not implement an optimized management policy for the display of these messages, it could lead to unnecessary driver's distraction. • In the technical specifications, a precise work on zone definitions (establishing a correspondence between the signs used in the mobile VMS and the graphic data dictionary) will be needed. **Dependencies** • This service is a "tool" that can be used to develop other use cases.

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C – Signage applications

C2 – In-vehicle dynamic speed limit information

C2 – In-vehicle dynamic speed limit information	
Type of road network	**All**
Type of vehicle	**All, adapted for automated driving systems**
Use case introduction	
Summary	The service aims at providing vehicles with dynamic speed limit from a traffic management centre. The variable speed limit is: • Imposed to the vehicle algorithm in order to change the driving rules of the vehicle; • Eventually displayed on-board for passenger(s) and human driver.
Background / added values	• Currently, to provide a speed limit, embedded systems are based either on navigation or on vehicle's cameras: ○ the navigation systems cannot take into account dynamic speed limits. ○ cameras can do it only if they are not on the same display frequency as the VMS. Moreover, if they are able to get the dynamic speed limit information, the vehicle is not able to prioritize between two contradictory speeds (VMS versus static panel). • This service would be able to to transmit the correct speed limit to the user, at all time.
Objective	The aim is to inform the user about the mandatory dynamic speed limit so he can adapt his speed.
Desired behaviour	The driver or the automated driving system adapts its driving behaviour compliant to the applicable driving speed limit.
Expected benefits	• For the operator: easier implementation of dynamic speed limit, and better regulation of speed, ensuring that road users always know the current speed limit. • For the road user: comfort (constant knowledge of the applied speed limit), safety.
Use case description	
Situation	A vehicle is approaching a regulated zone where the traffic management imposes a variable speed limit.
Logic of transmission	I2V Logic Broadcast
Actors and relations	• **Road operator:** the traffic operator from the traffic control center (TCC) is the sender of the message. • **The driver or the automated driving system of the vehicle** is the end-user of the service. • **The information provider** can either be : ○ The traffic operator himself ○ Another information provider (e.g. the Prefect in case of pollution) ○ Automatic data collection systems associated with speed control algorithms
Scenario	1. The Traffic Control Center (TCC) sends in broadcast a message with the mandatory dynamic speed limit. The speed limit can be targeted to a specific vehicle type (for e.g. Heavy Goods Vehicles). 2. Vehicles receive the message and display it on the HMI if relevant. The driver or the automated driving system adapts its speed.
Display principle / Alert logic	• The dynamic speed limit can be displayed continuously along the area concerned.

Possible standards	• There is a "contextual speed" standard (17 426) regarding the static speed limits, the dynamic speed limits, the recommended maximum speed. This use case deals with the section "Dynamic speed limit " of the CEN ISO/TS 17 426 standard that addresses the speed regulation. This applies to all cases where there is a modulation of the static speed: pollution, rain, traffic... • The 17 426 uses the message template defined in the CEN ISO/TS 19 321. • IVI
Constraints / Dependencies	**Constraints** • The service will exist only in areas with dynamic speed management. Consequently, no information will be given to the road users related to static speed limits. Therefore, the understanding of this use case by drivers could be difficult. • Attention to areas where the fixed vertical signaling is not in phase with the dynamic speed sent. • The efficiency of this service for automated driving systems relies on its compliance to the variable speed limit. **Dependencies** • In the particular case of road works warning, a speed information can be given through the B1a use cases.

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C3 – In-vehicle signage (embedded VMS)

C3 – In-vehicle signage (embedded VMS)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	• The service is to display to the user an information of type "free text ". The information can reproduce what display a physical VMS or display a new message (virtual VMS). • This service is the “tool” used by many other use cases.
Background / added values	• Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance its visibility by enabling it to last longer. Indeed, it is a well-known fact that the inability to have read the whole content of the message displayed on the VMS can cause anxiety among the drivers. • Another benefit would be to enable the information to be displayed in the driver’s own language (if possible). • Unlike a physical VMS, an embedded VMS enables a more important coverage, and the display is directly inside the vehicle, allowing the driver or the passenger to have enough time to read the message. It allows redundancy with physical VMS • Relative to DENM message, it is possible to display free contents.
Objective	• Transmit to road user’s information in “free text” that is not provided by other in vehicle signage use cases. • Add details to an already transmitted message (e.g. DENM) in order to provide a more precise and readable information to the road users to achieve the expected behaviour.
Desired behaviour	The desired behaviour depends of the message.
Expected benefits	• Traffic management: this use case allows to improve the traffic management (regulation, smart routing, etc.), because information can be broadcast on the scale of the complete network, beyond the limited cover of the physical VMS • Comfort: this use case allows a persistence of the information with regard to the physical VMS (limit the stress). • Optimization of the management costs of the road infrastructure. • In case of regulation information, the virtual VMS allows to display a message exactly in the zones of application, enhancing the compliance with regulations.
Use case description	
Situation	• Traffic management plan • Rerouting • Pollution • Kidnap alert • Special events (sports, demonstration...) • Travel time information • Speed advice • Information on services available on highway parking areas • information on the coming end (or start) of works on level crossings • Etc. The information may already be displayed on a physical VMS or other means of signaling on the road.
Logic of transmission	I2V logic Broadcast
Actors and relations	• **Road operator**: the traffic operator from the traffic control center (TCC) is the sender of the message.

	• **The vehicle driver** is the end user of the service.
	• **Information provider**:
	  ○ The road manager for information concerning traffic management, events, etc.
	  ○ Other road managers during coordinated traffic management
	  ○ Transport authorities for multimodal information
	  ○ Public authorities for all information concerning pollution, kidnap alert, etc.
	  ○ Other partners for all information concerning demonstrations, sport events, services in highway parking areas...

Scenario	4. The road manager wants to send an information to road users. The virtual VMS is a possible mean, as well as physical VMS, radio, the internet, etc. 5. The road manager broadcast the information. 6. Vehicles receive the information, and display it to the drivers, at the moment and around a location defined by the road manager. The priority of display is indirectly defined by the road manager.

Display principle / Alert logic	• There are two main display principle:
	  ○ Copy the contents of the message to be displayed as it is
	  ○ Other displays may be envisaged, such as a drop-down text, etc.
	• The display time is chosen by the road manager.

Possible standards	• ISO TS 17425 or ISO TS 19321 • ISO TS 14823 (Graphic data dictionary)
Constraints / Dependencies	**Constraints** • The French regulations (IISR part 9) does not specify the number of lines or characters and follows the recommendations of Geneva's agreements (RES2) of 7 words at most. However, a non-regulatory technical French guideline (*Panneaux à messages variables – La composition des messages – Collection Références CEREMA – 2014* issued by the CEREMA) recommends that the VMS have at most 4 lines of 21 characters each. • It is possible that some duplicates occur between DENM messages (or other messages) and embedded VMS messages. • Car manufacturers have a little control over the display on HMI (they do not know the content of the message). This can lead to driver distraction if road managers do not implement an optimized management policy for these messages. • A prioritization between the different C-ITS messages will be needed. • In the technical specifications, a precise work on zone definitions (establishing a correspondence between the signs used in the VMS and the graphic data dictionary) will be needed. • Be careful not to distract the driver by too many messages

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C4 – Toll Station Approaching: orientation of drivers

C4 – Toll Station Approaching: orientation of drivers	
Type of road network	**Motorways**
Type of vehicle	**All, adapted for automated driving systems**
Use case introduction	
Summary	When a vehicle is approaching a toll station, a specific message is sent by the traffic manager, helping it to orient itself towards an appropriate electronic toll collection lane.
Background	Currently, it may be difficult for human drivers, and even more for automated driving systems, to orient themselves through a toll station, and it can be dangerous.
Objective	The objective is to help in the orientation towards the most appropriate way for the vehicle according to the configuration of the station.
Desired behaviour	Human drivers and automated driving systems orient themselves when they approach the station, based on the information received.
Expected benefits	• Safety, driving comfort when approaching the toll station, less stress. • Improve the flow of traffic on the toll platform and upstream.
Use case description	
Situation	• A vehicle is approaching a toll station on a motorway. • According to the nature of the information, messages are different. Examples of message (list not exhaustive): ○ orientation according to the means of payment (e.g. “Télépéage will be to the left or to the right”; “any payment in central zone” ...) ○ Orientation according to the category of vehicles (e.g. “dedicated motorcycles way to the right”) ○ Information on a specificity of the station
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **The TCC or the TMC** (Toll Management Center) is the sender of the messages. • **The driver in his vehicle or the automated driving system** is the end-user of the service (receives the information). • **Information providers:** Database of the administrator.
Scenario	1. The TCC or the TMC, knowing the configuration of the toll station, sends information in broadcast to all vehicles. 2. Vehicles, knowing their main characteristics, can display the right information to drivers or process it to go to the right lane. 3. The information given is anticipated enough to permit the vehicles to adapt their trajectory towards the selected lane in advance.
Display / alert principle	• It is important that the vehicle receive the information upstream enough so that the driver or the automated driving system can act accordingly. The zone of scattering of the message is thus of some kilometers upstream to the toll. • If needed, the principle of display is a visual message on the HMI of the vehicle. Vehicles choose the way to display on the HMI, based on commonly specified communication profiles.
Possible standards	• MAP • IVI / IVS
Constraints / Dependencies	**Constraints** • Risk of radio disturbance for electronic toll equipment that operates in a frequency range close to the G5 when approaching toll booths. This risk is addressed by installing RSUs well upstream of toll stations and integrating toll mapping into vehicles to reduce emissions.

	Dependencies • Dependencies with the G7 use case (“HD cartography: extended services”). The MAP message specified in the G7 use case should be technically specified and developed using the same lane configuration as the one used in the C4 use case. • Dependencies with the C8 use case (“Toll Barrier Crossing for automated vehicles”). The SPAT message specified in the C8 use case should be technically specified and developed using the same lane configuration as the one used in the C4 use case. • Dependencies with the C7 use case (“Toll Station Approaching: enhanced orientation of drivers”). The message specified in the C7 use case should be technically specified and developed using the same lane configuration as the one used in the C4 use case.

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C5 – Toll Station Approaching: event information

C5 – Toll Station Approaching: event information	
Type of road network	**Motorways**
Type of vehicle	**All**
Use case introduction	
Summary	When a vehicle is approaching a toll station, a specific message is sent by the traffic manager, warning the driver about a specific event occurring in the station.
Background	• Provide traffic event information and advance instructions before arrival on toll station to drivers, which is difficult today. • Encourage the understanding of the user in the case of wrong-way driver, when road users remain stored on the platform with the toll lanes closed, or upstream in current section. • The whole, in order to improve / optimize the fluidity and safety on the toll platforms.
Objective	• The objective of the service is to inform drivers approaching of a toll station, or already on it, of a special event.
Desired behaviour	• Drivers orient themselves towards the way the most suited according to the configuration and to the particular event.
Expected benefits	• Safety, additional information, driving comfort when approaching the tool station, less stress, fluidity. • Promote fluidity on the toll platforms and upstream in the current section.
Use case description	
Situation	• Experiment (free flow lane, specific message) • Road work modifying the organization of the platform, being able to destabilize the users (Work in progress: T to the right, any payment to the left) • Vehicle driving the wrong way (“vehicle driving the wrong way, for your safety you are blocked in the toll station”) • Demonstration on the lanes...
Logic of transmission	I2V Logic, Broadcast

Actors and relations	• The **traffic operator** from the traffic control center (TCC) is the sender of the information.
	• The **driver in his vehicle** is the end-user of the service.
	• **Information providers:**
	  ○ Planned information from an operator (experiment, works)
	  ○ Cameras
	  ○ Rises of agents on the platform...

Scenario	1. An operator in the TCC (or in the TMC – Toll Management Center), knowing a particular event, broadcasts the information to all vehicles approaching or inside the toll station. 2. Vehicles receive the information and process it. 3. The message is displayed on the HMI. Drivers can adapt their behaviour accordingly.
Display / alert principle	• It is important that the driver knows enough upstream the information so that he can act/react accordingly. Thus, the zone of scattering of the message is some kms upstream of the toll. • The display principle is a literal message on the HMI of the vehicle. • The level of priority of the display can change according to the information.
Possible standards	• IVI / IVS • DENM
Constraints / Dependencies	**Constraints** • Risk of radio disturbance for electronic toll equipment that operates in a frequency

	range close to the ITS-G5 when approaching toll booths. This risk is addressed by installing RSU terminals well upstream of toll stations and integrating toll mapping into vehicles to reduce emissions. **Dependencies** • See the C4 use case, related to static information sent to vehicles approaching a toll station.

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C7 – Toll Station Approaching: enhanced orientation of drivers

C7 – Toll Station Approaching: enhanced orientation of drivers	
Type of road network	**Motorways**
Type of vehicle	**All**
Use case introduction	
Summary	When a vehicle is approaching a toll station, the road operator sends a specific message, helping the driver to orient himself through the station. Information given are in real-time provided by the Toll Management Center (TMC) and/or the Traffic Control Center (TCC). The state of the suitable lane is communicated according to the configured means of payment in the vehicle: opened/closed and estimated waiting time.
Background / added values	Currently, it may be difficult for drivers to orient themselves through a toll station, and it can be dangerous.
Objective	The objective is to help the driver to orient himself towards the most appropriate way, according to the configuration of the station, and the means of payment available configured on the vehicle.
Desired behaviour	Arriving on the toll station, the vehicle receives information about the suitable lane to take according to the means of payment of the driver or/and the vehicle, and the estimated waiting time. The driver of the vehicle follows the advised itinerary.
Expected benefits	• Safety, driving comfort when approaching the toll station, less stress. • Improve the flow of traffic on the toll area and upstream
Use case description	
Situation	The vehicle is approaching the toll station on motorways.
Logic of transmission	**V2I2V Logic, Unicast** 1. **V2I in unicast:** the vehicle sends to the road operator the means of payment configured in the vehicle. 2. **I2V in unicast:** the road operator sends back to this vehicle the state of the suitable lane to cross the upcoming toll station.
Actors and relations	• The driver of the vehicle is the **end-user** of the service: approaching the toll area, it sends the request with its configured means of payment and it receives the information. • The TMC and/or the TCC is the **sender of the information**.
Scenario	1. The vehicle sends to the road operator the available means to pay the toll fees. 2. The road operator, through the TMC, knows the configuration of the toll station. It sends the status of the appropriate lane to this vehicle to cross the toll station. 3. The vehicle displays through the HMI the advised itinerary considering the saved/chosen means of payment.
Display principle / Alert logic	It remains to the vehicle or the driver to filter the desired information to be displayed on the HMI. The HMI displays the advised lane. Additional information could be the advised itinerary to go to the concerned lane through some indications.
Possible standards	• IVI, IVS • Toll Announcement Message (TAM), Maneuver Coordination Message (MCM) are in process of being standardized by the ETSI.
Constraints / Dependencies	**Contraints :** • TMC and/or the TCC has to publish updated information. • The TMC and/or the TCC has to be able to estimate the waiting time for each lane in the toll plaza.

	• The advised itinerary has to be followed by the vehicle. **Dependencies:** • The mean(s) of payment is mentioned or configured on the vehicle

C8 – Toll Barrier Crossing for automated vehicles

C8 – Toll Barrier Crossing for automated vehicles	
Type of road network	**Motorways with toll barrier**
Type of vehicle	**Automated vehicle**
Use case introduction	
Summary	After an automated vehicle (AV) drives to a specific lane (C6 use case) and completes the transaction at a toll station (optionally thanks to the M1 use case), the traffic manager sends information about the status of the traffic light and the barrier.
Background / added values	• Toll station is an important stake to tackle in order to develop automated vehicles. • Once the vehicle has dealt with the choice of the lane and the transaction, it needs to know if he can cross and the sensors may not be sufficient, as the environment is complex.
Objective	The objective is to provide to the AV information about the traffic light and the barrier so that it can understand better the environment and determine whether it is allowed and safe to pass the toll gate or not.
Desired behaviour	The AV must then make the appropriate decision (slow down to a stop, remain stopped, start and pass the gate at the appropriate speed, or adjust speed and pass the gate at the appropriate speed) depending both on the information it receives through connectivity and the information it gets from its sensors, including the detection of obstacles that could prevent it from passing completely the gate.
Expected benefits	• Safety • Fluidity and comfort of the braking and acceleration going through the toll barrier.
Use case description	
Situation	• The vehicle is approaching the toll barrier on motorways. • It has already proceeded to the payment.
Logic of transmission	**I2V Logic, Broadcast**
Actors and relations	• The AV is the **end-user** of the service. • The TMC and/or the TCC is the **sender of the information**. • **Source of information:** database of the administrator, up to date, holding the static and dynamic characteristics of the toll station.
Scenario	4. The TCC or TMC, sends information about the status of the barriers (close or open) and the traffic lights (green or red). 5. Automated vehicles receive it, process it and make the appropriate decision: slow down to a stop, remain stopped, start and pass the gate at the appropriate speed or adjust speed and pass the gate at the appropriate speed.
Display principle / Alert logic	• The service may not visible for the potential fallback driver of the vehicle.
Possible standards	• DENM • IVI • Toll Announcement Message (TAM), Maneuver Coordination Message (MCM) are in process of being standardized by the ETSI. • SPaT/MAP
Constraints / Dependencies	**Contraints :** • The vehicle needs to know which barrier concerns it. • The broadcast communication of this message will have to deal with network constraints. If it is technically doable, it would be better to do unicast.

	Dependencies: • C4, G7 and C8 use cases should be developed with the objective of being used together. • The M1 use case can also be used in the same situation.

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C11 – Dangerous Vehicle Approaching a Road Works: Safety Recommendation to the Dangerous Vehicle

C11 – Dangerous Vehicle Approaching a Road Works: Safety Recommendation to the Dangerous Vehicle	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	When a vehicle is approaching with an inappropriate and a dangerous trajectory an ITS station in a light arrow trailer upsteam a road works, a safety recommendation is sent to the dangerous vehicle by the ITS station.
Background / added values	• Vehicles are only warned of the presence of workers and anyone else in and around a road work through a dynamic temporary sign such as light arrow trailer for roadworks. • Many road users enter the road works sites or strike the protection equipment of the site, sometimes causing victims. • So far, no external and connected system, such as an ITS station, informes vehicles of dangerous behaviours
Objective	To enhance the safety of road workers, drivers and anyone else being in the road work area, by sending a safety recommandation to dangerous vehicle driver in order to let him adapt his trajectory/speed
Desired behaviour	When receiving the safety recommendation, drivers adapt their behaviour by taking care of outside elements associated to the road works. For example, they will adapt their speed or correct their trajectory.
Expected benefits	• Safety for road works workers, as a result of the safety recommendation sent to the dangerous vehicle • Safety for drivers • To reduce number and severity of corporal and material accidents
Use case description	
Situation	• On a dual carriageway, one or more lanes are closed due to a road works (temporary or not). • The site is equipped with a system able to detect a dangerous vehicle approaching and connected (e.g., illuminated arrows linked with an OBUg; connected beacon, etc.). • Workers are operating inside the road-marking zone.
Logic of transmission	Vg2V or I2V logic, Unicast

Actors and relations	• **The sender is an ITS station,** which is an OBU in a trailer or on a deported beacon, named Vg.
	• **The driver of the dangerous vehicle** approaching is the end-user of the service.
	• **Road agents** equip their roadworks with an equipped trailer in front of their work site.
	• **Sources of information** could be:
	  ○ Messages from vehicles (CAM) received by the ITS station
	  ○ An infrared camera mounted at the top of the trailer
	  ○ Others (radar, other camara, etc.)

Scenario	1. An ITS station is installed in a trailer. 2. The trailer is positioned at the beginning of a road works area. 3. The ITS station computes the trajectories of the vehicles in front of the road works 4. A vehicle is approaching too close from the roadwork area with an inappropriate

	and dangerous trajectory and/or speed 5. ITS station detects that the vehicle is going inside a “dangerous zone”, meaning that it is becoming dangerous for the roadworks site. 6. A safety recommendation is immediately sent to the dangerous vehicle 7. The driver is informed (if it is still relevant), and he can adapt his behaviour (trajectory, speed).
Display principle / Alert logic	• In a context of road works warning, a DENM message will be sent when the vehicle will arrive next to the road works. There could be some issues in display prioritization (DENM vs IVI for safety recommendation).
Possible standards	• CAM (to calcultate the position, trajectory and speed of the approaching vehicles) • IVI (to send messages to the dangerous vehicle)
Constraints / Dependencies	Constraints : • There are very low latency requirements. Therefore some message types might be too heavy. • Wrong detection from the camera • The relevance of the signal **Dependencies:** • There are some dependencies with use case B4 “Dangerous vehicle Approaching a Road Works: Warning to the Dangerous Vehicle”. • Dependencies with the Yellow project. One of the following systems could be used: ○ An illuminated arrow linked with a OBUg and including the Yellow system phase 1 plus 2 could be used. ○ A connected beacon with an OBU and linked with an illuminated arrow indicating a track shift equipped with the Yellow system.

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D – Hazardous location notifications

D1 – Alert temporary slippery road

I2V use case

D1 – Alert temporary slippery road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that a portion of a road (or a single point) is temporarily slippery and sends it to the road user.
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better.
Objective	The objective of this use-case is to increase the awareness of drivers about dangerous slippery sections to make him adapt his speed and trajectory to the situation.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed) • Rerouting (for HGV for example)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	Depending on the cause of the slippery section, this use-case can concern both directions of roads, even for dual carriageways. Dealing with this information can be different for HGV or vehicles since HGV might even adapt completely their itinerary. Causes: • oil • rolling elements (bottles, golf balls, fruits,etc.) • black ice or water • ressuage • chemical loss • etc.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ Sensors
	  ○ etc.

Scenario	1. The operator in the TCC or the TCC automaticaly gets informed about a section that is slippery on his network 2. He puts the information in his TCC or the TCC aumomaticaly computes the information and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.

Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed or even his itinerary. However, since he should not forget about the alert, it could be repeated closer to the location.
Possible standards	DENM
Constraints / Dependencies	The vehicles might have to deal with two different sources of information for this use-case: from other vehicles (see next use-case) and from the TCC. Both information could inform about a different length of the zone. The vehicle will have to deal with the priority between both messages.

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V2V use case

D1 – Alert temporary slippery road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle detects that it is slipping and broadcasts an alert message to other vehicles.
Background / added values	Today, the information about slippery sections is very limited. This use-case could decrease the risks of accidents by broadcasting it more largely.
Objective	The objective of this use-case is to increase the awareness of driverss about dangerous slippery sections to make him adapt his speed and trajectory to the situation.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	Depending on the cause of the slippery section, this use-case can concern both directions of roads, even for dual carriageways. However, the vehicle might not be able to detect the difference. Causes: • oil • rolling elements (bottles, golf balls, fruits, etc.) • black ice or water • ressuage • chemical loss • etc.
Logic of transmission	V2V logic Broadcast
Actors and relations	• Sender is the vehicle detecting the slippery road • End-Receiver are all vehicles around. • Source: the vehicle and its equipments
Scenario	1. A vehicle detects a slippery section of the road and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: ABS, ASR, ESC, vehicle data, etc. 2. The information transmits the localization of the event, along with the quality and if possible, the measured external temperature (to possibly distinguish if it can be ice or not). 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.

Display principle / Alert logic	The alert needs to be early enough for the driver to adapt his speed without stress, but not too early so that the driver does not forget about the alert.
Possible standards	DENM
Constraints / Dependencies	The vehicles might have to deal with two different sources of information for this use-case: from other vehicles and from the TCC (see previous use-case). Both information could inform about a different length of the zone. The vehicle will have to deal with the priority between both messages.

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D2a – Alert animal on the road

I2V use case

D2a – Alert animal on the road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that an (or several) animal(s) is(are) wandering (are present) on his network and broadcasts the information to road users.
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better. The update of the information can also be improved (moving animal).
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, and the animal can be moving quite fast the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of itinerary (flock in mountains for example)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• flock • lonely wandering animals, etc According to the type of the road (and the speed limit consequently), the danger can be more or less important. A flock in the mountains can be quite frequent for example.
Logic of transmission	I2V Logic Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about the presence of one or several animal(s) on his network. 2. He puts the information in his TCC and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed or even his itinerary (in case of a flock for example). However, since he should not forget about the alert, it could be repeated closer to the location. The information could be displayed differently according to the type of the road.
Possible standards	• DENM
Constraints / Dependencies	The localization can be very imprecise. And the information cannot always be verified by the road operator.

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V2V use case

D2a – Alert animal on the road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A driver detects one or several animals on the road and signals it via his HMI, broadcasting a message to road users.
Background / added values	Wandering animals are not easily detected. Such a use-case can be an added information for the road users.
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, and the animal can be moving quite fast the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of itinerary (flock in mountains for example)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• Flock • lonely wandering animals • etc. According to the type of the road (and the speed limit consequently), the danger can be more or less important. A flock in the mountains can be quite frequent for example.
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the driver in his vehicle • End-Receivers are all vehicles around • The source of the information is the driver
Scenario	1. A driver detects the presence of one or several animal(s) on the road 2. He signals it via his HMI: the message is then broadcasted to the road users 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed or even his itinerary (in case of a flock for example). However, since he should not forget about the alert, it could be repeated closer to the location. The information could be displayed differently according to the type of the road.
Possible standards	• DENM
Constraints / Dependencies	Since it is a manual detection, and the animals can be moving (and quite fast), the localization can be very imprecise.

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D2b – Alert people on the road

I2V use case

D2b – Alert people on the road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that one (or several) person(s) is(are) wandering (are present) on his network and broadcasts the information to road users.
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better. The update of the information can also be improved (moving persons).
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, and the persons can be moving (slower than some animals though) the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• vehicle breakdown • accidents • persons taking a call • personal issues • etc.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about the presence of one or several person(s) on his network. 2. He puts the information in his TCC and the message is then broadcasted to the road users. 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets about the alert.
Standards	DENM
Constraints / Dependencies	The localization can be imprecise.

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V2V use case

D2b – Alert people on the road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A driver detects one or several persons on the road and signals it via his HMI, broadcasting a message to road users.
Background / added values	The update of such an information can be improved by this use-case.
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, and the persons can be moving (slower than some animals though) the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• vehicle breakdown • accidents • persons taking a call • personal issues • etc
Logic of transmission	**V2V Logic Broadcast**
Actors and relations	• Sender is the driver in his vehicle • End-Receivers are all vehicles around • The source of the information is the driver
Scenario	1. A driver detects the presence of one or several animal(s) on the road 2. He signals it via his HMI: the message is then broadcasted to the road users 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets about the alert.
Possible standards	• DENM
Constraints / Dependencies	The localization can be imprecise since it is a manual detection. It can also be different according to the persons (some signals in advance, others after the event for example).

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D3 – Alert obstacle on the road

I2V use case

D3 – Alert obstacle on the road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that there is one or several obstacles on one or several lanes of his network and broadcasts the information to road users. However, traffic can still go through (not a blockage).
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better.
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes
Expected benefits	• Reducing the risk of accidents • Improved traffic management.
Use case description	
Situation	The obstacles can be small and not harmful and still be dangerous since they can surprise the driver, who could brake of not alerted. There can also be big obstacles, lost furniture for example from a HGV, etc., that could result in the closure of a lane.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ etc

Scenario	1. The operator in the TCC gets informed about the presence of one or several obstacle(s) on his network. 2. He puts the information in his TCC and the message is then broadcasted to the road users. 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets about the alert.
Possible standards	DENM
Constraints / Dependencies	Depending on the source of information, the localization can be imprecise.

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V2V use case

D3 – Alert obstacle on the road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A driver detects one or several obstacles on the road and signals it via his HMI, broadcasting a message to road users. However, traffic can still go through (not a blockage).
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better.
Objective	The objective of this use-case is to alert a road user of a potential danger. Since there is no automatic detection, the precision of the localization is not very high. Hence, the road user needs to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	The obstacles can be small and not harmful and still be dangerous since they can surprise the driver, who could brake of not alerted. There can also be big obstacles, lost furniture for example from a HGV, etc., that could result in the closure of a lane.
Logic of transmission	V2V Broadcast
Actors and relations	• Sender is the driver in his vehicle • End-Receivers are all vehicles around • The source of the information is the driver
Scenario	1. A driver detects the presence of one or several obstacle(s) on the road 2. He signals it via his HMI: the message is then broadcasted to the road users 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets about the alert.
Possible standards	• DENM
Constraints / Dependencies	The localization can be imprecise since it is a manual detection. It can also be different according to the persons (some signals in advance, others after the event for example).

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D4 – Alert stationary vehicle / breakdown

I2V use case

D4 – Alert stationary vehicle / breakdown (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator detects that a vehicle is stopped/has broken down on his network and broadcasts the information to road users.
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better. The update of the information can also be improved (end of event).
Objective	The objective of this use-case is to alert a road user of a potential danger to increase his vigilance. A vehicle can be broken down on the middle of a road.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• stationary vehicle on the hard shoulder • stationary vehicle in the middle of the road
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ Incident detection systems...

Scenario	1. The operator in the TCC gets informed about the presence of a stationary vehicle 2. He puts the information in his TCC and the message is then broadcasted to the road users. 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets the alert.
Possible standards	• DENM
Constraints / Dependencies	Depending on the strategies of road operators, and their networks, if the detection comes from the vehicle itself, they might decide to only send the information if it is a broken down vehicle (length of the stay on the hard shoulder).

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V2V use case

D4 – Alert stationary vehicle / breakdown (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle detects that it has stopped for an undefined amount of time//has broken down and broadcasts an alert message to other vehicles.
Background / added values	The message of the detection of a stopped vehicle by the vehicle itself can largely help reducing accidents. It can also help road operators to intervene faster. If the vehicle could even detect on what lane it is stopped (not currently possible), this would be even more an added value.
Objective	The objective of this use-case is to increase the awareness of drivers about stationary vehicles to make him adapt his speed and trajectory to the situation.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• stationary vehicle on the hard shoulder • stationary vehicle in the middle of the road
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle detecting the stationary/broken down status • End-Receiver are all vehicles around. • Source: the vehicle and its equipment's
Scenario	1. A vehicle detects that it has stopped for an undefined amount of time/has broken down and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: warnings, parking brakes, vehicle data, breakdown sensors, etc. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The alert needs to be early enough for the driver to adapt his speed without stress, but not too early so that the driver does not forget about the alert.
Possible standards	• DENM
Constraints / Dependencies	The vehicles might have to deal with two different sources of information for this use-case: from other vehicles and from the TCC (see previous use-case).

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D5 – Alert accident area

I2V use case

D5 – Alert accident area (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator detects that an accident has happened on his network and broadcasts the information to road users.
Background / added values	Today, this information is provided only by the VMS or radio. With C-ITS, the availability is better. The update of the information can also be improved (end of event).
Objective	The objective of this use-case is to alert a road user of a potential danger to increase his vigilance.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents (or over-accidents) • Improved traffic management
Use case description	
Situation	• accident on the same direction of vehicles • accident on the other side of the road (dual carriageway): the drivers might slow down to look at the accident and create a danger for this side also.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ other vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ incident detection systems
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about an accident. 2. He puts the information in his TCC and the message is then broadcasted to the road users. 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed but not too early that he forgets the alert. One could wonder whether the display should only be for the drivers on the same direction of the road or both (because of the « look at the accident » phenomenon).
Possible standards	• DENM
Constraints / Dependencies	The vehicles might have to deal with three different sources of information for this use-case: from other vehicles (manual or automatic) and from the TCC (see next use-case).

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V2V use case

D5 – Alert accident area (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A driver detects that another vehicle (or himself) has been in an accident and signals it via his HMI. Alternatively, a vehicle detects that it has been itself in an accident. Those situations will be followed by the sending of a message to road users.
Background / added values	The message of the detection of an accident by the vehicle itself can largely help reducing accidents. It can also help road operators to intervene faster. If the vehicle could even detect on what lane it is stopped (not currently possible), this would be even more an added value. Even the manual detection can be a source of information that the road operators or road users do not have as much and help intervene faster.
Objective	The objective of this use-case is to increase the awareness of drivers about accidents to make him adapt his speed and trajectory to the situation and try to avoid over-accidents.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• accident on the same direction of vehicles • accident on the other side of the road (dual carriageway): the drivers might slow down to look at the accident and create a danger for this side also.
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle • End-Receiver are all vehicles around. • Source: the vehicle and its equipments or the driver
Scenario	1. A vehicle detects that is has been itself or a driver detects that there is an accident on the road and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: e-calls, speed, airbag, etc., or manually by the driver. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The alert needs to be early enough for the driver to adapt his speed without stress, but not too early so that the driver does not forget about the alert.
Possible standards	• DENM
Constraints / Dependencies	The vehicles might have to deal with three different sources of information for this use-case: from other vehicles (manual or automatic) and from the TCC (see previous use-case).

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D6 – Alert reduced visibility

I2V use case

D6 – Alert reduced visibility (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that a portion of a road has reduced visibility and sends it to the road user.
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better.
Objective	The objective of this use-case is to increase awareness of drivers about reduced visibility so that he can adapt his speed, driving and put on the appropriate equipment (fog lights for example).
Desired behaviour	• Increased vigilance • Adaptation of the speed • Put on the appropriate equipment
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	fog, smoke, heavy snow fall, heavy rain, heavy hail, etc.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ other vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ Weather stations
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about a visibility issue on his network 2. He puts the information in his TCC and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display can be moderately intrusive since this kind of event can be detected by the driver himself.
Possible standards	• DENM
Constraints / Dependencies	It should be noted that road operators are not providers of weather information.

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V2V use case

D6 – Alert reduced visibility (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle detects that it has been circulating in a reduced visibility zone for a specified amount of time and broadcasts an alert message to other vehicles.
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better.
Objective	The objective of this use-case is to increase awareness of drivers about reduced visibility so that he can adapt his speed, driving and put on the appropriate equipment (fog lights for example). This use-case can also help alerting vehicles on the other side of the road so it would interesting that vehicles keep sending the message for a while after the zone has passed.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Put on the appropriate equipment
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	fog, smoke, heavy snow fall, heavy rain, heavy hail, etc.
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle detecting the reduced visibility • End-Receiver are all vehicles around. • Source: the vehicle and its equipment
Scenario	1. A vehicle detects that it has been circulating in a reduced visibility zone for a specified amount of time and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: rear fog lights, dipped headlights, speed, etc. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display can be moderately intrusive since this kind of event can be detected by the driver himself.
Possible standards	DENM
Constraints / Dependencies	The message is more interesting for drivers far outside the zone.

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D7 – Alert wrong way driving

D7 – Alert wrong-way driving	
Type of road network	**Road with separate carriageways (non-urban)**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to warn the driver that he could stumble upon a vehicle that is driving in the wrong way. The aim is not to alert the wrong-way driver that he is on the wrong direction.
Background / added values	• Today, the information about a wrong-way driver exists but is only broadcasted by radio and VMS. • The added value of this use case is that directly concerned vehicles are informed. Moreover, the service permits to inform more drivers (not all drivers listen the road manager radio).
Objective	• The objective is to encourage the driver to adapt his speed and his behaviour, in case of a wrong-way driving around. • The aim is not to alert the wrong-way driver that he is on the wrong direction.
Desired behaviour	Drivers receiving this information: • can put themselves in safety (rest area, motorway interchange, etc) • can adapt their speed and / or trajectory • Pay more attention to their direct environment
Expected benefits	• Safety
Use case description	
Situation	• In a motorway, a vehicle takes a slip road in the wrong way or turns back in the toll station / rest area and takes the motorway in the wrong way. • In a ring road with separate carriageway, the situation can be the same, but with slip roads / exits more regular. • In the urban environment, the use case is not relevant.
Logic of transmission	I2V Logic, Broadcast

Actors and relations	• **Vehicle driver:** the end-users of this service are drivers in their vehicle, exposed to the wrong way vehicle.
	• **Road operator:** the sender of the message is an operator in the TCC.
	• **Information providers**:
	  ○ Automated wrong-way detector
	  ○ Camera
	  ○ Phone call (field operator, police, drivers, radio)
	  ○ Etc.

Scenario	1. An operator in the TCC is alerted of the presence of a wrong way vehicle. 2. The TCC broadcast the information in the relevant area. The subject of the message is “wrong-way driver on your way”. No detailed recommendations will be given. 3. Vehicles receive the information. 4. If the information is relevant for a vehicle, information is displayed to the driver with a high priority.

Display principle / Alert logic	• There are two main display possibilities:
	  ○ A moderately intrusive alert to encourage the driver to adapt his behaviour without risk of overreaction.
	  ○ An intrusive alert to encourage the driver to adapt his behaviour in urgency.
	• In both cases, the alert should be done enough in advance to give the time to drivers to adapt their behaviour.
	• Moreover, it could be relevant to switch on the warning lights of the vehicle receiving the information, in order to signal a problem to surrounding vehicles

	possibly non equipped.
Possible standards	• DENM • IVI/IVS
Constraints / Dependencies	**Constraints** • For this particular use-case, the validity duration and the dissemination area of the information will need to be studied precisely. • The information will not be precise enough to manage an imminent emergency.

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D8 – Alert unsecured blockage of a road

I2V use case

D8 – Alert unsecured blockage of a road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	An operator in the TCC gets informed that there is a blockage of a road. By the time that operating agents arrive to the site to protect and manage it, the operator sends a message to road users. A blockage means that there is no going through it (not an obstacle).
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better. In the mountain regions for example, where there is a lot of kilometers to be done before reaching a site for road operators, providing such an information before they arrive can be essential.
Objective	The objective of this use-case is a double one: • for vehicles that are very close to the blockage: to alert them about a danger • for vehicles much more upstream, to allow them to reroute This concerns one whole road, or one direction of a dual carriage way.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Rerouting
Expected benefits	• Reducing the risk of accidents • Improved traffic management
Use case description	
Situation	• a vehicle closed to the blockage • a more upstream vehicle Causes of blockage: • rocks falling • accidents of HGV • water flood • etc.
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ other vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	• etc.

Scenario	1. The operator in the TCC gets informed about a section that is blocked 2. He puts the information in his TCC and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour. 5. When the operating agents arrive on site, the blockage becomes managed.

Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed or even his itinerary. However, since he should not forget about the alert, it could be repeated closer to the location.
Possible standards	• DENM
Constraints / Dependencies	**Dependencies** • D9 a & b road closed in a mountain environment and managed • B1a road with lane(s) neutralization • B1b road closed and managed

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V2V use case

D8 – Alert unsecured blockage of a road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A driver detects a blockage on the road and signals it via his HMI, broadcasting a message to road users. Traffic cannot go through (not just an obstacle).
Background / added values	In the mountain regions for example, where there is a lot of kilometers to be done before reaching a site for road operators, providing such an information before they arrive can be essential. The V2V information especially because in those zones, there might not be a lot of road side equipment or signal to provide it.
Objective	The objective of this use case is to alert the vehicles of a danger so that the drivers can adapt their behaviour.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• rocks falling • accidents of HGV • water flood, • etc.
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the driver in his vehicle • End-Receivers are all vehicles around • The source of the information is the driver
Scenario	1. A driver detects the presence of a blockage of the road 2. He signals it via his HMI: the message is then broadcasted to the road users 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed or even his itinerary. However, since he should not forget about the alert, it could be repeated closer to the location
Possible standards	• DENM
Constraints / Dependencies	**Dependencies** • D9 a & b road closed in a mountain environment and managed • B1a road with lane(s) neutralization • B1b road closed and managed

	The localization can be imprecise since it is a manual detection.

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D9 – Alert temporary mountain pass route closure

D9 – Alert temporary mountain pass route closure	
Type of road network	**Two-way carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives an alert about a mountain pass route closure. He can also receive the recommended path.
Background / added values	• When road users are stuck without being informed on the situation, they can become anxious and they may do dangerous U-turns or use an inappropriate lane. Providing that kind of alert can prevent these situations bringing more comfort and safety to road users. • There is an added value in this use case if the information is accurately linked to re-routing information.
Objective	• Allow the driver to take another road, by giving him the temporary pass route closure information well in advance to reorganize its route • The objective is not to alert a driver already engaged that the road is blocked, but the one who still has a possibility to change the route.
Desired behaviour	• The driver changes his itinerary.
Expected benefits	• Avoid wasting time and prevent an anxiety situation for the driver • Comfort (the user arrives at his destination in good condition)
Use case description	
Situation	• A driver has, in his itinerary, a mountain pass route which is temporary closed.
Logic of transmission	I2V Logic Broadcast
Actors and relations	• **The Vehicle driver** is the end user of the use case. • **Road operator:** The sender is the traffic operator from the TCC. • **The information provider** can either be the traffic operator himself or another information provider (e.g. police).
Scenario	1. The driver informs in his navigation system his final destination. 2. The road manager sends the alert message in the appropriate area (wide enough to allow drivers to change the route if necessary) 3. The vehicle shall ensure that the closed pass is located on the vehicle's route before returning the information to the driver.
Display principle / Alert logic	• The information is only transmitted if the closed pass is on the driver's route. • Information is given in advance in order to permit to the driver to adapt his itinerary.
Possible standards	• DENM, IVI
Constraints / Dependencies	**Constraints:** • Prior his journey, the driver has to inform the navigation system with his final destination. **Dependencies** • See the E8 use case, where it is not necessary for the driver to inform the navigation system with his final destination. • Defining the different zones and so on in coherence with the use case re-routing.

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D10 – Alert emergency brake

D10 – Alert emergency brake	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle automaticaly detects an emergency brake and broadcasts an alert message to other vehicles.
Background / added values	No message of this type currently exists and it can help reducing accidents quite strongly. Especially because of the automatic detection.
Objective	The objective of the use-case to alert the driver of a very imminent and important danger so that he can act on it (brakes, reduces speed, changes lanes, etc).
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed) • Braking
Expected benefits	• Reducing the risk of accidents • Avoid a lot of brakes that could lead to a congestion
Use case description	
Situation	• a vehicle is one or two vehicles behind the one braking (not a lot of time to react) • a vehicle is more upstream (time to anticipate)
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle detecting the emergency brake • End-Receiver are all vehicles around. • Source: the vehicle and its equipment.
Scenario	1. A vehicle detects that the driver has done an emergency brake and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: warnings, brakes, vehicle data, etc. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display should be different according the position of the receiving vehicles or not even happen if the other vehicle is too close to the vehicle doing the emergency brake.
Possible standards	• DENM • CAM
Constraints / Dependencies	It can be noted that the road operator will not provide this information. However, this information from the vehicles (A2-D10) could help identify dangerous sections of the road in a delayed analysis.

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D11 – Alert end of queue

I2V use case

D11 – Alert end of queue (I2V)	
Type of road network	**All except urban**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator detects a queue, and sends the information to the road user, mentioning the length of it.
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better.
Objective	The objective of this use-case is not to inform about a queue but to inform a potentially dangerous end of queue. The driver can then adapt his speed and driving.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• the queue could only be on one lane (exit of a motorway for example) • or on the whole section
Logic of transmission	I2V Logic Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ others vehicles which have detected the danger
	  ○ Cameras (incident detection ones as well)
	  ○ Operating agents
	  ○ traffic loops
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about a queue on his network 2. He puts the information in his TCC with its length and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour. The road operator can have a system to automaticaly update the length of the queue.
Display principle / Alert logic	The display should be different according the position of the receiving vehicles or not even happen if the other vehicle is too close to the end of queue.
Possible standards	• DENM • CAM
Constraints / Dependencies	The precision of the information of the end of queue from the road operator can be low depending on the systems to update them. If loop detectors for example, the precision will be the length between two loop detectors. Low quality of localization of the end of the queue.

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V2V use case

D11 – Alert end of queue (V2V)	
Type of road network	**All except urban (because of red lights)**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle detects the end of a queue and broadcasts an alert message to other vehicles.
Background / added values	As mentioned in the D11 I2V message, the precision of the end of queue is usually very low. This use-case could help improve it since it is signalized by vehicles encountering it.
Objective	This objective of this use-case is to increase the awareness of drivers about end of queues so that he can adapts his speed and driving accordingly.
Desired behaviour	• Increased vigilance • Adaptation of the speed
Expected benefits	Reducing the risk of accidents (a lot are happening at end of queues)
Use case description	
Situation	• a vehicle is one or two vehicles behind the one braking (not a lot of time to react) • a vehicle is more upstream (time to anticipate)
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle detecting the end of queue • End-Receiver are all vehicles around. • Source: the vehicle and its equipment
Scenario	1. A vehicle detects that it has arrived at the end of a queue and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle and/or the information from other vehicles around: warnings, vehicle data, other vehicle messages, etc. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour
Display principle / Alert logic	The display should be different according the position of the receiving vehicles or not even happen if the other vehicle is too close to the vehicle sending the message.
Possible standards	DENM
Constraints / Dependencies	This use-case needs to have a lot of equipped vehicles to be of quality.

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D12 – Emergency Vehicle Approaching

D12 – Emergency Vehicle Approaching	
Type of road network	**All**
Type of vehicle	**Emergency vehicle / All**
Use case introduction	
Summary	The service is, by using information provided by the emergency vehicle, to warn drivers on the approach of the emergency vehicle (even when the siren and light bar may not yet be audible or visible). If the emergency vehicle is stationary, drivers are also warned on its presence (and possibly on the presence of staff in the area). Possibly, some safety instructions are given.
Background	• Today, emergency services use siren and light bar to warn about their presence and users have to look around to find out where the emergency vehicle is. • The B2 use case is similar but has been developed only for operator's vehicles. B2 could be generalized to other specific vehicles, or another solution could be considered if necessary.
Objective	• Facilitate the access to the area of incident / accident for the emergency vehicle, or to the emergency service. • Enhance the visibility of the emergency vehicle, sometimes hard to localize in urban environment.
Desired behaviour	• Emergency vehicles have priority over other vehicles, which must depart to let them pass. • Users clear the road properly and adapt their behaviour.
Expected benefits	Comfort, safety.
Use case description	
Situation	• Emergency vehicles are potentially firefighters, ambulances, security forces. • All types of roads are concerned (urban, non-urban, separated lanes or not, one-way roads).
Logic of transmission	V2V logic, Broadcast
Actors and relations	• The **emergency vehicle** is the sender of the message and the initiator of the service. The service is based on manual triggering conditions (declaration on the OBU of an ongoing emergency vehicle). • **Vehicle drivers** are the end-user of this service.
Scenario	1. The emergency vehicle wants the road to be cleared, the system is activated manually. 2. A message is sent by the emergency vehicle to nearby vehicles, in broadcast. 3. The subject of the message is the information of an emergency vehicle approaching an its position. Possibly, some safety instructions may be given. 4. The information is delivered to the drivers around through their on-board units (OBU). 5. Drivers can adapt their behaviour to the given situation (park, shift lane...).
Display / alert principle	• The message priority on drivers' OBU is maximal • A « how to display » in the receiver vehicle may also be proposed for positioning emergency vehicle issues.
Possible standards	• DENM (like in SCOOP part 1 Use case B2) • CAM
Constraints / Dependencies	**Constraints** • Emergency vehicle approaching may shift from a lane to another very quickly, so it may become hard to well inform the receiver. • Cartography is not always lane accurate. However, it is important that the emergency vehicle (= the transmitter) gives an enhanced position (including lane positioning if

	possible) to allow the receiver to correctly adapt its position. A method for the transmitter determines automaticaly its lane positioning may be proposed. • Emergency vehicles can exceed speed limits (awareness time and dissemination zone may have to be higher than usual). • French police and military forces prefer manual triggering conditions to automatic. **Dependencies** • The B2 use case « road operator vehicle approaching for an emergency intervention » has been developed under SCOOP@F wave 1, based on the DENM standard. The next step is to evaluate what is the best option, between generalizing B2 use case (using DENM) to other vehicles type or using CAM which could be more appropriate for dynamic events. Latency and transfer data rate should be examined. • Links can be done with the G4 use case (signal violation) • Links van be done with the G2 use case (signal priority)

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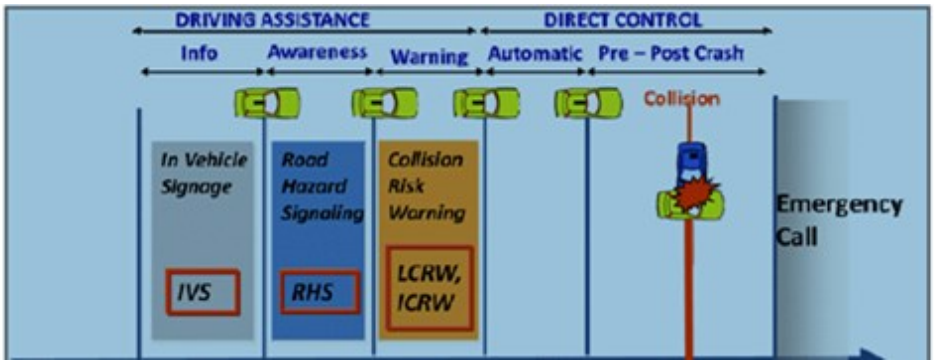
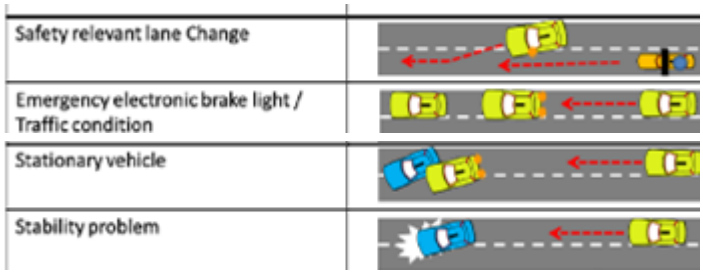
D13 – Longitudinal Collision Risk Warning

D 13 – Longitudinal Collision Risk Warning (LCRW)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Based on C-ITS received messages, the system detects or is informed of a longitudinal collision risk and put forward such notification to the driver and to the other C-ITS stations involved in this collision risk, in order to take immediate actions (including possibly ADAS actions). Longitudinal collision refers to the collision between vehicles (or a vehicle and an obstacle) at any part on the front or rear side of vehicle.
Background	• Further to IVS (In Vehicle Signage) and RHS (Road Hazard Signaling), LCRW complete the C-ITS-based driving assistance mechanism to prevent collision.  *Source : ETSI TS 101 539 – 3* • C-ITS messaging are used as a sensor to expand the collective vision range of vehicles for Collision avoidance or at least collision consequences mitigation.
Objective	• The objective is to avoid longitudinal collision, by warning strongly the vehicle drivers about the risk of an imminent longitudinal collision.
Desired behaviour	• LCRW requires immediate action from the driver. The immediate action might be to brake or keep/change lane to avoid the collision. • Some ADAS functions might be activated.
Expected benefits	• Safety
Use case description	
Situation	• Some examples of situations:  *Source : ETSI TS 101 539 – 3*
Logic of transmission	V2V Logic, Unicast (and possibly some broadcast) Unicast communication between the two vehicles involved in the collision risk. Possibly, some broadcast to surrounding vehicles.
Actors and relations	• **The subject vehicle** is the vehicle which is going to hit the rear side of another vehicle.

	In the description, the subject vehicle is **named vehicle A**. • **The target vehicle** is the vehicle under a risk of collision from another vehicle. In the description, the target vehicle is **named vehicle B**. • **Other vehicles** in the surrounding, which are not involved in the collision risk, can be alerted, without activating the LCRW alert for themselves. • **Sources of information:** ○ CAM (new usage of CAM to provide triggering data) ○ DENM (additional DENM type dedicated to LCRW) ○ Radar...
Scenario	**From the vehicle A point of view (target vehicle):** 1. Each vehicle (A and B) broadcast and receive C-ITS messages. 2. Vehiclese A and B process the received C-ITS messages. 3. Vehicle A detects a risk of collision into vehicle B. 4. Vehicle A activates the LCRW mode: • The driver of vehicle A receives a strong notification, requesting an immediate action. • Vehicle B receives a message in unicast by vehicle A. • Vehicle A activates the appropriate ADAS functions. By example: rear light warning activation, pre-crash ADAS activation, CAM frequency increasing. 5. When LCRW triggering conditions are not fulfilled anymore, vehicle A deactivates the LCRW mode. From the vehicle B point of view (subject vehicle): 1. Each vehicle (A and B) broadcast and receive C-ITS messages. 2. Vehicle B receives a LCRW message from vehicle A. 3. Vehicle B activates the LCRW mode: • The driver of vehicle B receives a strong notification • Vehicle B activates the appropriate ADAS functions. • Vehicle B assess LCRW messages triggering conditions according to B features. • Vehicle B sends LCRW messages in unicast to A up until the LCRW mode deactivation. 4. When LCRW triggering conditions are not fulfilled anymore, B deactivates the LCR mode.
Display / alert principle	• The driver warning need to be a very strong advice that requires an immediate action of the driver to avoid an imminent longitudinal collision and might lead to activation of ADAS components.
Possible standards	• The use case description follows the ETSI TS 101 539-3 V1.1.1. (2013-11) standard. • Triggering conditions C2C CC for dangerous situation (2016).
Constraints / Dependencies	**Constraints** • The urgency of an imminent risk must not lead to reckless action on the part of the user by a bad reflex. • End-to-End Latency need to be very tight (e.g. time between CAN subject vehicle – IHM target vehicle < 300ms)? • A very good localization accuracy / longitudinal alignment between the two vehicles • Data processing of OBUs need to be very efficient (e.g. > 1000 CAM and DENM per second).

	• During the LCRW activation state, C-ITS broadcast messages are emitted as usual, but emission frequency might be modified. • It will be needed to take into account the following elements: distance separating the subject vehicle from the target vehicle, speed of the subject vehicle, confidence level in the received information, started drivers actions, consistency of simultaneous requests, possibility to merge several requests into one consistent assistance advice (aggregation). **Dependencies** • The use case B4 “Dangerous vehicle approaching a road works: warning to the dangerous vehicle” is similar, but in a I2V logic. Conditions and specification should be the same.

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D14 – Alert slow vehicle

D14 – Alert slow vehicle	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The presence of a slow vehicle on the road is reported to the following vehicles. This case may also extend to frequent stops, carts and driving schools.
Background / added values	Today, the slow vehicles can be a source of accidents because the other drivers don't have the information of their presence soon enough. With this service, they could be aware of the situation in advance and adapt their speed and behaviour accordingly.
Objective	The objective of this use-case is to anticipate a potential overtaking, to avoid a sudden breaking or a collision. This use-case can also limitate the effect of surprise.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes (if needed)
Expected benefits	• To avoid collisions between vehicles • To reduce the risk of accidents during an overtaking of slow vehicles in low visibility or caused by over-confidence
Use case description	
Situation	A slow connected vehicle circulates on the road. Slow vehicles can be found evrywhere but are more dangerous in some situations such as: • a blind country turn • the top of a hill • just after an intersection • a highway • in high-speed countryside roads
Logic of transmission	V2V Broadcast
Actors and relations	• **The sender** is the slow vehicle. • **The end-receivers** are the vehicles near the slow vehicle.
Scenario	1. A vehicle is driving slowly relatively to the speed limit. 2. The vehicle sends automaticaly the information that it is driving slowly. 3. The vehicles in a close area receive the information. 4. The drivers adapt their behaviour and their speed to avoid a potential collision.
Display principle / Alert logic	The display to the driver needs to be early enough to adapt his speed.
Possible standards	• CAM • DENM
Constraints / Dependencies	Constraints: • It is necessary to define when a vehicle is considered as "slow" beforehand.

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E – Traffic information and smart routing

E1 – Traffic information about snow on the road

E1 – Traffic information about snow on the road	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Local real-time information about the impact of snow on the road accessibility are provided by road operators to be then displayed in the road users' cars.
Background / added values	• Provide relevant information about snow on the road directly in the vehicle.
Objective	• Allow the driver to adapt his route and / or driving according to the traffic conditions related to snow.
Desired behaviour	• If necessary, the driver adapts his driving, changes his route, or decides to pause, waiting for better conditions.
Expected benefits	• Improve road safety by alerting the driver with the driving conditions.
Use case description	
Situation	• Winter Viability
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Road operator:** the sender is the traffic operator from the traffic control center (TCC). • **Vehicle driver:** the end-user that should benefit from this information is the road user in his vehicle. • **The information provider** is a road agent. A road agent on the field evaluates the impact of the snow on the road accessibility (C1, C2, C3, C4) and informs the TCC.
Scenario	1. The road operator sends the road condition (using categories C1, C2, C3, C4) sufficiently upstream in broadcast. 2. The driver can adapt his trajectory. 3. If the information is received later, the driver adapts his behaviour. Reminder: • C1 – normal conditions • C2 – delicate conditions • C3 – Difficult conditions • C4 – Circulation impracticable
Display principle / Alert logic	• Road hazard warning (with a higher anticipation to allow the change of route)
Possible standards	• IVI / IVS
Constraints / Dependencies	**Constraints** • Information about snow on the road is not easily accessible in the TMS. A possibility would be to send this information could be send from the national platform. **Dependencies** • E6 use case "Alert extreme weather conditions"

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E2 – Rerouting

E2 – Rerouting	
Type of road network	**Non-urban**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives information about a recommended itinerary.
Background / added values	• The display directly inside the vehicle could prevent the driver from following his own navigation without worrying about the indications of the physical VMS.
Objective	• Allow the driver to use a better itinerary. • Allow the road operator to manage the traffic repartition on road.
Desired behaviour	• The driver adapts his route according to the recommendation.
Expected benefits	• Improved traffic management
Use case description	
Situation	• Accident, traffic jam, snow • Rerouting on the network of a road operator • Rerouting requiring coordination between several road operators
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Road operator**: the sender is the traffic operator from the traffic control center (TCC). • **Vehicle driver:** the end-user of the service is the road user in his vehicle. • **The information provider** is the road operator, which can be in contact with other road managers in order to implement a smart and coordinated deviation itinerary.
Scenario	1. The road manager identifies a critical situation. 2. He identifies a recommended itinerary. 3. A message is then broadcasted to the road users sufficiently in advance so that users can adapt their itinerary. 4. The vehicle receives the information and displays it to the driver
Display principle / Alert logic	• Alert sufficiently in advance to allow the driver to change his itinerary.
Possible standards	• IVI / IVS
Constraints / Dependencies	**Constraints** • The recommended itinerary is identified by the operator based on the local traffic management plan, which therefore need to be available. **Dependencies** • The use case C3 – Embedded VMS could be used to implement the E2 use case.

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E3 – Smart routing

E3 – Smart routing	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The driver asks for a smart recommended itinerary, based on a collective optimum.
Background / added values	• In cars that have a connected navigation, the recommended itinerary is today based on an individual optimum calculation: the car recalculates its route regardless of traffic management plans from the road managers. The purpose here is to use a collective optimum, an even the social optimum. • The user's experience should become more comfortable.
Objective	• Allow the road operator to optimize the distribution of traffic on its network, recommending a route to the drivers based on a calculation of collective optimum.
Desired behaviour	• The driver complies with the recommended route.
Expected benefits	• Better distribution of traffic.
Use case description	
Situation	• The smart routing can be used to a lot of situations, especially traffic jam.
Logic of transmission	V2I2V Logic, Unicast

Actors and relations	• **Vehicle driver** initially sends a request of smart routing. He is then the end-user of the service.
	• **The Service provider** provide the smart routing information. The service provider can be the road operator.
	• **Information providers:**
	  ○ Road operator (information on specific wishes, network constraints, etc.)
	  ○ Service provider

Scenario	1. The driver indicates his destination in his navigation system. 2. He then requests a smart routing via its HMI. 3. A message is sent by the vehicle in unicast mode to a service provider. 4. The service provider provides a smart recommended itinerary according to the previous road operator specification.
Display principle / Alert logic	• Same as navigation.
Possible standards	• None identified by the working group.
Constraints / Dependencies	**Constraints** • No alternative route can be implemented in cars that have no navigation system. • The compatibility with traffic management plans and the existing alternative route signaling need to be checked. • Concerning the legal issues, the notion of license should be considered: open access – creative commons, open database license (ODbL)

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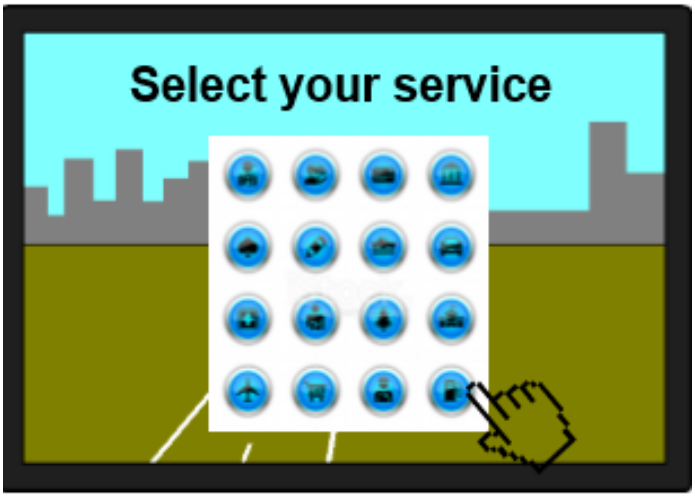
E4 – Smart POI

E4 – Smart POI	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	• The service is to provide dynamically and up-to-date information about various subjects on the HMI of vehicles (by broadcast). The end-user can reach additional information in unicast mode. Moreover, an URL link can be display for further information (e.g. the internet website of a railway operator). • This provision of this service can be free, or subject to conditions, such as a subscription. • This service is the "tool" used by many other use cases.
Background / added values	• Information are dynamically updated. • URL links are allowed.
Objective	• Allow the driver (or the passengers) to have information on numerous items, in a dynamic and interactive way. • Allow local communities to promote certain places of interest or to give local information.
Desired behaviour	• No specific behaviours. Depends on the information.
Expected benefits	• Comfort • Encourage the multimodality (by providing timetables, etc.) • Local tourism promotion
Use case description	

Situation	• Some examples of situation:
	  ○ Public transport timetables
	  ○ Transition/transfer modes
	  ○ Car sharing/parking
	  ○ Noteworthy events and sites (patrimony, sport)
	  ○ Accommodation/catering
	  ○ Consultation/reservation/ticketing
	• Current implementation entails the following categories: museum, video, leisure, supermarket, gas, toilets, bar, cinema, shopping, health, monument, library, and malls.

Logic of transmission	I2V Logic, Broadcast (to give the POI) V2I2V Logic, Unicast (if the end-user makes a request to reach additional services)
Actors and relations	• **Road operator:** the road operator can be directly the sender of POI, transmitting information based on its partnerships. • **Service provider:** service providers can be the sender of POI, transmitting information based on its partnerships. • **The end-user** of the service is the driver in his vehicle and / or his passengers. Moreover, when the driver (or his passenger) makes a request to reach additional services, he is the initiator of the use case. • **Information providers:** the source of a POI is diverse and depends of the type of POI (localization of chain fitting facilities, localizations of pharmacies...). By consequence, POI can result from multiple sources of information.
Scenario	1. The service provider and/or the road operator provide a list of POIs with relevant information.

	2. These information are broadcasted to the vehicles by a service provider (himself or another) or by the road manager. 3. The information is displayed to the driver and / or his passengers via the HMI. 4. The driver (or his passenger) can then reach additional information in unicast mode by making a request.
Display principle / Alert logic	• Interactive and customized POI service provides smart discovery and selection of POI according to car users' profiles and preferences and offers new POI suggestions during navigation. • Potentially, everything can be displayed in this smart POI use case. The user who encounters a new type of dynamic POI, dynamic information included, will validate or not the recurrence of this type of POI. This choice will then be linked to the user's profile. 
Possible standards	• ETSI TS 101 556 01v010101p(POI)
Constraints / Dependencies	**Constraints** • A wide variety of information providers is possible, with potential difficulty to manage. • Non-free information should be clearly identified. • Concerning the legal issues, the notion of license should be considered: open access – creative commons, open database license (ODbL), etc.

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E5 – Travel Time of Heavy Goods Vehicle

E5 – Travel Time of Heavy Goods Vehicles	
Type of road network	**All**
Type of vehicle	**Heavy goods vehicles**
Use case introduction	
Summary	This service indicates to heavy goods vehicles (HGV) their specific travel time (TT).
Background	Currently there is no specific travel time information for HGVs.
Objective	• The objective is to send to HGVs drivers the journey time to several given destinations likely to interest them.
Desired behaviour	• These information are used by HGVs drivers to better assess their travel time, and eventually adapt their itinerary.
Expected benefits	• Planning • Flow of traffic
Use case description	
Situation	• An HGV is going to a logistics platform on a motorway.
Logic of transmission	I2V Logic, Broadcast

Actors and relations	• **Road operator:** the sender of this message is the traffic management system (TMS) of the road manager via the Central ITS platform.
	• **Other road operators:** if information is exchanged with other road operators, possibility to have the HGVs travel time on alternative routes.
	• **Heavy Trucks Drivers** are the end-users of the service.
	• **Service provider:** these information could also be exchanged with service provider (e.g. J use cases).
	• **Sources of information** to build the travel time data:
	  ○ FCD data (consistency in a homogeneous way on the traffic management system network and outside).
	  ○ ETA data from J use cases
	  ○ CAM aggregation
	  ○ Data from the counting stations

Scenario	1. Travel Time data for HGV, by segment, are determined by the road manager. 2. For each relevant areas of its road network, the road manager identifies 3 to 4 points of interest particularly relevant for the HGVs traffic (e.g. logistics platform, ports, etc.). Each HGV, in function of its position, will be allocated the 3 to 4 points of interest pre-identified by the road manager. 3. The TMS (Traffic management system) OR the vehicle calculates the travel time of each HGV to each associated point of interest, in function of its position, and transfer it to the central ITS platform. 4. Travel time data are broadcasted to all vehicles. 5. HGVs receive these travel time data. 6. The Travel time will be periodically displayed on the embedded VMS. 7. These road information can also feed service providers (e.g. The Noscifel platform).
Display / alert principle	• Travel time message is displayed on the HMI inside the HGVs (e.g. the display could be similar to the VMS of the ALLEGRO's network). • The pace of the travel time display on the HMI could be 2 to 3 km. • Display examples, without / with pictogram:

	POI information  **Routing** 
Possible standards	• IVI / IVS • CAM
Constraints / dependencies	**Constraints** • If the embedded VMS is used to display the TT, there are the same constraints as for conventional VMS (number of lines and characters). But a specific display mode is also an option. • The road manager needs to have enough HGVs mobile sources to calculate the HGV travel time. • It would be necessary to provide a fail-soft mode, giving for example the TT for all vehicles bounded by the speed limit of the HGVs on every section. • This use case requires targeting information by vehicle category (HGVs and LVs) automaticaly and in a transparent manner. • The destination points need to be adapted to the travel time display, and that could be specific for HGV and different from those proposed to the LVs. **Dependencies** • The use case C3 – Embedded VMS could be used to implement the E2 use case. • If HGV travel times by section are uploaded in the central ITS platform in real time, they could be used to enhance the multimodal cargo optimization use cases (J) and in particular the truck ETA use case. These information would be useful for logistics companies to better plan their vehicles movement, via an overall evaluation of the travel time. • The E5 use case could also be offered to Light Vehicles, with different destination points.

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E6 – Alert extreme weather conditions

I2V use case

E6 – Alert extreme weather conditions (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A road operator knows that a portion of a road has reduced extreme weather conditions and sends it to the road user.
Background / added values	Today, this information is provided only by the VMS. With C-ITS, the availability is better.
Objective	The objective of this use-case is to increase awareness of drivers about extreme weather conditions so that he can adapt his speed, driving and put on the appropriate equipment (lights for example).
Desired behaviour	• Increased vigilance • Adaptation of the speed • Put on the appropriate equipment
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• strong winds • thunderstorms
Logic of transmission	I2V Broadcast

Actors and relations	• Sender is an operator in the TCC
	• End-receiver is the driver
	• Sources of information can be:
	  ○ other vehicles which have detected the danger
	  ○ Cameras
	  ○ Phone call of a witness
	  ○ Operating agents
	  ○ Weather stations or information
	  ○ etc.

Scenario	1. The operator in the TCC gets informed about an extreme weather conditions on his network 2. He puts the information in his TCC and the message is then broadcasted to the road users 3. The vehicles receive the information and display it to the driver. 4. The driver adapts his behaviour.
Display principle / Alert logic	The display can be moderately intrusive since this kind of event can be detected by the driver himself.
Possible standards	• DENM
Constraints / Dependencies	It should be noted that road operators are not providers of weather information.

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V2V use case

E6 – Alert extreme weather conditions (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	A vehicle detects that it has been circulating in an extreme weather conditions zone for a specified amount of time and broadcasts an alert message to other vehicles.
Background / added values	
Objective	The objective of this use-case is to increase awareness of drivers about reduced visibility so that he can adapt his speed, driving and put on the appropriate equipment (lights for example). This use-case can also help alerting vehicles on the other side of the road so it would interesting that vehicles keep sending the message for a while after the zone has passed.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Put on the appropriate equipment
Expected benefits	Reducing the risk of accidents
Use case description	
Situation	• heavy rain
Logic of transmission	V2V Logic Broadcast
Actors and relations	• Sender is the vehicle detecting the reduced visibility • End-Receiver are all vehicles around. • Source: the vehicle and its equipment
Scenario	1. A vehicle detects that it has been circulating in an extreme weather conditions zone for a specified amount of time and broadcasts the information. This detection is done by analyzing automaticaly the different systems of the vehicle: windscreen wipers, speed, rain sensors, etc. 2. The information transmits the localization of the event, along with the quality. 3. The vehicles around receive the information and display it to their drivers. 4. The drivers adapt their behaviour.
Display principle / Alert logic	The display can be moderately intrusive since this kind of event can be detected by the driver himself.
Possible standards	• DENM
Constraints / Dependencies	The message is more interesting for drivers far outside the zone.

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E7 – Traffic jam ahead

E7 – Traffic jam ahead	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	Within his TCC a road operator detects a traffic jam, and sends the information to the road user, mentioning the position and the length of the traffic jam. It can also provide the section/lanes concerned, the duration necessary to cross the traffic jam and other useful information if they are available.
Background / added values	With C-ITS, the availability and the precision of the traffic jam ahead warning is better than conventional means such as VMS, and therefore drivers are warned with higher information quality, including the accuracy of the road segments and the possibly lanes involved. The C-ITS use case may be used for more localized traffic jams than the VMS is.
Objective	The objective of this use-case is to inform about a traffic jam that the driver will encounter. Thereby, the driver can anticipate an increasing duration of his trip and he can react by changing his itinerary or adapting his speed approaching the traffic jam.
Desired behaviour	• Modification of itinerary • Increased vigilance • Adaptation of the speed • The constant speed adaptation of single vehicles when approaching the end of queue area has also an impact on the overall traffic flow.
Expected benefits	• Helping people to anticipate their travel time • Reducing the traffic jams as the drivers may take another itinerary • Reducing the risk of accidents
Use case description	
Situation	The traffic jam can be on • one specific lane (e.g. at an exit of a motorway) of a road; • on the whole section The warning message is sent out to road users approaching the traffic jam area.
Logic of transmission	I2V Broadcast
Actors and relations	• The sender is an operator in the TCC • The end-receiver is the driver • The sources of information can be: ○ other vehicles which have detected the traffic jam and report it to the road operator ○ Cameras ○ Operating agents ○ Traffic loops ○ etc.
Scenario	1. The operator in the TCC gets information about a traffic jam on his network. 2. He sets the information in his TMS, confirms it with its length and/or lane if possible and/or travel duration if possible. The message is then broadcast to the road users. 3. The vehicles nearby the traffic jam area receive the information and display it to their drivers. 4. The driver adapts his itinerary and/or behaviour. 5. The road operator can have a system to automaticaly update the length and/or

	lane of the traffic jam, and communicates the end of the traffic jam area, when regular travelling speed is confirmed.
Display principle / Alert logic	• The user is provided with related information, displayed on the dashboard. Layout and sequence of presentation is left to OEM-specific implementation. • The in-vehicle information should be adapted to the relative position between the vehicle and the traffic jam. • The in-vehicle information can mention a possibility to take another itinerary to avoid partially or entirely the traffic jam.
Possible standards	• DENM • IVI
Constraints / Dependencies	• The precision of the localization of the information from the road operator can be low depending on the available information sources used by the road operator and the information that can be set in his TMS.

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E8 – Approaching vehicle: Traffic information on the closure of a mountain pass

E8 – Approaching vehicle: Traffic information on the closure of a mountain pass	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	The driver receives information about a closed mountain pass route approaching. The driver is already engaged in the road to the mountain pass.
Background / added values	• When road users are stuck without being informed on the situation, they can become anxious and they may do dangerous U-turns or use an inappropriate lane. Providing that kind of information can prevent these situations bringing more comfort and safety to road users.
Objective	• The objective is to inform the driver already engaged that the road is blocked. • The objective is to allow the driver to do U-turns, by giving him the temporary pass route closure information well in advance.
Desired behaviour	• The road user is already engaged between the last choice point and the mountain pass route which is closed. Therefore, the road user is expecting to turn around safely and to reroute himself on the bypass itinerary.
Expected benefits	• Comfort (the user arrives at his destination in good condition) • Prevents an anxiety situation for the driver
Use case description	
Situation	• A driver is engaged in a road leading to a closed mountain pass route.
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Road operator**: The sender of the message is the traffic operator from the traffic control center (TCC). • **The Vehicle driver** is the end user of the service. • **The information provider** can either be the traffic operator himself or another information provider (example: police).
Scenario	1. The road manager sends the closed mountain pass route information by broadcast in the appropriate area. 2. The vehicle displays the information to all the drivers in the area.
Display principle / Alert logic	• The information is transmitted enough in advance in order to permit to the driver to adapt his behaviour.
Possible standards	• IVI
Constraints / Dependencies	**Dependencies** • See the D9 use case, where it is necessary for the driver to inform the navigation system with his final destination.

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F – Parking, park & ride, multimodality

F1a – Information on parking lots location, availability and services in urban area

F1a – Information on parking lots location, availability and services in urban area	
Type of road network	**Urban**
Type of vehicle	**Light Vehicles**
Use case introduction	
Summary	The service is to provide to drivers of light vehicles information related to parking lots (location, availability, services, rates...) and on carpooling areas facilities.
Background / added values	• Today, there are announcements via variable message signs. This use case bring the information inside the vehicle. • The core value of this service is to create and share a same display of this type of information that is independent of the sources of information (which are numerous and are displayed differently on websites). Above all, it is a matter of bringing more comfort to the road user. However, this information can also bring more safety by helping the road user manage his driving time. • Also, this kind of information can help the road user to gain time on the whole trip. • For passenger cars, even without the linkage with the transit departure times use case, the information on accessible park-and-ride facilities has value itself because some park-and-ride facilities are not accessible to all users as they are reserved for subscribers.
Objective	• Allow drivers to manage their driving time according to the availability of parking lots and associated services. • Better inform drivers and encourage them to share their vehicle according to carpooling areas on their route.
Desired behaviour	• Drivers adapt their journey based on received information.
Expected benefits	• Security • Traffic management • Parking lots management • Comfort (information on services at the parking) • Increased carpooling thanks to broad and appropriate information
Use case description	
Situation	Information provided can be: • the location of parking lots, • the number of their available spaces. If not known, information provided is just “full” or “free”, • Vehicle Types permitted to be parked, • Services provided in the parking lot, and associated rates, • If the parking is secured of not. • If there is a charging point for electric vehicle (with the power, the availability...) • The location of the Carpooling area (with indications on access route, if possible), • The possible advantages granted to car-poolers (reserved parking space at the P+R, advantageous rates where applicable, savings made, ...), • The fares and times of use if applicable (e.g. in case of carpooling spaces in public park and ride facilities), • Nearby transport services and their frequency (station, tram, BRT or bus), where applicable

Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Parking operators:** The sender can be directly parking operators • **Road operator**: The road operator can also be the sender of the information, after obtaining the information from the parking operators. • **The carpooling area operator**: the sender can be directly the carpooling area operators • **Vehicle drivers** are the end-users of the service. • **Information providers:** road operator, parking operators, carpooling operator
Scenario	1. The road manager, or the parking operator, get the information by his own means or through his relationships. 2. He broadcasts it to all vehicles, in a relevant area. 3. Vehicles get the information. 4. When drivers ask for the information, the vehicles display it to drivers via the HMI. 5. Drivers adapt their trip and choose a parking lot according their needs. 6. Eventually, the road user could put his itinerary in the guidance system of the vehicle that is connected to the C-ITS system to go to the parking lot.
Display principle / Alert logic	• Information is provided to drivers who are seeking for it (e.g. POI)
Possible standards	• ETSI TS 101 556 01v010101p(POI)
Constraints / Dependencies	**Constraints** • The important points of considerations concerns the information supply and its quality. • HMI constraints to display the information properly. • Make sure that there is enough resources available to carry out a comprehensive work of specifications (parking operators should be willing to equip their parking with RSU...). • The messages's area of dissemination and the center of destination could be adapted according to the vehicle category and the type of the parking lot. **Dependencies** • The Smart POI use case (E4) could be used to implement this use case.

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F1b – Information on parking lots location, availability and services on highways

F1b – Information on parking lots location, availability and services on highways	
Type of road network	**Dual carriageway**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to provide to drivers of all vehicles (light vehicles and heavy goods vehicles) information related to parking lots (location, availability, services, rates...).
Background / added values	• Today, there are announcements via variable message signs. This use case bring the information inside the vehicle. • The core value of this service is to create and share a same display of this type of information that is independent of the sources of information (which are numerous and are displayed differently on websites). Above all, it is a matter of bringing more comfort to the road user. However, this information can also bring more safety by helping the road user manage his driving time. • Also, this kind of information can help the road user to gain time on the whole trip.
Objective	• Allow drivers to manage their driving time according to the availability of parking lots and associated services. • This use case applies as well to the HGV drivers, submitted by regulations to a maximal time of driving, as to Light vehicle drivers.
Desired behaviour	• Drivers adapt their journey based on received information.
Expected benefits	• Security • Traffic management • Parking lots management • Comfort (information on services at the parking)
Use case description	
Situation	Information provided can be: • the location of parking lots, • the number of their available spaces. If not known, information provided is just “full” or “free”, • Vehicle Types permitted to be parked, • Services provided in the parking lot, and associated rates, • If the parking is secured of not (especially for truck parking). • If there is a charging point for electric vehicle (with the power, the availability...) • The fares and times of use if applicable
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Parking operators:** The sender can be directly parking operators • **Road operator**: The road operator can also be the sender of the information, after obtaining the information from the parking operators. • **Vehicle drivers** are the end-users of the service. • **Information providers:** road operator, parking operator
Scenario	1. The road manager, or the parking operator, get the information by his own means or through his relationships. 2. He broadcasts it to all vehicles, in a relevant area. 3. Vehicles get the information. 4. When drivers ask for the information, the vehicles display it to drivers via the

	HMI, adapted if possible to the vehicle types (e.g. Light Vehicle or Heavy Goods Vehicle). 5. Drivers adapt their trip and choose a parking lot according their needs. 6. Eventually, the road user could put his itinerary in the guidance system of the vehicle that is connected to the C-ITS system to go to the parking lot.
Display principle / Alert logic	• Information is provided to drivers who are seeking for it (e.g. POI)
Possible standards	• ETSI TS 101 556 01v010101p(POI)
Constraints / Dependencies	**Constraints** • The important points of considerations concern the information supply and its quality. • HMI constraints to display the information properly. • Make sure that there is enough resources available to carry out a comprehensive work of specifications (parking operators should be willing to equip their parking with RSU...). • The messages's area of dissemination and the center of destination could be adapted according to the vehicle category and the type of the parking lot. **Dependencies** • The Smart POI use case (E4) could be used to implement this use case.

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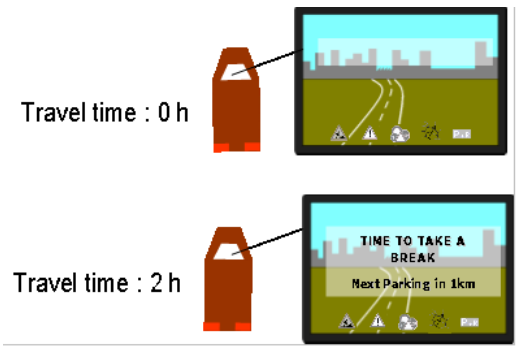
F2 – Parking lots location and availability: break time indication

F2 – Parking lots location and availability: break time indication	
Type of road network	**All (except in dense urban area)**
Type of vehicle	**All (HGV included)**
Use case introduction	
Summary	The service is to display at a certain frequency, the available parking spots along the way of a driver.
Background / added values	Enabling road users to make a safer journey by providing information on parking availability, at a relevant frequency.
Objective	The objective is to encourage the driver to take a break time, by advising him a parking lot with available spaces.
Desired behaviour	The driver will park his vehicle after a relevant driving time to get some rest.
Expected benefits	Comfort, Security
Use case description	
Situation	A driver with long journey. For example: • a driver needs to park his HGV in a truck parking, respecting the travel time regulation. • a driver needs to plan his lunch break.
Logic of transmission	I2V Logic, Broadcast

Actors and relations	• **Parking operators:** The sender can be directly parking operators
	• **Road operator**: The road manager can also be the sender of the information, after obtaining the information from the parking operators.
	• **Vehicle driver** are the end-users of the service (LVs or HGVs).
	• **Information providers:**
	  ○ Parking operators
	  ○ Road operators

Scenario	1. The road manager or the parking manager collects information by its own means or relationships. 2. Information is broadcasted to all vehicles within a perimeter which is considered as relevant. 3. The vehicle makes calculation of the remaining time until a break, taking into account the location of rest areas. 4. The road user is driving, parking spots are displayed along the way at a certain frequency, in a pop-up to suggest to take a break. 5. The driver adapts his route and can choose a parking area.
Display principle / Alert logic	• The information is pushed to the HMI with an alert, in order to encourage the driver to take some rest. • For Light vehicle drivers, the frequency could be every two hours. • For HGV drivers, the frequency could be based on the driving time already done compared to the driving / break / rest times from the regulation. • The frequency may also be pre-specified, in function of vehicle types (light vehicle or heavy goods vehicle)

	
Possible standards	• None identified by the working group.
Constraints / Dependencies	**Constraints**: • Heavy Goods vehicles have to take into account the regulation of driving time / break time. Driving time, break time and rest time of HGV drivers (>3,5T, more than 9 seats) are defined in the European Social Regulation No 561/2006 of 15 March 2006. • HMI constraints to display the information properly. **Dependencies**: • There is a link with the Smart POI use case. This use case could be extended, by displaying the services available in the parking areas.

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F3 – Information about the schedule of the next public transport after parking at the station

F3 – Information about the schedule of the next public transport after parking at the station	
Type of road network	**All**
Type of vehicle	**Passengers vehicles**
Use case introduction	
Summary	The road user is parked at a Public Transport (PT) and can access the information about the next transit departure from his car.
Background / added values	• The advantage for the user is to have this information in his car, in order to wait in his car (parked in the parking lot relay) rather than on the platform.
Objective	• Improve the comfort of the user, by giving him a reliable information awaiting the next PT.
Desired behaviour	• N.A.
Expected benefits	• Limit the number of users waiting on the PT platforms • Comfort: optimizing the user time
Use case description	
Situation	• Park-and-ride • Parking of a railway station • Etc.
Logic of transmission	I2V Logic, Broadcast OR V2I2V Logic, Unicast
Actors and relations	• **Parking operators:** The sender can be the parking operator • **Public transport operators:** The sender can be the public transport operator • **Service provider:** The sender can be a service provider. • **The regulatory authority for transport** can be the sender of the information. • **Vehicle drivers** are the end-users of the service. • **Information providers:** Transit/parking operator's sources of information
Scenario	**<u>If I2V Logic, Broadcast:</u>** 1. A driver parks his car in the vicinity of a PT station 2. The manager or authority of this station broadcast the PT timetables 3. The vehicle that is stationed near the station receives the information and displays it to its driver. **<u>If V2I2V Logic, Unicast:</u>** 1. A driver parks his car in the vicinity of a PT station 2. The driver asks to access the schedule of the next train for his specific destination 3. Infrastructure answers specifically for the asked destination, by sending the timetables in unicast. 4. The vehicle which is stationed in the vicinity of station receives the information and displays it to its driver.
Display principle / Alert logic	• On the HMI, the display would be similar to the one of public station screens.
Possible standards	• There are available standards (TPEG CEN/ISO 18234-5) related to public transportation that define the types of messages related to public transportation. • SIRI standard (Service Interface for Real time Information) CEN/TS 15531:2007

Constraints / Dependencies	**Constraints:** • The PT timetables should be up to date, to take account of delays / cancellations of departures. • Interfacing with existing systems to exchange data • Possible problems of information dissemination in enclosed spaces such as parking lots. **Dependencies:** • The Smart POI use case (E4) could be used to implement this use case.

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F4 – Information about the schedule of the next public transport when approaching a station

F4 – Information about the schedule of the next public transport when approaching a station	
Type of road network	**All**
Type of vehicle	**Passengers vehicles**
Use case introduction	
Summary	The road user is driving toward a destination known by his navigation system. He requests the schedule of the next train and receives the static or dynamic information of the trains going to the same location.
Background / added values	• Better integration of the public transport information in the vehicle compared to a smartphone.
Objective	• Allow the user to know in his car the schedule of the next PT when he is approaching a station, in order to help him choosing his mode of travel. • Indeed, this information can help the driver to assess the opportunity to take a public transport (with static or dynamic departure time).
Desired behaviour	• The driver assesses the opportunity to take a public transport.
Expected benefits	• Users: ○ Comfort with real-time information (especially if dynamic) ○ Path optimization ○ Safer than smartphone to consult PT information • Authorities: Enabling modal transfer
Use case description	
Situation	• A user who is accustomed to change his travel mode at a park-and-ride makes sure of the schedule of his next train. • A user who is accustomed to maintain his mode may change if the road traffic is too intense.
Logic of transmission	V2I2V logic, Unicast
Actors and relations	• **Parking operators:** The sender can be the parking operators • **Public transport operators:** The sender can be the public transport operator • **Service provider:** The sender can be a service provider. • **The regulatory authority for transport** can be the sender of the information. • **Vehicle drivers** are the end-users of the service. • **Information providers:** The transit operator's sources of information.
Scenario	1. The road user is driving toward a destination known by his navigation system. 2. The user wishes to know the schedule of the next train going to his final destination, from an approaching station along his route. He requests the schedule of the next train. 3. Infrastructure transmit the information. 4. The vehicle receives the information and displays it to the user. 5. The user adapts his / her route if necessary.
Display principle / Alert logic	• On the HMI, the display would be similar to the one of smart POI use case.
Possible standards	• There are available standards (TPEG CEN/ISO 18234-5) related to public transportation that define the types of messages related to public transportation. • SIRI standard (Service Interface for Real time Information) CEN/TS 15531:2007
Constraints / Dependencies	**Constraints:** • Interaction with public transport operators

	Dependencies: • The Smart POI use case (E4) could be used to implement this use case.

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F5 – Information P+R in order to modal transfer

F5 – Information P+R in order to modal transfer	
Type of road network	**All categories** (priority on the most important roads: national roads, hierarchical road)
Type of vehicle	**All light vehicles**
Use case introduction	
Summary	The service consists of providing drivers with information on park-and-ride facilities (location, availability, etc.), with an additional indication of a comparative journey time by type of transport (vehicle, modal transfer to tramway, BRT or bus) in order to encourage a modal shift and change in travel behaviour.
Background / added values	• Today, this information on park-and-ride (location, availability) is displayed at best via variable message signs in specific locations and in a non-permanent manner. A program is planned in the coming years to deploy signs on the main infrastructures leading to the metropolis. • This use case allows information to be sent directly to the vehicle, over a wider radius of action around the P+R and therefore in advance. This information can be about the nearest and the next P+R, in order to adapt to the traffic and car park use condition. • With the information on the compared travel time (possibly accompanied by the GHG impact, and/or a sensitization message), the motorist has more complete information in favour of a modal shift, or even the time saved on the whole trip thanks to this modal shift. • The main value is therefore to gather a set of information in favour of modal shift, geolocalized, and to share it on a single display in an anticipated manner, independent of the sources of information (which are numerous and displayed differently on websites).
Objective	• Better inform drivers of private cars and allow them to switch to public transport according to the availability of parking spaces [and possibly associated services], based on targeted information or even advice to switch to public transport.
Desired behaviour	• Drivers adapt their trips according to the information and advice they receive and make greater use of park-and-ride facilities and public transport.
Expected benefits	• Increased modal shift to public transport and/or active mobility thanks to broad and appropriate information • Secure access to the P+R through advance information [if the P+R is full, for example]. • Management of multimodal traffic • Filling of parking lots
Use case description	
Situation	The information provider can be : • The location of the parkings, • with indications on access route, if possible, • The number of their available spaces in real time. If not known, information provided could be just “full” or “free”, • The travel time saving in case of modal shift (to tramway, BRT or bus) • The gain in terms of GHG and/or a message of awareness of sustainable mobility (reference to the Climate Resilience Law) • The frequency of public transport (tramway, BRT or bus) • The hours of use of the parkings and the fare • The services provided in the parking lot (type of vehicle allowed, electric recharging point and their availability, reserved spaces for car-poolers, bike-sharing system, etc.),
Logic of transmission	I2V Logic, Broadcast

Actors and relations	• **The regulatory authority for transport :** the sender can be the regulatory authority for transport • **The road operator :** the sender can be the road operator • **The parking operators :** the sender can be the public transport operator (in case of P+R) or the off-street parking manager • **The service provider** : the sender can be a service provider • **Public transport operators :** the sender can be the public transport operator • **The vehicle drivers** are the end-users of the service (motorized two-wheelers included) • **Information providers :** parking operator ; road operator ; public transport operators ; service provider ; the regulatory authority for transport
Scenario	1. The road manager gets the information by his own means or through his relationships (e.g., by contract with the parking operator) 2. He broadcasts it to all vehicles, in a relevant area (or through a digital service provider) 3. Vehicles get the information. 4. When drivers ask for the information (application settings), the vehicles display it to drivers via the HMI, adapted, if possible, to the vehicle types (e.g. Light Vehicles, …) 5. Drivers adapt their trip and choose a P+R according to their needs. 6. Eventually, the road user could put his itinerary in the guidance system of the vehicle that is connected to the C-ITS system to go to the P+R.
Display principle / Alert logic	• Information is provided to drivers who are seeking for it or approaching P+R (application settings)
Possible standards	• ETSI TS 101 556 01v010101p (POI) • IVI / IVS • SIRI standard (Service Interface for Real time Information) CEN/TS 15531:2007 • There are available standards (TPEG CEN/ISO 18234-5) related to public transportation that define the types of messages related to public transportation.
Constraints / dependencies	Constraints : • The important points of considerations concern the information supply and its quality. • The constraints concerning the HMI is to display this information in a satisfactory and adapted way, which can be quite complete, by favouring the most environmentally efficient information without degrading security by too many of messages. Dependencies • The Smart POI use case (E4) could be used to implement this use case.

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F6 – Reservation of a parking space released by a user

F6 – Reservation of a parking space released by a user	
Type of road network	**All**
Type of vehicle	**All (HGV included)**
Use case introduction	
Summary	A road user is searching for a parking space. Another road user, with the same vehicle type (Light Vehicle / Heavy Goods Vehicle) is going to leave his parking space. They are connected, and the leaving vehicle waits for the searching vehicle before to leave the space.
Background / added values	• Current systems mainly focused on off-street parking management. This use case permit to optimize the on-street parking.
Objective	• Allow a road user looking for a space in a given area to book a place and get there immediately.
Desired behaviour	• The searching vehicle goes to the parking space. • The leaving vehicle waits for the searching vehicle before leaving its parking space.
Expected benefits	• Reduced search time for a parking space. • Guarantee of success during the research of a parking place (if there is at least one leaving vehicle).
Use case description	
Situation	• In city: on-street parking • In City or in motorway: off-street parking • Park-and-ride...
Logic of transmission	V2V Logic, Broadcast Then V2V Logic, Unicast
Actors and relations	• 2 drivers in 2 vehicles of the same category (Light Vehicle / HGV) • **The sender** is the driver of the leaving vehicle • **The end-receiver** is the driver of the searching vehicle • **Information provider**: the driver of the leaving vehicle.
Scenario	1. A searching vehicle broadcasts a message stating that it is looking for a parking space 2. A parked vehicle, who is preparing to leave, receives this message and launches a unicast communication signaling that he is releasing its parking space It can be considered that the unicast link is sufficient for the parking space to be reserved, but it does not guarantee that it will be free when the searching vehicle will arrive. An option to guarantee the reservation would be the following. 3. The searching vehicle sends to the leaving vehicle its position and confirms that it is approaching. If the searching vehicle has several proposals, it informed only the one chosen. 4. When the searching vehicle arrives at the destination, the leaving vehicle leaves its space, and put its warnings so that the searching vehicle recognizes it.
Display principle / Alert logic	• It is necessary to enter a specific "parking" mode for both drivers • In this mode, the principle of requests and acknowledgments is used.
Possible standards	• No standards identified.
Constraints / Dependencies	**Constraints:** • Manage the size / type of vehicles and parking spaces • This use case will not work completely in covered parking lots (positioning

	problem) • This use case needs to use a navigation system to realize the guidance. • It is necessary to enter a specific "parking" mode for both drivers **Dependencies:** • Similar to the F7 use case, but the F6 use case permits to assure the searching vehicle that the parking space will be available when it will arrive there.

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F7 – Information about a parking space released by a user

F7 – Information about a parking space released by a user	
Type of road network	**All**
Type of vehicle	**All (HGV included)**
Use case introduction	
Summary	A road user releases his parking space and broadcast the information to the surrounding vehicles.
Background / added values	• Current systems mainly focused on off-street parking management. This use case permit to optimize the on-street parking. • Permits to increase the cover of the information (compared to F6 use case). • Permits to transmit the information even if the vehicle has already leaved its parking space (compared to F6 use case).
Objective	Allow to a road user looking for a space in a given area to be informed of a space being released, and to go there immediately.
Desired behaviour	The searching vehicle goes to the parking space.
Expected benefits	Reduced search time for a parking space.
Use case description	
Situation	• In city, on-street parking • In City or in motorway, off-street parking • Park-and-ride...
Logic of transmission	V2V Logic, Broadcast

Actors and relations	2 vehicles of the same category (Light Vehicle / HGV).
	• **The sender** is the driver of the leaving vehicle (if triggering conditions are manual) or is the vehicle itself (if triggering conditions are automatic)
	• **The end-receive**r is the driver of the searching vehicle.
	• **Information provider:**
	  ○ Sensors of the vehicle if triggering conditions are automatic
	  ○ Driver of the leaving vehicle if triggering conditions are manual

Scenario	1. A vehicle or its driver broadcasts message stating that it is leaving a parking space 2. A searching vehicle display the information on the HMI of its driver. 3. The driver goes to the released parking space.
Display principle / Alert logic	• A specific “parking” mode needs to be activated beforehand by both drivers. • Automated treatments detecting the presence of the vehicles in an area likely to require parking spaces
Possible standards	• No standards identified.
Constraints / Dependencies	**Constraints:** • The parking space may no longer be available when the searching vehicle arrives (several searching vehicles can receive the same information) • The time duration of the message, as well as its dissemination area is very important. • Manage the size / type of vehicles and parking spaces • This use case will not work completely in covered parking lots (positioning problem) • A specific “parking” mode needs to be activated beforehand by both drivers. **Dependencies:** • Similar to the F6 use case, but the F6 use case permits to assure the searching vehicle that the parking space will be available when it will arrive there.

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F8 – Car-sharing service between two specific stations

F8 – Car-sharing service between two specific stations	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The road operator sends automaticaly to the vehicles close to a car-sharing station the information of a pedestrian request to be taken in charge at that station. The car-sharing station destination is chosen by the pedestrian and sent to the vehicle. The vehicle driver answers if he agrees to drive the pedestrian.
Background / added values	Today, the car-sharing is only accessible for those who have the specific applications. This service opens the possibility of having new car-sharing users.
Objective	The objective is to propose a free car-sharing service between two specific places.
Desired behaviour	• The vehicle driver confirms if he can take in charge the pedestrian by sending a confirmation message, then he picks the pedestrian up and drives him to the requested destination. • The pedestrian agrees to enter in the vehicle and to be driven to the requested location.
Expected benefits	• Propose a new type of car-sharing service, • Optimize the car occupancy rate, • Eventually set up dedicated carpooling lanes, • Reduce CO2 emissions.
Use case description	
Situation	A pedestrian is at a car-sharing station and needs to be driven to another car-sharing station.
Logic of transmission	**I2V2I Logic, Broadcast then Unicast** 1. **I2V in broadcast**: the road operator sends in broadcast information about the presence of a pedestrian to be taken in charge, with the specific locations of the departure and arrival stations. 2. **V2I in unicast**: the vehicle sends back to the infrastructure that the driver will drive the pedestrian to his destination.
Actors and relations	• **The initiator** of the service is the pedestrian as he needs to select his destination on an interface located at the station, in order for the road operator (and then the vehicle driver) to know the destination. • **The sender** is the road operator that transmits automaticaly the request to close vehicles. • **The end-receiver** is the driver of the vehicle.
Scenario	1. The pedestrian waits at a car-sharing station. He presses a button that informs the road operator about his destination. He may also press a button to cancel his request. 2. The road operator automaticaly sends a message to the vehicles close to the pedestrian informing about the departure and arrival stations requested by the pedestrian. It may also transmit the cancelling order. 3. The driver of a vehicle confirms to the road operator that he will take the pedestrian in charge. 4. The road operator may inform the pedestrian that a vehicle is coming, through the interface. 5. The vehicle picks up the pedestrian at the departure station.
Display principle / Alert logic	The display to the driver on a HMI needs to be early enough to answer if he needs to stop. If he validated, the alert could be repeated closer to the pick-up location.

Possible standards	• DENM • IVI
Constraints / Dependencies	• Some stations, with the designated interface, need to be implemented by the road operator. • The road operator could have the possibility to reach the pedestrian to inform him that a vehicle is coming to pick him up.

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F9 – Information on special street parking spaces

F9 – Information on special street parking spaces	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to provide to drivers of vehicles with special needs regarding street parking spaces (Person with Reduced Mobility – PRM & Goods Delivery Service) information related to parking spaces (location, availability …).
Background / added values	• The core value of this service is to create and share a same display of this type of information (which are not always available) for drivers of vehicles with special needs regarding street parking spaces. Above all, it is a matter of bringing more comfort to the road user. • Also, this kind of information can help the road user to gain time on the search for a street parking space.
Objective	• Allow drivers to manage their driving time according to the availability of street parking spaces.
Desired behaviour	• Drivers adapt their journey based on received information.
Expected benefits	• Traffic management (drivers could reach directly the location of parking spaces without having to look a parking space near their destination) • Parking lots management • Comfort (information on services at the parking)
Use case description	
Situation	Information provided can be: • the location of PRM/goods delivery street parking spaces, • the number of their available spaces. • Services provided in the parking lot, and associated rates, • If there is a charging point for electric vehicle (with the power, the availability...) • Nearby transport services and their frequency (station, tram, BRT or bus), where applicable
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **Road operator**: The road operator can also be the sender of the information, after obtaining the information from the parking operators. • **Vehicle drivers** are the end-users of the service. • **Information providers:** road operator
Scenario	1. The road manager, or the parking operator, get the information by his own means or through his relationships. 2. He broadcasts it to all vehicles, in a relevant area. 3. Vehicles get the information. 4. When drivers ask for the information, the vehicles display it to drivers via the HMI. 5. Drivers adapt their trip and choose a parking lot according to their needs.
Display principle / Alert logic	• Information is provided to drivers who are seeking for it (drivers transporting people with reduced mobility & goods delivery service)

Possible standards	• POI
Constraints / Dependencies	**Constraints** • The important points of considerations concern the information supply and its quality. • HMI constraints to display the information properly. • Processing capacity of a large number of data (more than 3000 street parking spaces and approximately the same volume for PRM parking spaces). • Frequency of updating of information (especially on changes in the location of street parking spaces). **Dependencies** • The Smart POI use case (E4) could be used to implement this use case • A link may be done with F1 (Information on parking lots location, availability and services).

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G – Intersections

G1a – Green Light Optimal Speed Advisory (GLOSA)

G1a – Green Light Optimal Speed Advisory (GLOSA)	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to give to drivers advices permitting to optimize their approach to a traffic light (maintain actual speed, slow down, adopt a specific speed).
Background	Today, drivers have to look at the traffic light to know whether it is red or green (it can be sometimes “hard to say” because the sun shades colors). It may lead to acceleration (to get the green) and sudden brakes in case of a red light.
Objective	To smooth the traffic approaching traffic lights.
Desired behaviour	Users adapt their speed to pass easily traffic light with an authorized speed. In addition, they are prepared to brake smoothly if they will have a red light.
Expected benefits	• Smart routing • Fluid driving conditions • Less stress for the driver • Better average speeds in urban context (and eventually in highway or ring road regulatory access, roadworks temporary traffic lights) • Safety (thanks to guided intersection approach) • Lower consumption and less CO2 emissions.
Use case description	
Situation	A connected vehicle is approaching an equipped traffic lights intersection.
Logic of transmission	I2V logic Broadcast
Actors and relations	• **Traffic light controller or the traffic light centralized regulation system** is the sender of the message. • **Divers of approaching vehicles** to the traffic lights are the end-users of the service. • **Information providers**: Infrastructure / TCC managing traffic lights or Traffic light Controller
Scenario	1. A driver is approaching a traffic light. 2. Messages are broadcast from traffic lights to approaching vehicles informing them of the traffic light phase schedule. 3. This information, completed by the position and speed of the vehicle and the distance to the traffic light, will enable an algorithm in the vehicle to calculate the optimal speed of approach (under mandatory speed limit) and display it on the HMI. 4. The driver adapts its speed accordingly.
Display / alert principle	• When the light is green (and the driver can pass it without exceeding the speed limit), the driver receives a speed advice to continue and pass the green light. • When the light is green, but the driver cannot pass it without exceeding the speed limit, no speed advice is given. The driver receives the advice to prepare to stop. • When the light is red and the driver has to stop, the advice is to stop. • When the light is red but about to turn green, the driver receives a speed advice to pass the green light if he needs to slow down to get the green, or the advice to continue and pass the green light.
Possible standards	• SPAT/MAP
Constraints / Dependencies	**Constraints:** • Start & go is not always appropriate (number of start/stop is limited depending on

	battery capacity) • If there is a traffic jam in front of a traffic light, GLOSA becomes useless but could be adapted if it is possible to integrate this information in the algorithm. • GLOSA depends on the data provided by the Traffic light controller or the Traffic light management center. The provided information may not be adapted to GLOSA especially if the phases are adaptative. • The given speed advice has to be lower than the speed limit. • Integrate the service in other traffic light deployments like Tram traffic lights or regulation traffic lights for ring-road or highway access **Dependencies:** • This use case is linked with G1b (Time to green), G2 (priority request) and any situation that changes the time phases of traffic lights. • Experimented through COMPASS4D and C-TheDifference projects, this use case is essentially adapted to urban traffic lights, but it could be worthy to study the benefits to adapt it to highway or ring road regulatory access traffic lights. An adaptation to roadworks temporary traffic lights is not excluded.

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G1b – Time To Green (TTG)

G1b – Time To Green (TTG)	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to give to drivers the time to green to optimize their approach to a traffic light (maintain actual speed, slow down and adopt a specific speed).
Background	Today, drivers have to look at the traffic light to know whether it is red or green (it can be sometimes “hard to say” because the sun shades colors). It may lead to acceleration (to get the green) and sudden brakes in case of a red light.
Objective	To smooth the traffic approaching traffic lights.
Desired behaviour	Users adapt their speed to pass easily the traffic light with an authorized speed.
Expected benefits	• Smart routing • Fluid driving conditions • Less stress for the driver • Better average speeds in urban context (and eventually in highway or ring road regulatory access, roadworks temporary traffic lights) • Safety (thanks to guided intersection approach) • Lower consumption and less CO2 emissions.
Use case description	
Situation	A connected vehicle is approaching an equipped traffic lights intersection.
Logic of transmission	I2V logic Broadcast
Actors and relations	• **Traffic light controller or the traffic light centralized regulation system** is the sender of the message. • **Divers of approaching vehicles** to the traffic lights are the end-users of the service. • **Information providers**: Infrastructure / TCC managing traffic lights or Traffic light Controller
Scenario	1. A driver is approaching a traffic light. 2. Messages are broadcast from traffic lights to approaching vehicles informing them of the time remaining to the next green light. 3. The time to green is displayed on the HMI of the vehicles.
Display / alert principle	• When the light is red, the HMI should display the time remaining to the next green phase.
Possible standards	• SPAT/MAP
Constraints / Dependencies	**Constraints:** • Start & go is not always appropriate (number of start/stop is limited depending on battery capacity) • TTG depends on the data provided by the Traffic light controller or the Traffic light management center. The provided information may not be adapted to TTG especially if the phases are adaptative. • Integrate the service in other traffic light deployments like Tram traffic lights or regulation traffic lights for ring road or highway access. **Dependencies:** • This use -case is linked with G1a (GLOSA), G2 (priority request) and any situation that change time phases of traffic lights. • Experimented through COMPASS4D and C-TheDifference projects. This use case is essentially adapted to urban traffic lights, but it could be worthwhile to study the

	benefit to adapt it to highway or ring road regulatory access traffic lights. An adaptation to roadworks temporary traffic lights is not excluded.

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G2 – Traffic signal priority request by designated vehicles

G2 – Traffic signal priority request by designated vehicles	
Type of road network	**Urban**
Type of vehicle	**Designated vehicles**
Use case introduction	
Summary	• The service is to give priority to specific vehicles at traffic lights.
Background	• Today, in many cities, systems exist to give a level of priority to designated vehicle (emergency services, public transports and so on) at traffic light. • It is based on several technologies (radio-communication, GPS positioning, remote control). • In many other cities, authorized vehicle has to pass through a red light (police, ambulance and so on).
Objective	• Enhance the smart routing • Give priority to vehicles under logical considerations (transport policy included) • Reduce risks of collision at traffic lights.
Desired behaviour	• Traffic light give priority to specific users. The vehicle can therefore go through the traffic light intersection with no or limited waiting time.
Expected benefits	Smart routing, security, safety, enhanced travel time for requesting vehicle
Use case description	

Situation	• Equipped traffic lights
	• Vehicles enabled to ask for priority could be (non-exhaustive list):
	  ○ Emergency vehicles (firefighters, security forces, ambulances)
	  ○ Public transport
	  ○ High occupancy vehicles

Logic of transmission	V2I logic Vr (vehicle requesting priority) => to => I (RSU on/around traffic light or before it) Broadcast and/or Unicast

Actors and relations	• **The vehicle asking for priority** is the initiator of the service. It is also the end-user of the service. There are 3 possibilities to initiate the use case:
	  ○ Automatic from equipment (triggering conditions analysis from equipment: usual CAM emitted by vehicles)
	  ○ Automatic from vehicles (automatic requests with triggering conditions)
	  ○ Manual from vehicles (via OBU interface)
	• **The infrastructure (traffic lights)** is the end-receiver of the message.
	• **Other vehicles** at the intersection adapt their behaviour in order to respect the traffic lights.

Scenario	1. A designated vehicle asks the priority to an equipped infrastructure. 2. The infrastructure decides if the priority is given and how. Different levels of priority can be applied, e.g. extension or termination of current phase to switch to the required phase. 3. Appropriate level of green priority may depend on the vehicle type (e.g. emergency vehicle) and status (e.g. public transport vehicle on time or behind schedule). 4. Driver of the requesting vehicle adapts his behaviour in function of the decision made by infrastructure on the traffic lights. There is no confirmation message from infrastructure to the requesting vehicle.
Display / alert principle	• Itinerary may be set into HMI so that the hold on appropriated traffic light will be applicated with an advanced phase or properly on complex route (itinerary to event or for public transport service).
Possible standards	• DENM and/or CAM

	• SREM/SSEM • NF P 99-105:1991: Traffic control - Traffic light junction controllers - Functional characteristics. Currently under review. • NF P99-071:2015: Regulation of road traffic by traffic lights - Specification of the standard dialogue of traffic control equipment - Diaser
Constraints / Dependencies	**Constraints:** • If too many vehicles are taken priority on traffic lights, the overall traffic management will be disturbed. • It will be necessary to list the different possible situation in this use case, in order to analyze them and arbitrate them (e.g. emergency vs public transport, level of priority needs, their conditions depending vehicle and/or traffic management considerations, etc.). **Dependencies:** • This UC may be combined with D12 (emergency vehicle approaching). • This UC may interact badly with G3 (GLOSA) because it changes phase of the red light. • An application of this UC to roadworks temporary red lights is not excluded.

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Example of implementation in Helmond:

- *"In case emergency vehicles have their light-bar activated, absolute priority request will be activated automaticaly at crossings, and the emergency vehicles get green light as soon as possible (taking into account minimal green times and evacuation time). Trucks equipped with this service have 'light' / 'selective' priority, meaning that when there are no emergency vehicles with light-bar activated or other trucks are in the vicinity, green light will be extended (till the maximum green time) or red light will be shortened (when possible)."*
- This implementation does not surely cover all needs of this use case (public transport, high occupancy vehicles, etc.). Triggering conditions and technology could be different. Calculations by infrastructure when several requests may be in scope.

G3 – Intersection violation: Warning to the violator vehicle

G3 – Intersection violation: warning to the violator vehicle	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to inform a driver that he is going to viol a red light or stop if nothing is done.
Background	Today, except in some vehicles with CAM detectors, user's safety only depend on driver attention at signalized intersection.
Objective	• The objective is to warn a driver that he is going to viol a signalized intersection. • The objective is not to warn other vehicles approaching the signalized intersection of a risk a violation.
Desired behaviour	• The driver of the violator vehicle is warned of a red light or stop violation coming for himself and can adapt his behaviour consequently. • Eventually, an automatic action of the vehicle is not excluded.
Expected benefits	• Reduce the number and severity of collisions at signalized intersections.
Use case description	
Situation	• The Intersection need to be equipped by an RSU. It can be an intersection with lights or a stop intersection.
Logic of transmission	I2V logic, Unicast
Actors and relations	• **Infrastructure** (red light or stop with RSU or RSU around) is the sender of the message, and the initiator of the service. • **The driver of the violator vehicle** is the end-user of the service. • **Source of information:** infrastructure can determine the risk of violation through classic automatic detections (camera, radar) or through detection and analysis of the CAM of the violator vehicle compared to the color of traffic light for example. It means an auto-detection by infrastructure of a violation (radar or check of CAM received).
Scenario	1. An intersection (red light or stop) is equipped with a RSU 2. A vehicle is going to disrespect a signal (stop or red light). 3. This incoming violation is detected by the infrastructure 4. The information is delivered by the infrastructure to the on-board units (OBU) of the vehicle, which is going to violate the intersection. Unicast communication. 5. The driver of the violator vehicle can adapt his behaviour. 6. Automatic reaction of vehicle itself is not excluded.
Display / alert principle	• High priority display for the message on the HMI of the violator vehicle, so he may stop just before the break of rule or the collision happens. • The display needs to be done enough in advance to let the time to the driver of the violator vehicle to adapt his behaviour.
Possible standards	• DENM • CAM • IVI/IVS
Constraints / Dependencies	**Constraints:** • The method to detect the violation has to be efficient to avoid alerts happen anytime vehicles approach intersections or does not happen when necessary. **Dependencies:** • There is a link with D12 UC (emergency vehicle approaching) which can overpass any signals. • The case where the violation detection would be done by the violator vehicle, based on information broadcast by infrastructure, is a sub-case of the GLOSA service.

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Example of implementation in Helmond (Red Light Violation Warning – RLVW):

- *"In case truck drivers might violate a red sign at one of the equipped 24 crossings, they will receive a warning on their display: 'If you continue driving this speed you will violate a red sign'. In the OBU there is a setting for the deceleration. If it is calculated that with a 'standard' deceleration for trucks the red light will be violated, a warning is given. This warning is given shortly (few meters) before the stop bar. This service works for trucks heading straight. When a truck is already braking (as is the case when taking a turn) the service does not work*."
- In this case, calculations are done in the violator vehicle knowing red light situation. This use case works differently, with calculations by infrastructure.

G4 – Intersection Violation: Warning to approaching vehicles

G4 – Intersection Violation: Warning to approaching vehicles	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to inform drivers approaching an equipped intersection that a vehicle is probably going to make a red light or stop violation.
Background	• Today, except in some vehicles with CAM detectors, user's safety only depends on driver's attention at signalized intersection.
Objective	• The objective is to warn vehicles approaching the signalized intersection of a risk of a violation by another vehicle. • The objective is not to warn the driver of the violator vehicle.
Desired behaviour	• Users be warned of a red light or stop violation from another vehicle and adapt their behaviours. • Eventually, an automatic action of vehicle computer is not excluded.
Expected benefits	• Reduce the number and severity of collisions at signalized intersections.
Use case description	
Situation	• The Intersection need to be equipped by an RSU. It can be an intersection with lights or a stop intersection.
Logic of transmission	I2V logic, Broadcast
Actors and relations	• **Infrastructure** (red light or stop with RSU or RSU around) is the sender of the message, and the initiator of the service. • **Drivers of vehicles approaching the intersection** (except the violator vehicle) are the end-user of this service. • **Source of information:** infrastructure can determine the risk of violation through classic automatic detections (camera, radar) or through detection and analysis of the CAM of the violator vehicle compared to the color of traffic light for example. It means an auto-detection by infrastructure of a violation (radar or check of CAM received).
Scenario	1. An intersection (red light or stop) is equipped with a RSU 2. A vehicle is going to disrespect a signal (stop or red light) 3. The infrastructure detects an ongoing or incoming violation (detection is done by infrastructure calculation). 4. Information is delivered, by the infrastructure, on the on-board units (OBU) of all other vehicles at the intersection. Information is composed by the current allowed vehicle flows, and the position, trace, and possibly intended direction of the vehicle which has violated the signal or the allowed flow. 5. OBU display the received information in the most relevant vehicles. 6. Approaching drivers receiving this information can adapt their behaviour. 7. Automatic reaction of vehicle itself is not excluded.
Display / alert principle	• Very high priority display for the message • The display needs to be done as soon as possible to give enough time to drivers to adapt their behaviour.
Possible standards	• DENM • CAM • SPAT/MAP
Constraints / Dependencies	**Constraints:** • The method to detect the violation has to be efficient to avoid alerts happen anytime vehicles approach intersections or does not happen when necessary. Risk of false

	positive. • Accurate positioning requirements • Low latency • Up-to-date allowed vehicle flow • Liabilities: who will be responsible (violator, OEM, warned driver, infrastructure manager)? **Dependencies:** • There is a link with D12 use case (emergency vehicle approaching) which can overpass any signals. • There is a link with G3 use case

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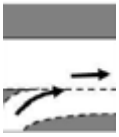
Example of implementation in Helmond (Red Light Violation Warning – RLVW):

- "*In case truck drivers might violate a red sign at one of the equipped 24 crossings, they will receive a warning on their display: 'If you continue driving this speed you will violate a red sign'. In the OBU there is a setting for the deceleration. If it is calculated that with a 'standard' deceleration for trucks the red light will be violated, a warning is given. This warning is given shortly (few meters) before the stop bar. This service works for trucks heading straight. When a truck is already braking (as is the case when taking a turn) the service does not work*."
- In this case, calculations are done in the violator vehicle knowing red light situation. Vehicles around are not warned of the incoming violation, only the user of truck knows. This UC works differently: calculations by infrastructure and then broadcast to all vehicles.

G5 – In-vehicle signage at a merge for vehicles on the entry slip road

G5 – In-vehicle signage at a merge for vehicles on the entry slip road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to display information for vehicles driving on an on-ramp (*entry slip road*) about the presence of vehicles arriving on the upstream section of the main road.
Background	Merges are well known to be sources of traffic congestion and accidents. Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance their visibility by enabling it to last longer. Another benefit would be to enable the information to be displayed in the driver's own language (if possible).
Objective	At the microscopic scale, the main objective is to manage efficiently the insertion of vehicles at a merge by avoiding brutal stops or forced lane changes for vehicles circulating on the main road. At the macroscopic scale, the objectives are: • To improve the road safety for all users; • To make flows and travel times more reliable; • To avoid useless pollution by smoothing accelerations of inserting vehicles.
Desired behaviour	The driver adapts its speed depending on the presence or not of arriving vehicles on the main section.
Expected benefits	The benefits are: • For traffic management centres, to decrease the number of interventions due to accidents and to improve the traffic flow at merges by avoiding capacity drop effect; • For road users, to augment drivers/vehicles perception; • For society, to improve road safety: less accident, lower severity of injuries.
Use case description	
Situation	A vehicle is arriving on the entry slip road. The infrastructure sensors are monitoring the possible arrival of vehicle on the main section. 
Logic of transmission	I2V logic broadcast

Actors and relations	• **Service provider:**
	  ○ The information are given by a local infrastructure equipment formed by one (or many) sensor(s) together with a road-site unit;
	  ○ The road operator does not need to qualify the information.
	• **The end-user** of the service is the road user on the entry slip road.
	• **Road user on the main road:** no action is required from his side.

Scenario	1. A vehicle (or a group of vehicles) is driving on the main road in a predefined section upstream of the merge (and up to the merge); 2. The sensor detects the vehicle(s); 3. The information is shared to the road side unit that broadcasts it to the vehicles on the on-ramp (entry slip road); 4. If a vehicle arrives on the entry slip road, it will receive the information that vehicles are circulating on the main road.
Display / alert	The user gets an alert about the presence of vehicles on the main road.

principle	
Possible standards	• CAM • DENM • CPM
Constraints / Dependencies	• This use case needs a local infrastructure equipment able of a high detection quality. A particular attention should be paid to the cases of false or no detection. • The multiplication of messages displayed to the driver implies to prioritize them.

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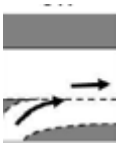
G5 – In-vehicle signage at a merge for vehicles on the entry slip road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to display information for vehicles driving on an on-ramp (*entry slip road*) about the presence of vehicles arriving on the upstream section of the main road.
Background	• Merges are well known to be sources of traffic congestion and accidents. • Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance their visibility by enabling it to last longer. • Another benefit would be to enable the information to be displayed in the driver's own language (if possible).
Objective	• The objective is to enhance the perception of the driver at an entry slip road. • Indeed, the goal is to manage efficiently the insertion of vehicles at a merge by avoiding brutal stops or forced lane changes for vehicles circulating on the main road.
Desired behaviour	The driver adapts its speed depending on the presence or not of arriving vehicles on the main section.
Expected benefits	• To improve the road safety for all users; • To make flows and travel times more reliable; • To avoid useless pollution by smoothing accelerations of inserting vehicles. • For traffic management centres, to decrease the number of interventions due to accidents and to improve the traffic flow at merges by avoiding capacity drop effect.
Use case description	
Situation	• A vehicle is arriving on the entry slip road. • The infrastructure sensors are monitoring the possible arrival of vehicle on the main section. 
Logic of transmission	V2V logic broadcast
Actors and relations	• **Service provider:** ○ The information are given by the vehicle driving on the upstream section of the main road, which directly communicates its position to vehicles arriving on an on-ramp (entry slip road). • **Road user on the entry slip road**: the end-user that should benefit from this information is the driver of the vehicle on the entry slip road who adapts the speed in order to give way the vehicle on the main road (see priority rule respect).
Scenario	1. A vehicle drives on on the upstream section of the main road and send its position continuously via CAM message. 2. The vehicle arriving on an on-ramp receives the CAM message and display it to the driver who adapts/controls the speed in order to give way the vehicle on the main road before entering on the main road.
Display / alert principle	• The road user has to receive the alert in due time to allow him to adjust the driving speed. • The alert needs to be displayed on the HMI early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• CAM • DENM

	• CPM
Constraints / Dependencies	• This use case needs a high detection quality. It also questions the case of faulty detection of road users. • The multiplication of messages displayed to the driver implies to prioritize them.

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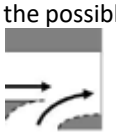
G6 – In-vehicle signage at a merge for vehicles on the main road

G6 – In-vehicle signage at a merge for vehicles on the main road (I2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to display information for vehicles driving on the upstream section of the main road about the presence of vehicles arriving on an on-ramp (*entry slip road*).
Background	Merges are well known to be sources of traffic congestion and accidents. Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance their visibility by enabling it to last longer. Another benefit would be to enable the information to be displayed in the driver's own language (if possible).
Objective	At the microscopic scale, the main objective is to manage efficiently the insertion of vehicles at a merge by avoiding brutal stops or forced lane changes for vehicles circulating on the main road. At the macroscopic scale, the objectives are: • To improve the road safety for all users; • To make flows and travel times more reliable; • To avoid useless pollution by smoothing accelerations of inserting vehicles.
Desired behaviour	The driver could adapt its speed or anticipate a lane changing if possible, depending on the presence or not of arriving vehicles on the entry slip road.
Expected benefits	The benefits are: • For traffic management centres, to decrease the number of interventions due to accidents and to improve the traffic flow at merges by avoiding capacity drop effect; • For road users, to augment drivers/vehicles perception; • For society, to improve road safety: less accident, lower severity of injuries.
Use case description	
Situation	A vehicle is arriving on the main section of the road. The infrastructure sensors are monitoring the possible arrival of vehicle on the entry slip road. 
Logic of transmission	I2V logic broadcast

Actors and relations	• **Service provider:**
	  ○ The information are given by a local infrastructure equipment formed by one (or many) sensor(s) together with a road-site unit;
	  ○ The road operator does not need to qualify the information.
	• **The end-user** of the service is the road user on the main road.
	• **Road user on the entry slip road:** no action is required from his side.

Scenario	1. A vehicle (or a group of vehicles) is driving on the entry slip road in a predefined section upstream of the merge (and up to the merge); 2. The sensor detects the vehicle(s); 3. The information is shared to the road side unit that broadcasts it to the vehicles on the main road as long as at least one vehicle is detected on the entry slip road; 4. If a vehicle arrives on the main road, it will receive the information that vehicles are circulating on the entry slip road.
Display / alert principle	The user gets an alert about the presence of vehicles on the entry slip road.

Possible standards	• CAM • DENM • CPM
Constraints / Dependencies	• This use case needs a local infrastructure equipment able of a high detection quality. A particular attention should be paid to the cases of false or no detection. • The multiplication of messages displayed to the driver implies to prioritize them.

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G6 – In-vehicle signage at a merge for vehicles on the main road (V2V)	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to display information for vehicles driving on the upstream section of the main road about the presence of vehicles arriving on an on-ramp (*entry slip road*).
Background	• Merges are well known to be sources of traffic congestion and accidents. • Rather than providing a new kind of information, the value of this service is to provide a potentially targeted information to road users and enhance their visibility by enabling it to last longer. • Another benefit would be to enable the information to be displayed in the driver's own language (if possible).
Objective	• The objective is to enhance the perception of the driver on the main road. • Indeed, the goal is to manage efficiently the insertion of vehicles at a merge by avoiding brutal stops or forced lane changes for vehicles circulating on the main road.
Desired behaviour	The driver adapts its speed and lane position depending on the presence or not of arriving vehicles on the entry slip road.
Expected benefits	• To improve the road safety for all users; • To make flows and travel times more reliable; • To avoid useless pollution by smoothing accelerations of inserting vehicles. • For traffic management centres, to decrease the number of interventions due to accidents and to improve the traffic flow at merges by avoiding capacity drop effect.
Use case description	
Situation	• A vehicle is arriving on the main road. • The vehicle sensors are monitoring the possible arrival of vehicles on the entry slip road. 
Logic of transmission	V2V logic broadcast
Actors and relations	1. **Service provider:** ○ The information are given by the vehicle driving on entry slip road, which directly communicates its position to vehicles arriving on the main road. • **Road user on the main road**: the end-user that should benefit from this information is the driver of the vehicle on the main road who adapts the speed and their lane position in order to avoid any strong braking, and/or any collisions.
Scenario	• A vehicle drives on the entry slip road section and send its position continuously via CAM message. • The vehicle arriving on the main road receives the CAM message and display it to the driver who adapts/controls the speed and the lane position in order to avoid any strong braking and/or collision.
Display / alert principle	• The road user has to receive the alert in due time to allow him to adjust the driving speed and the lane position. • The alert needs to be displayed on the HMI early enough and is moderately intrusive (at the manufacturer's discretion).
Possible standards	• CAM • DENM • CPM

Constraints / Dependencies	• This use case needs a high detection quality. There is the risk of faulty detection of road users. • The multiplication of messages displayed to the driver implies to prioritize them.

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G7 – HD cartography extended services

G7 – HD cartography extended services	
Type of road network	**Urban**
Type of vehicle	**Automated vehicle (level 3 or more)**
Use case introduction	
Summary	**In urban areas**, the infrastructure sends detailed maps of the intersection with the different storage lanes to enhance the perception of the autonomous vehicle (AV) and its comprehension at a lane level and live details. Including road signs, pole, position and state of the traffic lights. **On highways**, HD Cartography can be displayed for Toll Station crossing, roadworks crossing and for roadworks on Services areas. 
Background	Some road configurations can be very complicated and the road markings may not be sufficient, especially for automated vehicles.
Objective	The objective is to inform the AV about the permanent or provisional road configuration in order to take the correct decisions and choose the adapted path to cross it.
Desired behaviour	The vehicle adapts its speed and trajectory in order to cross the configuration safely.
Expected benefits	• To reduce accidents, severe injuries and fatalities. • To make flows and travel times more reliable by avoiding traffic jam due to a priority conflict or an accident. • To decrease the number of interventions due to an accident.
Use case description	
Situation	An automated vehicle approaches a particular road configuration with a RSU close to it.
Logic of transmission	I2V
Actors and relations	• The road operator sends the precise map of the intersection and is the provider of the service. • The autonomous vehicle receives the indications and is the end user of the service.
Scenario	1. The AV rolls toward a road configuration, which may be complex. 2. The road operator broadcasts the cartography of the infrastructure. 3. The vehicle adapts its trajectory and speed to the received information and its direction.
Display / alert principle	The cartography may be displayed through the HMI.
Possible standards	• MAPEM • DENM
Constraints / Dependencies	The cartography of the road configuration needs to be predefined and updated by the road operator.

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G8 – Green Phase extension for pedestrians

G8 – Green Phase extension for pedestrians	
Type of road network	**All categories** (selection of crossings according to road safety considerations) Accessible pedestrian routes

Type of vehicle/users relevant to the use case	• **Pedestrian's profiles**:
	  ○ Group of school children accompanied by teachers
	  ○ Group access to a specific sports or cultural sites
	  ○ Group of tourists accompanied by a guide
	  ○ Elderly people or centers frequented by people with disabilities

Use case introduction	
Summary	The service consists of anticipating the users' arrival at a signalized intersection by informing them about the status of the pedestrian light, and by encouraging the request to cross upstream of the pedestrian traffic light, then by allocating a green time slot adapted to the user profile.
Background / added values	• Today, crossing requests are activated via the use of push buttons on the equipped pedestrian traffic lights. These requests are processed by the traffic light controller. Adapted crossing times are programmed on a case-by-case basis for sectors located near either schools or sports/cultural centres or specialized institutions. • This use case allows to slightly anticipate the arrival of users at the intersection, by informing them about the status of the pedestrian light and the next phase change, and by a digitalized request to cross before the pedestrian light. It allows the identification of the authorised user on the one hand and the optimisation of the approach and the triggering of the pedestrian light on green on the other hand, with the allocation of an increased green time range adapted to the user profile, • This use case could also increase the number of signalized intersections that are able to provide this service.
Objective	• Facilitating the use of walking and making safe crossings of busy roads by adapting crossing times on a protected pedestrian passage for specific groups and users. • Deploying the service within the area of influence of facilities frequented by the public.
Desired behaviour	• Users can cross safely after a minimized waiting time. • The regulation system delivers a crossing time adapted to the user' profile. • The authorized users are identified (and registered before) and ensure that their accreditation is renewed every year, if necessary (back to school, ...), in order to avoid the action being triggered indiscriminately, discrediting the traffic management.
Expected benefits	• Safer pedestrian crossings. • Facilitating the use of the footpath for access to key facilities.
Use case description	

Situation	• Urban traffic light intersections equipped with pedestrian crossing markings and pedestrian traffic lights, within the perimeter of influence of a key facility frequented by the public (schools, cultural centres, museums, specialised establishments, etc.).
	• On busy roads and accessible pedestrian paths.
	• Users are accredited and in position to make the crossing request.
	• Regulations issued :
	  • The engaged phase will be given as soon as possible according to traffic regulation information and safety times.
	  • The duration of the green pedestrian phase will be increased and adapted to the group or specific public (disabled person, slow pedestrians) on a case by case basis according to the configuration of the intersection.
	• Feedback to the accredited user :

	• Status of the pedestrian light on the selected path (or even the expected time before the next change of status), • Consideration of the users' crossing request.
Logic of transmission	P2I, I2P Logic, Unicast (Pedestrians) I2V logic, Broadcast (Vehicles)
Actors and relations	• **The Traffic Coordination Centre (TCC) (or the traffic management operator (regulation system))** is the sender of the message • **The Pedestrians** are the end users of the service (receive upstream information on the status of the pedestrian light, issue an early request to cross and receive information on whether their request has been taken into account and, if so, on the waiting or remaining time) • **Information providers**: Infrastructure ; TCC managing traffic lights or Traffic light Controller
Scenario	1. A pedestrian or a group of accompanied pedestrians (The user) is approaching a traffic light intersection. The user asks to cross on the pedestrian passage. 2. The user receives, if possible beforehand, information on the status of the pedestrian light. 3. The traffic manager receives the request. 4. This request is analysed and processed by the control system according to the traffic conditions and the control system triggers as soon as possible a specific pedestrian light phase with a crossing time adapted to the user profile. 5. The user is informed of the close triggering by the traffic manager (or the traffic management operator or the service provider) and then of the authorization to cross and of the time allocated, if necessary.
Display principle / Alert logic	• The HMI is used (application settings: voice command, virtual push button, automatic way, …) to trigger a crossing request, and receives in return information on whether the regulation system has taken it into account. • The HMI informs the user of the imminence of the green light and then of the authorization to cross with an indication about the time remaining, if necessary.
Possible standards	• DENM and/or CAM • MAP and SPAT for pedestrian lights • NF P 99-105 :1991 : Traffic control - Traffic light junction controllers - Functional characteristics. • NF P99-071 : 2015 : Regulation of road traffic by traffic lights - Specification of the standard dialogue of traffic control equipment - Diaser
Constraints / Dependencies	Constraints : • The constraints concerning the HMI are to allow the request for pedestrian crossing and to display, in a satisfactory and adapted way, the information on the acknowledge of the request, the waiting time then the triggering the green light and the allocated crossing time. • G8 depends on the data provided by the Traffic light controller or the Traffic light management centre. The provided information may not be adapted to GLOSAP especially if the phases are adaptive • Pedestrian Accreditation Process Dependencies • Link between Pedestrian and COOPITS (pedestrian request – virtual push button) • This use case is linked with G1a (GLOSA), G1b (Time to green), G2 (priority request) and any situation that changes the phases of traffic lights

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H – Traffic management

H1 – Permanent Traffic Ban to Specific Vehicles

H1 – Permanent Traffic Ban to specific vehicle	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	This service informs drivers of a permanent traffic ban to specific vehicles on a determined road / section / zone.
Background	
Objective	• The aim is to inform users of a permanent traffic ban. • The objective is not to control them.
Desired behaviour	• Drivers do not go in road / section / zones forbidden for them and adapt their route in consequence.

Expected benefits	• Inform drivers of bans in advance for:
	  ○ a better respect of regulation (better awareness)
	  ○ a better road safety
	  ○ time saving
	• Improved traffic management
	• This use case could be used, additionally, by service providers in order to update their map database (open data)

Use case description	
Situation	A permanent traffic ban message is sent to all vehicles but displayed only for specific vehicles. The ban can be based on (non-exhaustive list): • Vehicle type (Heavy Goods Vehicles for example) • Weight • Length • Pollution level • Loading type • Exceptional transportation • Dangerous transportation
Logic of transmission	I2V Logic, broadcast

Actors and relations	• **The Road operator** is the sender of the information TCC), oor more globally, **authorities**.
	• **Vehicle drivers** are the end-users of the service.
	• **Information provider:**
	  ○ Network manager
	  ○ Others Network Managers
	  ○ Law enforcement
	  ○ City
	  ○ Departments
	  ○ Authorities know permanent traffic bans.

Scenario	1. The TCC broadcasts an information of a permanent traffic ban on a road / section / area. 2. Vehicles receive the message and process it. 3. If a vehicle is concerned by the ban, the message is displayed on its HMI. 4. The driver adapts his route.
Display / alert principle	• The message needs to be broadcasted as far from traffic ban section as possible to allow the users to modify his itinerary. • Several options

	○ Ad this information within the car navigation on a map ○ Icon could be enough to explain the traffic ban. Textual message should complete the information (restricted road / section / zone)
Possible standards	• MAP • IVI
Constraints / dependencies	**Constraints**: • Inform the driver in advance to allow him to adapt his itinerary involves that vehicle has to be able to know if the message concern it. However, how to be sure that the driver is going to take the restricted road if the message is sent too far from the ban? Easy in simple cases, could be difficult in complex cases. • For complex situation, link this UC with an itinerary calculator could be necessary. • Clear restricted zone description (by axes) • Difficult for network operators to keep update a complete database with all traffic bans. • Precise vehicle type concerned by the traffic ban • Language issue in case of textual message • In the case of a traffic ban near the limit of two road operators' networks, how to manage the dissemination? **Dependencies**: • There are some dependencies with use cases C1 "in vehicle signage". Nevertheless, this service provides specific information (dynamic traffic ban information) to specific vehicles (vehicle type identifies within the message). • The use case could also aware the user about substitution itinerary allowed for his vehicles type. Therefore, it could be linked with the use case E3 « smart routing »

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H2 – Dynamic Traffic Ban to Specific Vehicles

H2 –Dynamic Traffic Ban to specific vehicles	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	This service informs drivers of a dynamic traffic ban to specific vehicles on a determined road / section / zones and for a specific time duration. A dynamic traffic ban to all vehicles according a special event can also be implemented.
Background	
Objective	• The objective is to inform users of a specific traffic ban. • The objective is not to control them.
Desired behaviour	• Drivers do not use road / section / zones forbidden for them and adapt their route in consequence.
Expected benefits	Inform drivers of bans in advance for: • a better respect of regulation (better awareness) • a better road safety • time saving
Use case description	
Situation	There are two main situations: • A dynamic traffic ban message, linked to a normal network management or planned roadworks, is sent to all vehicles, but display only for specific vehicles. The ban can be based on (non-exhaustive list): ◦ Vehicle type (Heavy Goods Vehicles for example) ◦ Weight ◦ Length ◦ Pollution level (in case of pollution peak, for example) ◦ Loading type ◦ Exceptional transportation ◦ Dangerous transportation • A dynamic traffic ban message, based on a specific event, sent to all vehicles: ◦ in case of exceptional driving conditions (by example, storm or strong wind) ◦ in case of an exceptional event (e.g. a demonstration, a sport event)
Logic of transmission	I2V logic, broadcast.
Actors and relations	• **The Road operator** is the sender of the information TCC), or more globally, **authorities**. • **Vehicle drivers** are the end-users of the service. • **Information provider:** ◦ Network manager ◦ Others Network Managers ◦ Law enforcement ◦ City ◦ Departments ◦ Authorities know permanent traffic bans.
Scenario	1. An authority decides a specific ban. 2. The TCC broadcasts the information of this temporary traffic ban on a road / section / area. 3. Vehicles receive the message and process it. 4. If a vehicle is concerned by the ban, the message is displayed on its HMI.

	5. The driver adapts his route.

Display / alert principle	• The message needs to be broadcast as far from traffic ban section as possible to allow the users to modify his itinerary.
	• Several options on the HMI:
	  ○ Ad this information within the car navigation on a map
	  ○ Icon could be enough to explain the traffic ban. Textual message should complete the information (restricted road / section / zone and time duration)

Possible standards	• IVI
Constraints / dependencies	**Constraints:** • Inform the driver in advance to allow him to adapt his itinerary involves that vehicle has to be able to know if the message concern it. However, how to be sure that the driver is going to take the restricted road if the message is sent too far from the ban? Easy in simple cases, could be difficult in complex cases. • For complex situation, link this UC with an itinerary calculator could be necessary. • Precise geographic information is needed. • From July 2017, UE directive enforces route planner to consider network manager information. Nevertheless, some TCC are not disposed / able to send this kind of information. • Language issue in case of textual message • In the case of a traffic ban near the limit of two roads operators' networks, how to manage the dissemination? **Dependencies**: • There are some dependencies with use cases D9.

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H3 – Dynamic Lane Management – Reserved lane (I2V2I)

H3 – Dynamic Lane Management	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	• The service is to inform drivers of the presence of a reserved lane on a designated section, and to notify if they can use it, according a vehicle's feature chosen by the road manager. • In parallel, vehicles send its own features to the road manager. This probe vehicle data helps the road manager to manage the dynamic lane according the traffic type.
Background	• Currently, dynamic lanes need to be clearly identified in the field by signalization. With this service, it would be possible to implement easier dynamic lane on the network.
Objective	• Inform the user of a dynamic lane opening and notify him if his vehicle is allowed or not to use it. • Get for the road manager precise information on real-time traffic on the designated section, in order to better manage the lane and to better know traffic.
Desired behaviour	• Only authorized vehicles use the reserved lane. • The authorities know some key features (occupancy average rate for example), to optimize and measure the impacts of its mobility policy.
Expected benefits	• Better awareness and safer traffic • Traffic optimization (Road operators could use in real time the information to improve the management of the dynamic lane) • Authorities get information on traffic which can be useful for statistics and to know how the road is used (e.g.: vehicle occupancy rate)
Use case description	
Situation	Two initial situations can be encountered: • the lane(s) is open to any vehicle and restricted to one or more categories of vehicles at times. • the lane(s) is closed to all vehicles (e.g. auxiliary track BAU A4 / A86) and authorized to one or more categories of vehicles at times. Expected using situation: • High Occupancy Vehicle (HOV) lane • Bus and Taxi reserved lane • Eco-friendly vehicle reserved lane
Logic of transmission	**I2V2I Logic, Broadcast then Unicast** 1. **I2V in broadcast:** Infrastructure send in broadcast information on the presence of the dynamic lane, its status (open / closed), and the vehicle concerned**.** 2. **V2I in unicast:** Vehicle send back to the infrastructure, in unicast, data about its type/characteristics and about its reserved lane utilization.

Actors and relations	• **The sender** is the TCC (or more globally, authorities).
	• **The end-receiver** is the driver and the road operator.
	• **Information providers:**
	  ○ Road operator in the TCC for the I2V information
	  ○ Vehicles sensor / characteristics for the V2I information

Scenario	1. Dynamic lane characteristics are broadcast by the road manager in a specific area to all vehicles (presence of a dynamic lane, status (open / close), vehicle

	concerned) 2. Vehicles going through the area process the information received: ○ If the dynamic lane is open, display on the HMI whether or not the driver can use it (taking into account its own characteristics) ○ If the dynamic lane is closed, nothing is displayed on the HMI. 3. It does not matter whether the lane is open or closed, vehicles send information on its characteristics relevant to the dynamic lane. Information can be occupancy rate, emissions level, etc. 4. In function of the probe vehicle data, the road manager can decide to open / close the dynamic lane, to adapt the features of the lane, etc.
Display / alert principle	• Messages from infrastructure need to be broadcast upstream the dynamic lane in order to drivers to adapt their behaviour. • Several options to display on the HMI: ○ Within car navigation system ○ Icon + text message
Possible standards	• For I2V messages, standards used depend on the option chosen for the display: MAP or DENM • For V2I messages, it can be done through CAM or DENM.
Constraints / dependencies	**Constraints:** • For HOV lane, vehicles need to be equipped on a passenger presence sensor • For environmental restriction, vehicles need to know their own motorization type. • For Taxi and bus lane, vehicles need to know if they are is a Taxi or a bus • Vehicles that are not concerned by the reserved lane need to know their own type to notify to the drivers that they are not allowed to use it. • Normative evolution (CAM or DENM) is needed for V2I communication to allow vehicle to send its own type. **Dependencies:** • Dependencies with H4 use case

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H4 – Dynamic Lane Management – Reserved Lane (I2V)

H4 - Dynamic traffic lane management – reserved lanes	
Type of road network	**RCS**
Type of vehicle	**All**
Use case introduction	
Summary	The road operator restricts the use of one or more lanes to a certain category of road users and transmits the information sufficiently upstream. The vehicle receiving the information does not necessarily known by its own if it is affected by the restriction.
Background	• Currently, dynamic lanes need to be clearly identified in the field by signalization. With this service, it would be possible to implement easier dynamic lane on the networks.
Objective	• Inform the user of a dynamic lane opening and notify him if his vehicle is allowed or not to use it.
Desired behaviour	• Anticipation of a possible change of lane if concerned
Expected benefits	• Traffic regulation • Better comprehension by road users, implying a better respect of the reserved lane.
Use case description	

Situation	• Two initial situations can be encountered:
	  ○ the lane(s) is open to any vehicle and restricted to one or more categories of vehicles at times.
	  ○ the lane(s) is closed to all vehicles (e.g. auxiliary track BAU A4 / A86) and authorized to one or more categories of vehicles at times.
	• This case of use does not concern the closure of lanes to all the categories of road users.
	
	• Expected using situation:
	  ○ High Occupancy Vehicle (HOV) lane
	  ○ Bus and Taxi reserved lane (e.g. Bus lane in Grenoble)
	  ○ Eco-friendly vehicle reserved lane (e.g. Crit'Air)

Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **The road operator,** through its Traffic Control Center (TCC), is the sender of the message. It can be done by a TCC operator or by an automatic system. • **The vehicle driver** is the end-user of the service. • The information provider is the road operator in the TCC (may get the information of a reserved lane activation need through an automatic system).
Scenario	1. Reserved lane characteristics are broadcast by the road manager in a specific area to all vehicles (presence of a dynamic lane, status (open / close), vehicle concerned) 2. Vehicles going through the area process the information received. Depending on the vehicle's equipment, the vehicle detects whether it is affected or not. 3. Display to road user whether the lane(s) is (are) open or closed, and the categories permitted.

Display principle / Alert logic	• Several options to display on the HMI:
	  ○ Within car navigation system
	  ○ Icon + text message
	• If the vehicle is able to identify whether it is affected by the characteristics of the reserved lane, the display may be more intrusive.

Possible standards	• IVI standard, or MAP.

Constraints / Dependencies	**Constraints:** • For HOV lane, vehicles need to be equipped on a passenger presence sensor • For environmental restriction, vehicles need to know their own motorization type. • For Taxi and bus lane, vehicles need to know if they are a Taxi or a bus • Vehicles that are not concerned by the reserved lane need to know their own type to notify to the drivers that they are not allowed using it. **Dependencies:** • Dependencies with H3 use case.

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H5 – Dynamic Lane Assignment

H5 – Dynamic Lane Assignment	
Type of road network	**All (non urban)**
Type of vehicle	**All**
Use case introduction	
Summary	The road operator closes one or more lanes and transmits the information sufficiently upstream.
Background / added values	• Currently, dynamic lanes need to be clearly identified in the field by signalization. With this service, it would be possible to implement easier dynamic lane on the networks. • The signaling is thus better for the users, and it would be possible in the long term to limit the number of VMS in the field.
Objective	• Allow the user to anticipate a change of lane
Desired behaviour	• Change of lane
Expected benefits	• Safety: the main difference in comparison to the H4 use case is that the lane(s) is closed to any type of vehicle, requiring greater user alertness to change lanes.
Use case description	
Situation	• Auxiliary lane • bridge (e.g. Aquitaine bridge) or tunnel • Reversible lane
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **The road operator,** through its Traffic Control Center (TCC), is the sender of the message. It can be done by a TCC operator or by an automatic system. • **The vehicle driver** is the end-user of the service. • **The information provider** is the road operator in the TCC.
Scenario	1. The TCC closes a lane (either manually by an operator or automaticaly by some field detection systems) or assigns to it a specific way of circulation. 2. The TCC transmits the information in broadcast (open / closed lanes, way of circulation) 3. The vehicle receives, processes the information and displays it to the user.
Display principle / Alert logic	• Icon + text message. • The alert needs to be more intrusive than for the H4 use case.
Possible standards	• IVI or IVS • DENM • MAP
Constraints / Dependencies	• Since the lane is closed to any vehicle (or is in the other direction), there is an absolute necessity to increase vigilance compared to the H4 use case.

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H6 – HGV overtaking ban

H6 – HGV overtaking ban	
Type of road network	**Dual carriage way**
Type of vehicle	**HGVs**
Use case introduction	
Summary	This service informs HGVs drivers of a permanent, variable or dynamic overtaking ban on a specific road section.
Background	• To inform users about the overtaking ban via the HMI permits a better respect of the ban, and thus, to improve security and traffic management. • Moreover, this service would be able to to transmit the overtaking ban information to the user at all time in the concerned road section.
Objective	• The aim is to inform users of a specific overtaking ban. • The objective is not to control them.
Desired behaviour	• Drivers do not overtake when it is forbidden.
Expected benefits	• Better respect of regulation (better awareness) • Better road safety
Use case description	
Situation	• Permanent HGVs overtaking ban on a specific road section • Variable HGVs overtaking ban on a specific road section • Dynamic HGVs overtaking ban on a specific road section
Logic of transmission	I2V logic, broadcast.

Actors and relations	• **The Road operator** is the sender of the information TCC), or more globally, **authorities**.
	• **Vehicle drivers** are the end-users of the service.
	• **Information provider:**
	  ○ Road operator
	  ○ Others Road operators
	  ○ Law enforcement
	  ○ City
	  ○ Departments
	  ○ Authorities know permanent traffic bans.

Scenario	**<u>Permanent HGV overtaking ban:</u>** 1. The TCC broadcasts an information of a permanent overtaking ban on a road section. 2. Vehicles receive the message and process it. 3. If a vehicle is concerned by the ban (HGV), the message is displayed on the HMI. 4. The driver adapts his behaviour. **<u>Variable HGV overtaking ban:</u>** 5. The TCC broadcasts an information of a variable overtaking ban on a road section. 6. Vehicles receive the message and process it. 7. If the variable ban is active, and if the vehicle is concerned by the ban (HGV), the message is displayed on the HMI. 8. The driver adapts his behaviour. **<u>Dynamic HGV overtaking ban:</u>** 1. An authority or road operator decides a specific dynamic HGVs overtaking ban. 2. The TCC broadcasts the information of this temporary overtaking ban in the

	specific area 3. Vehicles receive the message and process it. 4. If a vehicle is concerned by the ban (HGV), the message is displayed on the HMI. 5. The driver adapts his behaviour.

Display / alert principle	• 2 Options on the IHM:
	  ○ Ad this information within the car navigation on a map
	  ○ Icon could be enough to explain the overtaking ban. Textual message should complete the information (restricted road section and time duration)

Possible standards	• MAP • IVI
Constraints / dependencies	**Constraints:** • Precise geographic information is needed. • Language issue in case of textual message • In the case of an overtaking ban near the limit of two roads operators' networks, how to manage the dissemination? **Dependencies:** • There are some dependencies with use cases C2 ("in vehicle dynamic signage") from scoop@f project. However, this service is a specific information (dynamic or permanent overtaking ban information) send to specific vehicles (HGVs).

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H8 – Vehicle entering a non-autonomous zone

H8 – Vehicle entering a non-autonomous zone	
Type of road network	**All**
Type of vehicle	**Automated vehicles (level 4 or 5)**
Use case introduction	
Summary	The service is to inform the automated vehicle that it is entering a zone where the road operator advises against the use of a fully automated driving system.
Background	• Today, automated systems of level 4 SAE capabilities have been tested through numerous experimentations. An automated vehicle is considered level 4 SAE if it can perform fully automated driving in specific conditions like in designated area or generic areas that respect a series of predefined characteristics. • The benefit of this use case is to help the automated vehicle to know if it can use its automated system or handover to the driver in a specific area. • The French “Strategic Orientations for Public Action” on autonomous vehicles states the fact that the sections of infrastructure "opened to automated driving" are not to be defined by road operators. However, they may assist the vehicles on their process to recognize whether the area is safe for an automated system or not, eventually through connectivity.
Objective	The objective is to advise the automated vehicles on their choices of delegation mode in a specific area.
Desired behaviour	The system receiving an alert by a road operator on the fact that the area is not safe for an automated system is expected to handover the driving to the human driver. If not, it would be necessary that the system gets more careful and lowers the speed of the vehicle by itself.
Expected benefits	• Increase safety, security • Facilitate the use of automated vehicles and the recognition of its operational design domain
Use case description	
Situation	An automated vehicle is entering a zone where the infrastructure is connected and the road operator has decided the area is not safe for an automated system to have control of the vehicle. The zone could include a thin road or a road where road markings are deteriorated for example.
Logic of transmission	I2V broadcast
Actors and relations	• **Road operator**: the road operator, from the TCC, is the sender of the message. • **The vehicle driver or system** is the end user of the service. • **Information provider**: ○ The transport operators and manufacturers may inform the road operators about the problematic situations regarding automated vehicles.
Scenario	1. The road operator knows, updates and broadcasts in real time the areas where an automated system of driving is not recommended. 2. An automated vehicle approaches or enters one of these predefined areas. 3. The vehicle receives the message and decides whether it should warn the driver, handover the driving manoeuvres or handle the situation by itself.
Display principle / Alert logic	The driver can be alerted via an HMI if it needs to take back the control of the car or not.
Possible standards	• DENM • MAPEM
Constraints /	**Constraints:**

Dependencies	• Define necessary criteria that imply that a vehicle cannot drive through an automated system. • The road operator/PTO should continuously monitor survey the quality of the road/environment/elements in the designed areas. **Dependencies:** • Strong relation between the advancement of the technology of AD and the definition of the zone where the AD can be performed.

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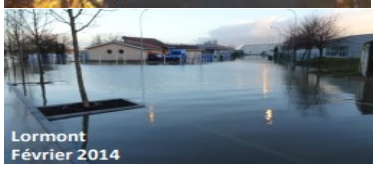
H9 – Flooded roads

H9 – Flooded roads	
Type of road network	**All**
Type of vehicle	**All vehicles**
Use case introduction	
Summary	The service consists of alerting road users of flooded road sections, after an estuarine flood warning has been issued. The intervention agents share also information on the implementation (or adjustment) of the operational plan (feedback from the field), which is aggregated for monitoring the operating system.
Background / added values	The agglomeration of Bordeaux is affected by river-sea flooding from both the rivers (Garonne and Dordogne) and the ocean during a storm event. The flood phenomena result from a complex combination[1] of these different parameters. A large number of roads[2] in the metropolis area are located in flood zones. Approximately 40 km of roads were identified as not passable[3] for the average event. The last major flood in February 2014 raised awareness of the need for greater anticipation in terms of crisis management, to ensure continuity of road services.    Roads closed and deviations set up during estuarine flooding episodes (ONI: Bègles Floirac sector)  Four reference flood scenarios[4] have been mapped and form the basis of **the flood response plan** (plan for the continuity of public road services): triggering the deployment of the alert, road closures and the communication and information sharing system. The intervention plan can also be activated during sudden events (e.g. violent storms, intense rainfall, ...) in specific areas[5].

[1] Hydrodynamic modelling of fluvio-maritime events is operational; it has made it possible to define the four hydraulic reference events, and can be used for forecasting simulations (13,500 ha located below the highest water level of the Garonne, i.e. ¼ of the territory and 17 communes; 125 km of roads for the frequent flooding event and nearly 500 km for the average event)

[2] Number of km to be confirmed

[3] A "classic" car is no longer manoeuvrable (starts to float) at a water height of 0.3 m and/or at a speed of more than 0.5 m/s. The passability of flooded roads is characterised by 4 classes.

[4] Event#1 : 4.40 m NGF < water height< 5.10 m NGF ; Event#2 : 5.10 m NGF =< water height ; Event#3 : 5.20 m NGF =< water height ; Event#4 : 5.40 m NGF =< water height. The water level is measured at the Bordeaux tide gauge.

[5] E.g. in sensitive areas such as the Bd Entre deux Mers basin, riverside roads, quays, hopper, …

	The deployment of the alert is gradual depending on the event or its evolution: - Activation of the on-call teams and monitoring of the riverbanks and related roads (24-hour and seasonal watch) in the vicinity of the events and on the known sensitive sectors (Event #1). - Activation of the metropolitan crisis unit from event #2 and on the decision of the executive, then implementation of the operational plan adapted to the scenario (#2, #3, #4). - Alerting the municipalities. **The operational plan** also includes, in a gradual manner, the programmed closure of sections of roads with the installation of appropriate signage (major roads and plans for each municipality), and associated diversion routes. Road operators are present on the ground in certain sectors to assess the situation and trigger partial or total road closures (injunction or programmed closure). The presence in the field also makes it possible to detect the need to readjust the plan locally according to the hazards (situation of a dike, hydraulic valve, surge caused by ships in the port area, etc.). It also allows to end the alert. This plan also aims to optimise the impact on traffic, which is very sensitive (e.g. riverside roads), especially as the flood phenomenon is correlated with the tide and can last for several days at a time, thus affecting the morning and/or evening traffic rush hours. The traffic manager is closely involved (Traffic Control Center - TCC). **The communication and information-sharing system** covers the following items : - Internally within the Bordeaux Metropole services, with communication via the Tetra radio network and the broadcasting of situation bulletins. - With the municipalities as part of their crisis management organisation via a dedicated Tetra radio network. - And communication to the people via the radio and print media, and social networks. The added value of the service is to provide relevant real-time information about flooded roads directly in vehicles, with alternative route, where and when appropriate. Road operators also have the possibility to provide information from the field and to enrich the dynamic visualization of the system implementation. The risk manager has an additional focus on on street parking (and some off-street parking) areas which could be concerned by flooding and depending on scenario. This concerns more particularly the right bank of Bordeaux (Quais de Queyries sector), where parking spaces are preventively closed, and fallback parking areas proposed.
Objective	• Enable the driver to anticipate the neutralization of a road section and adapt his route and / or driving according to the traffic conditions related to flood. • Complete the communication and information sharing system: ○ Internally within the departments and units of Bordeaux Metropole as well as with the municipalities, with the feedback of information from the field, ○ Then towards the road users.
Desired behaviour	• If necessary, the well-informed driver adapts his driving, increases vigilance, changes his route, or decides to park waiting for better conditions. • The road operator can manage a mass dissemination of relevant information. • The TCC has real-time information on the implementation of the operational plan and can take measures on the related routes.
Expected benefits	• Well informed driver about the risk of flooded roads, as close to the field as possible, and about the disrupted traffic conditions. • Greater anticipation and vigilance of the driver, to facilitate a possible change of route. • Increased road safety under the circumstances. • Interesting digital medium for mass dissemination of information. • Enabling greater anticipation and vigilance, as close to the field as possible to facilitate a possible change of route. • Improved RT information flow.

Use case description	

Situation	• Flooding in estuarine area, monitored by the risk manager.
	  ○ Characterisation of the flood event
	  ○ Analysis and forecasting, engagement of the on-call system.
	• Alerting system and implementing the operational plan.
	• GIS layer dedicated to metropolitan roads likely to be flooded, associated closure and diversion plans:
	  ○ Temporary road sign expected to be installed on geolocated site (or field injunction).
	  ○ Necessary field resources.
	  ○ Direction of the associated diversions route.
	• Rerouting on the network of another road operator.
	• Rerouting requiring coordination between several road operators.
	• Closure of the usual flooded parking areas and proposition of alternative parkings.

Logic of transmission	I2V Logic, Broadcast
Actors and relations	• Sender is an operator/the on call team in the TCC • End-receiver is the vehicle driver • Sources of information can be : weather stations / weather forecast, road operator, on-call team, other vehicles which have detected the danger, metropolitan crisis unit
Scenario	1. The risk manager has defined the flood characteristics and an operational response plan. 2. The risk manager triggers the on-call team according to the announcements/forecasts. 3. The on-call team implements the surveillance system. 4. The risk manager (or the on-call manager) deploys the alert if necessary. 5. The road operator implements the operation plan (lane closures and predefined deviations) and the communication system. 6. The road operator adapts the plan locally, if necessary, according to the circumstances (closure on injunction). 7. The road operator reports on localized situations in order to have an aggregate and up-to-date follow-up of the implementation of the operational plan. 8. Vehicles approaching a neutralized road section receive the alert message and display it to drivers who react according to the situation. 9. Vehicles follow the proposed diversions routes if necessary. 10. Vehicles approaching a closed parking area receive the alert message and display it to drivers with proposition of alternative parking. 11. Vehicles follow the proposed alternative parking if necessary.
Display principle / Alert logic	• When planning his journey or at the beginning of his trip, the user is informed of the flood alert. • When approaching the site of Road hazard warning the user receives an alert to allow it to adjust its speed and trajectory (with a higher anticipation to allow the change of route if necessary). • Messages are sent sufficiently in advance to drivers, with a high display priority.

	• These messages should be clear and users should have no difficulty in understanding them.
Possible standards	• DENM • MAP • IVI / IVS
Constraints / Dependencies	The messages communicated to the vehicle must match the situation on the field, so as not to discredit the system and to maintain user confidence.

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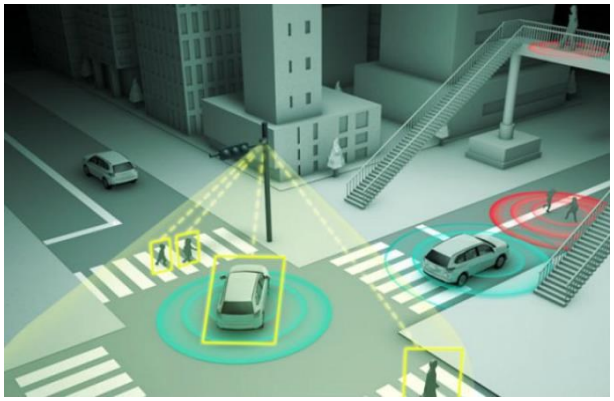
I – Vulnerable users

I1a – Pedestrian violating the right of passage - warning to vehicles

I1a – Pedestrian violating the right of passage - warning to vehicles	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	The service, based on infrastructure analysis, intends to prevent risks of collision between a pedestrian and a vehicle by warning relevant drivers of approaching vehicles when a risk of collision is identified.
Background	• There are a lot of collision between cars and pedestrians in urban areas. • Some available commercial systems (ex. collision avoidance systems) have been developed by vehicle manufacturers for several years. However, current systems suffer from several challenges, especially the pedestrian recognition.
Objective	• The objective is to warn drivers of approaching cars that a pedestrian is on its trajectory (violating the pedestrian signal) and is crossing the road whereas the signal is green for vehicles.
Desired behaviour	• The driver adopts an anticipatory action by slowing down and becoming vigilant of the crossing pedestrian.
Expected benefits	• Improving vehicle-pedestrian interactions in urban areas • Decreasing the number of accidents and conflicts in dense urban areas • Increasing safety
Use case description	
Situation	• Intersections with marked zebra and traffic/pedestrian lights**.** Intersections have to be chosen because of a high density of pedestrians and vehicles (commercial areas, schools, etc.) where accidents and conflicts take place between road users.
Logic of transmission	I2V logic, Broadcast
Actors and relations	• **Infrastructure** is the initiator of the service and send the message. • **Vehicles approaching** the intersection are the end-user of the service. • **Pedestrian** is not aware of the exchange of information. • **Sources of information**: Data is collected through cameras placed at the intersection. Cameras and algorithms now make it possible to distinguish a pedestrian finely and quickly in the visual scene.
Scenario	1. A pedestrian is crossing an intersection against the red man light 2. The infrastructure detects the pedestrian and sends by broadcast a message to all surrounding vehicles. The message informs and warn about the presence of a pedestrian who is violating the signal on the concerned intersection. 3. Vehicles surrounding approaching receive the message. Each vehicle does a treatment, in order to determine if the vehicle is approaching the pedestrian and if there is a risk. 4. If the vehicle detects a risk, a warning message is display ton the driver signaling the presence of a pedestrian on its trajectory. 5. The driver reacts to the message by adopting a safe behaviour.

	 *(Source: https://www.asmag.com/showpost/21548.aspx)*
Display / alert principle	• Messages are sent as soon as possible to the drivers, with a high priority of display. • These messages will have to be clear and users may experience no difficulties to understand them
Possible standards	• DENM • MAP
Constraints / dependencies	**Constraints:** • This use case can be difficult to implement if too many pedestrians are crossing the intersection against the red light in the same time. • The use case requires online data processing. • Guaranty no delay between online data camera processing and the transmission of the message on the driver HMI. • The case where a pedestrian is crossing the intersection with a green light, and a vehicle is approaching also with a green light (turn on right) with a risk of collision is not treated by this use case. However, this situation is particularly risky. • Zebra non-equipped by traffic/pedestrian lights, and mid-block crossing (i.e. the road sections between the intersections) could also be concerned in a more generic use case, but implementation issues would be harder. **Dependencies:** • A link may be done with G3 and D13 use cases.

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I1b – Pedestrians waiting at signalized intersections – safety recommendation to vehicles

I1b – Pedestrians waiting at signalized intersections – safety recommendation to vehicles	
Type of road network	**Urban area**
Type of vehicle	**All**
Use case introduction	
Summary	The service, based on infrastructure analysis, intends to prevent risks of collision between pedestrians and a vehicle by sending a safety recommendation to relevant approaching vehicles when a critical number of pedestrians is detected. The service wil be provided at signalized intersections identified as major by the road operator.
Background / added values	• There are a lot of collision between cars and pedestrians in urban areas • Some available commercial systems (ex. collision avoidance systems) have been developed by vehicle manufacturers for several years. However, current systems suffer from several challenges, especially the pedestrian recognition.
Objective	• The objective is to warn drivers of approaching cars that an important number of pedestrians is waiting at the red light in a signalized intersection.
Desired behaviour	The desired behaviour is to make the road user be more vigilant when crossing the intersection.
Expected benefits	• Improving vehicle-pedestrian interactions in urban areas • Decreasing the number of accidents and conflicts in dense urban areas • Increasing safety
Use case description	
Situation	Intersections with marked zebra and traffic/pedestrian lights. Intersections have to be chosen because of a high density of pedestrians and vehicles (commercial areas, schools, etc.) where accidents and conflicts take place between road users.
Logic of transmission	I2V logic Broadcast
Actors and relations	• **Road operator** is the initiator of the service and sends the message. • **Vehicles approaching** the intersection are the end-user of the service. • **Pedestrian** is not aware of the exchange of information. • **Sources of information:** Data is collected through cameras or sensors placed at the intersection. Cameras and algorithms now make it possible to distinguish a pedestrian finely and quickly in the visual scene.
Scenario	1. The detection system acknowledges the number of pedestrians waiting at the red light is over a defined threshold. 2. The infrastructure broadcasts a message to all surrounding vehicles. The message informs and warns about the presence of an important number of pedestrians at the intersection. 3. Vehicles approaching receive the message. A safety recommendation message is displayed to drivers signaling that they should be cautious when crossing the intersection. 4. The driver reacts to the message by adopting a safe behaviour.
Display principle / Alert logic	• Messages are sent as soon as possible to the drivers, with a high priority of display. • These messages will have to be clear and users may experience no difficulties to understand them.
Possible standards	• IVI • MAP

Constraints / Dependencies	**Constraints** • The use case requires online data processing. • Guarantee reliability of information processed by the algorithm at the activation of the transmission of the message on the driver HMI. • Zebra non-equipped by traffic/pedestrian lights, and mid-block crossing (i.e. the road sections between the intersections) could also be concerned in a more generic use case, but implementation issues would be harder. • A prioritization between the different C-ITS messages will be needed. • Be careful not to distract the driver by too many messages in dense urban environment and especially at proximity of intersections. **Dependencies:** • Link to I1a use case warning about pedestrians violating the right of passage.

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I2 – Pedestrian at signalized intersection: warning to pedestrian

I2 – Pedestrian at Signalized Intersection: warning to pedestrian	
Type of road network	**Urban areas**
Type of vehicle	**Pedestrian**
Use case introduction	
Summary	The service, based on infrastructure analysis, intends to prevent risks of collision between a pedestrian and a vehicle, by warning the pedestrian when a risk is identified.
Background	• Although many vehicle manufacturers have developed some available commercial systems (ex. collision avoidance systems) for several years, none of them provides alerts for pedestrians to avoid traffic collisions. • Sharing position among neighboring users is another solution for pedestrian safety but most of the available works suffer positioning information, which is difficult for pedestrians. • None of the pedestrian aids available on the market (e.g., navigation applications like Google maps) provides safety information for pedestrians that can help them adopt safer street-crossing behaviours and make safer crossing decisions.
Objective	• The objective is to warn pedestrian crossing an intersection against the signal (and equipped with the system) that a vehicle is dangerously approaching his walking path, with a high risk of collision if no evasive action is taken.
Desired behaviour	• The pedestrian will have to become more attentive to the approaching traffic and adapt his behaviour (for example, by accelerating). Potentially, an evasive action will be necessary.
Expected benefits	• Improving vehicle-pedestrian interactions in urban areas • Decreasing the number of accidents and conflicts in dense urban areas • Increasing safety • Helping pedestrians choose a safe gap for crossing, mostly for older pedestrians who are known to be particularly at-risk
Use case description	
Situation	• Intersections with marked zebra and traffic/pedestrian lights. Intersections have to be chosen because of a high density of pedestrians and vehicles (commercial areas, schools, etc.) where accidents and conflicts take place between road users.
Logic of transmission	P2I2P logic, Unicast

Actors and relations	• **Equipped pedestrian**: the initiator of the use case is the equipped pedestrian, which enable the communication by identifying himself to the infrastructure. He is also the end-user of the service.
	• **Infrastructure** is the sender of the warning message, and detects the risk of collision
	• **Sources of information:**
	  ○ Data would be collected through cameras placed at the selected intersection(s). Cameras and algorithms now make it possible to distinguish a pedestrian finely and quickly in the visual scene.
	  ○ Message analysis (e.g. CAM) from approaching vehicle could also be used to determine if a vehicle is approaching the intersection.

Scenario	1. An equipped pedestrian is crossing an intersection against the red man light. 2. The infrastructure detects the pedestrian and detects also an approaching vehicle. 3. A warning message is immediately sent to the pedestrian, informing about the presence of approaching vehicles on his walking path or about a possible "dangerous" situation. **The warning is only based on the presence/absence of approaching vehicles towards his direction**, regardless of their approaching distance / speed (the pedestrian is not in his right by crossing against the signals, and if he does, he may not have perceived that vehicles are approaching because of a too great distance, a lack of visibility, etc). 4. Users may react to the messages by adopting safe behaviours.
Display / alert principle	• Requirements are to send these messages as soon as possible to the pedestrians. • These messages will have to be clear and users may not have trouble to understand them. Ergonomics and psychological recommendations published in the literature of ITS and humane-machine interfaces will be useful to design these messages. • Wearable haptic devices can be useful for walking, wayfinding, and street crossing since they can provide information while freeing the user's hands, ears, and eyes[6]
Constraints / dependencies	**Constraints** • Pedestrians have to be equipped by a system, which can be a smartphone. • This use case can be difficult to implement if too many pedestrians are crossing the intersection against the red light in the same time. • The use case requires online data processing. • Message to send between infrastructure and equipped pedestrian to be determined. • Guaranty no delay between online data camera processing and the transmission of the message on the pedestrian system. • Especially for older people, receiving additional visual/auditory feedback during their main task of walking can be a danger in itself, due to their cognitive limitations and their difficulty switching between different cognitive processes and information sources. Using a sensory modality other than vision or hearing is currently an alternative means of guaranteeing pedestrian safety. • The case where a pedestrian is crossing the intersection with a green light, and a vehicle is approaching also with a green light (turn on right) with a risk of collision is not treated by this use case. However, this situation is particularly risky. • Zebra non-equipped by traffic/pedestrian lights, and mid-block crossing (i.e. the road sections between the intersections) could also be concerned in a more

[6]Haptics is a feedback technology that takes advantage of the human sense of touch by applying forces, vibrations, and/or motions to the user through a haptic-enabled device that is worn or held, such as a smartphone (Jacob et al., 2012). They come in various forms, ranging from belts to vests to wristbands. IFSTTAR recently had such an initiative. Their simulator study was aimed at assessing the effectiveness of a vibrotactile device designed to help pedestrians make safer street-crossing decisions in front of approaching cars. Results showed very promising findings: the percentage of decisions that led to collisions with approaching cars decreased significantly when participants wore the wristband.

	generic use case, but implementation issues would be harder. **Dependencies:** • A link could be done with G1a, G1b and D12 use cases.

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I3 – Road Workers in the field

I3 – Road Workers in the field	
Type of road network	**Motorways**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to send a message to approaching vehicle indicating that a road agent is in operation on circulating lanes or nearby.
Background	The value of this service is to increase security for road agent and drivers when an operation has to be done on circulating lane, without operator vehicle nearby to alert vehicles of the presence of the road agents.
Objective	The aim is to deliver a message saying that a road agent is on operation on circulating lanes.
Desired behaviour	Drivers are more cautious, and adapt their behaviour (speed, trajectory, etc.).
Expected benefits	Safety, local information completing the one that can be sent by the traffic control center (TCC), visibility increased by electronics means completing yellow jackets.
Use case description	
Situation	The only condition is to be equipped. Therefore, the “road agent” can be: • a road worker • a firefighter • a police officer • a pedestrian
Logic of transmission	P2V logic, Broadcast
Actors and relations	• **The road agent,** equipped with a Portable Road Side Unit (PRSU), is the initiator of the service and the sender of messages). • **Approaching vehicles** are the end-users of the service.
Scenario	1. An equipped road agent is on the field. Prior his intervention, he has provided some information on its PRSU, at least the indication of the direction (mandatory). 2. The road agent activates his system. 3. A message with his location is sent with high frequency in Broadcast. 4. Vehicles arriving receive this message and display it on the OBU with a high priority.
Display / alert principle	• Use of highest priority messages to warn drivers and prevent accidents. • Message needs to be display on the HMI of driver in advance, in order to let them enough time to adapt their behaviour.
Possible standards	• CAM or DENM
Constraints / Dependencies	• The road agent must be equipped, and he has to provide information to his PRSU before the intervention (at least the indication of the direction of the road), which can be completed by GPS. • A low delay latency is needed, and a goot repeat frequency of messages. • Acceptance by agents of a body proximity ITS-G5 transmitter. The transmitter could be also put on the side of the road before the intervention. Study with reference health authorities of direct exposition to WIFI G5 emissions has to be done • If CAM are used, it will be necessary to make a map matching.

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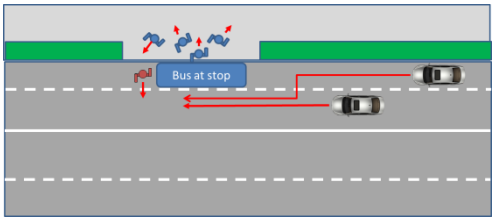
I4 – Pedestrian out of intersections and out of pedestrian crossings: warning to vehicles

I4 – Pedestrian out of intersections and out of pedestrian crossings: warning to vehicles	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	• Pedestrian crossing roads out of pedestrians crossing, outside intersections, while a vehicle is approaching. • This situation could be more dangerous when it comes to reduced mobility persons and children who can decide to cross spontaneously without checking before crossing. • The service, based on P2V analysis, intends to prevent risk of collision between a pedestrian and a vehicle by warning relevant drivers of approaching vehicles when a risk of collision is identified.
Background	• Road safety stakes for pedestrians and especially for children and mobility-reduced persons have to be evaluated. • This connected service allows to improve the pedestrian's recognition, especially children and reduced mobility persons, by anticipation.
Objective	The objective is to warn drivers of approaching cars that a pedestrian is on its trajectory, out of pedestrians crossing, and is crossing the road.
Desired behaviour	The driver adopts an anticipatory action by slowing down and becoming vigilant of the crossing pedestrian (increased vigilance, adaptation of the speed, braking and so on).
Expected benefits	Reduction of accidents, fatalities.
Use case description	
Situation	• Hurried up Pedestrians who do not take time to reach pedestrians crossings and cross the road outside it (walking or running). • Pedestrians who do not respect the rules and cross the road outside the pedestrian crossings (walking or running). NB1: the situation gets particularly dangerous when it comes to children (especially close to schools), reduced mobility persons and elderly persons (crossing slowly). NB 2: mask of visibility like darkness, rain, mist, trees, billboards, etc could increase the risk due to the bad visibility.
Logic of transmission	P2V transmission logic
Actors and relations	• **Equipped pedestrian**: the initiator of the use case is the equipped pedestrian, who enables the communication by identifying himself to the vehicles. • **Pedestrian** is the sender of the warning message. • **Driver of the approaching vehicle** is the end-received of the warning message and detects the risk of collision. • **Sources of information:** ○ Pedestrian: sensor/transmitter could be in its smartphone, its shoes or bag. ○ Children: sensor/transmitter could be in the satchel or in the shoes ○ Reduced mobility persons: sensor/transmitter could be in the shoes
Scenario	1. A pedestrian equipped with a sensor/transmitter decides to cross the road outside any regulated conditions and outside intersections. 2. The signal of presence is emitted. 3. The approaching vehicles receive the signal at a sufficient distance to inform the driver in order to get the right behaviour.

Display / alert principle	• These messages will have to be clear and users should not have trouble to understand them. • Ergonomics and psychological recommendations published in the literature of ITS and humane-machine interfaces will be useful to design these messages.
Possible standards	• CAM • DENM • CPM: Cooperative Perception message
Constraints / dependencies	**Constraints:** • Pedestrians have to be equipped by a system, which can be a smartphone, sensor/transmitter or other. They need to be able to communicate with the vehicles. • To evaluate the acceptability of such connectivity and tools by the pedestrians, especially children, reduced mobility persons and elderly persons. (Acceptability of wearing a tool, of understanding the usage, of bearing the waves, of being geolocalized, etc). • The message to send between equipped pedestrians and vehicles has to be determined. **Requirement:** • Requirements is to send these messages as soon as possible and guaranty very short delay between online data sensor/transmitter processing and the transmission of the message to the vehicle in order to display the message in due time to the drivers of the approaching vehicles.

I5 – Vulnerable user at a public transport stop

I5 – Vulnerable user at a public transport stop	
Type of road network	**Urban**
Type of vehicle	**All**
Use case introduction	
Summary	• The objective is to warn the vehicle that a vulnerable may be on its trajectory at a bus stop. • A public transport vehicle alerts that the doors are opened and that pedestrians may want to cross the road.
Background	In urban areas, especially just after bus stops, the areas are very dangerous for pedestrians because of the various masks.
Objective	• The objective is to warn drivers of approaching cars that a pedestrian may be crossing the road as some just left the bus.
Desired behaviour	• The driver adopts an anticipatory action by slowing down and becoming vigilant of the potentially crossing pedestrian (increased vigilance, adaptation of the speed, braking, etc).
Expected benefits	Reduction of accidents, fatalities.
Use case description	
Situation	• A bus stops at the bus stop and releases pedestrians. 
Logic of transmission	V2V transmission logic, Broadcast
Actors and relations	• **The public transport vehicle** is the initiator of the service and send the message. • **Vehicles approaching** the bus stop are the end-user of the service. • **Pedestrian** is not aware of the exchange of information.
Scenario	1. A bus equipped with connectivity opens its doors and the driver sends manually or automaticaly an alert. 2. The message is broadcasted to the vehicles near the bus stop. 3. The drivers of the vehicles pay more attention and slow down.
Display / alert principle	• The message will be displayed on the HMI of the vehicles. • These messages will have to be clear and users should not have trouble to understand them.
Possible standards	• DENM • CPM
Constraints / dependencies	**Constraints:** • Guaranty low delay between the event and the transmission of the message

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I6 – Pedestrian crossing outside signalized intersection: warning to vehicles approaching

I6 – Pedestrian crossing outside signalized intersection: warning to vehicles approaching	
Type of road network	**All**
Type of vehicles/users relevant to the use case	**All vehicles, pedestrians**
Use case introduction	
Summary	The service consists of warning vehicles in approach of a pedestrian crossing outside a signalized intersection (specific point identified by the traffic manager) and encouraging vehicle drivers to exercise caution.
Background / added values	• In less dense urban areas (in or outside built-up sectors), the road operator manages a good number of pedestrian crossings located outside signalized intersections, on major roads with limited speed to 50 km/h or higher (70 or 80 km/ in the absence of buildings and/or local residents access). These crossings provide access to facilities (natural areas, sports centres, leisure centres, etc.), which are sometimes not easily identifiable by vehicle drivers in these less dense areas. • This use case makes it possible to warn vehicles approaching such a specific point, in the presence of a specific proven safety issue validated by the road manager, with an alert directly on board and a reminder to the driver to be vigilant. • In such specific locations, a connected device of this type is preferable to flashing lights which have little influence on vehicle driver behaviour, or when 30 km/h zones or speed moderation measures are difficult to be credible. • The main value is to be able to issue the warning in a manner sufficiently anticipated and adapted to these specific locations and to the speed of the approaching vehicles.
Objective	• Warning drivers of approaching vehicles at a pedestrian crossing outside a signalized intersection and invite them to be vigilant. Option: possibility of real time detecting the crossing of one or more pedestrians and triggering the alert to approaching vehicles.
Desired behaviour	• The vehicle driver anticipates by slowing down and increasing his/her vigilance when approaching the pedestrian crossing. The driver should be able to stop the vehicle if necessary.
Expected benefits	• Improve interactions between vehicles and pedestrians in less dense urban areas and reduce the number of conflicts there. • Increase travel safety, avoid material or physical accidents at specific points without "over alerting" the drivers so as not to discredit the messages.
Use case description	
Situation	• Pedestrian crossings located outside traffic lights and in less dense urban areas, generally close to trip generators (natural areas, sports centres, leisure centres, etc.) • Specific point(s) selected by the traffic manager, corresponding to uncommon situations and to be selected sparingly, where a connected device is preferred to flashing lights which have little influence on user behaviour, or 30 or 50 km/h zones which are difficult to be credible.
Logic of transmission	I2V Logic, Broadcast
Actors and relations	• **The traffic Coordination Centre (TCC) :** the sender can be directly the TCC • **The road operator :** the sender can be directly the road operator, • **The vehicle drivers** are the end-users of the service and including the motorized two-wheelers,

	• **The pedestrians,** who are not aware of the situation, are the end users of the service. • **Information providers**: TCC ; road operator ; other
Scenario	1. The traffic manager has selected all the sensitive points in terms of safety on pedestrian crossings located outside traffic lights intersections. As well as the conditions for broadcasting the information (daytime, night-time, 24/24, according to a time slot evening Rush Hour, Morning RH, …). 2. The traffic manager (or the service provider) broadcasts the cautionary warning 100 m ahead to approaching vehicles, and according to the predefined conditions. 3. The approaching vehicles receive the message, and the drivers react by adapting their speed. 4. The drivers stop if one or more pedestrians cross the road. Option: possibility to equip the infrastructure to real time detect the crossing of pedestrians and send alerts to approaching vehicles.
Display principle / Alert logic	• Messages are sent sufficiently in advance to drivers, with a high display priority. • These messages must be clear, and users should have no difficulty in understanding them.
Possible standards	• DENM • IVI • MAP
Constraints and dependencies	Constraints • These messages must be targeted in specific cases, where issues are identified by the road manager on the difficulty of perceiving conflicts of use, so as not to discredit the messages of caution or replace the essential vigilance towards vulnerable peoples within built-up areas. • The corresponding data are not necessarily open (closed data). Dependencies • There are some dependencies with use cases C3 “in vehicle signage (embedded VMS)” • Option: The use case with camera-based pedestrian detection requires online data processing. In this case, it is necessary to ensure that there is no delay between the online processing of the data by the camera and the transmission of the message to the driver's HMI, as well as the technical conditions for the detection and processing of the data (compliance with the GDPR)

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I7 – Bicyle lane in opposite direction in a one way road

I7 – Bicyle lane in opposite direction in a one-way road	
Type of road network	**Urban area**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to display to the vehicle in a one-way road the information that it may meet a cyclist coming the other way.
Background / added values	• Rather than providing a new kind of information, the value of this service is to remind the road user about the circulation rule • Another benefit would be to enable the information to be displayed in the driver's own language (if possible). • It allows redundancy with physical road sign.
Objective	• Transmit to the road user information about an unusual and accident-prone urban circulation rule. • Add redundancy to an already transmitted information (road sign present at the beginning of the one-way road).
Desired behaviour	The desired behaviour is to make the road user be more vigilant.
Expected benefits	• Safety: Reduce the accident risk. • Comfort: this use case allows the information to stay present while the road user drives in the concerned road.
Use case description	
Situation	The vehicle enters a one-way road where cyclists are allowed to drive contraflow. This traffic rule is signaled at the beginning of the section with the appropriate road sign.
Logic of transmission	I2V logic Broadcast
Actors and relations	• **Road operator**: the traffic operator from the traffic control center (TCC) is the sender of the message. • **The vehicle driver** is the end user of the service. • **Information provider**: the road manager for information concerning traffic management.
Scenario	1. The infrastructure broadcasts the information. 2. Vehicles receive the information, and display it to the drivers as long as he is driving in the one-way road.

Display principle / Alert logic	• There are two main display principles:
	  ○ A pictogram to indicate that cyclists are allowed to ride contraflow in the one-way street is displayed.
	  ○ A text is displayed in addition.
	• The display time is permanent.

Possible standards	• IVI (ISO TS 19321)
Constraints / Dependencies	**Constraints** • The message should be displayed in limited zones, only when the road user is driving in a road concerned by the circulation rule. • A prioritization between the different C-ITS messages will be needed. • Be careful not to distract the driver by too many messages in dense urban environment. **Dependencies** • There are some dependencies with use cases C3 "in vehicle signage (embedded VMS)"

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J – Multimodal Cargo Transport Optimization

Summary	The Multimodal Cargo Transport Optimisation (MCTO) is a service helping the truck driver when transporting containers to a logistic hub and crossing the channel. The use cases functional descriptions from the "J" category are fully aligned with the description realized in the InterCor project.
Background	Often truck drivers have to wait for some time when they arrive to a logistic hub. This service is meant to provide a more accurate estimated time of arrival and to optimize the planning for (un)loading trucks at logistic hubs.
Objective	Optimizing the predictability of travel times for cargo transport, decreasing waiting times at logistics hubs, simplifying access to the ports and terminals.
Expected benefits	For the driver: Simplification of terminal access, gain of time, less stress, problem anticipation. For Terminal operator: Optimized truck flow management around the port. For Port authorities, reduction of the traffic volume of trucks at the entrance of the port and reduction of risks of accidents and congestion.
Use Cases	J1 : Estimated Time of Arrival (ETA) for terminal operator J2 : Dock reservations J3 : Assigning a slot to a given vehicle for cross channel trafic J4 : Information on the site's access conditions J5 : Optimal route advice for trucks J6 : Guide the truck in the port (terminal or truck parking)

J1 – Estimated Time of Arrival (ETA) for terminal operators

J1 – Estimated Time of Arrival (ETA) for terminal operators	
Type of road network	**All**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Optimization of cargo transport to logistic hubs by giving to the terminal a real-time information on truck ETA (Estimated Time of Arrival).
Background	Often truck drivers have to wait for some time when they arrive on a logistic hub. This service is meant to provide to terminal operators at logistic hubs a more accurate estimated time of arrival. When terminal operators know the ETA of the trucks, then it is possible to optimize the planning for (un)loading trucks.
Objective	For a terminal operator to be informed regularly (in real time) of the ETA of a truck, to broadcast information on port entrance, and to decrease waiting time at logistics hubs.
Desired behaviour	The terminal operators consult the ETA of trucks on a user interface taking into account real-time traffic information. The Terminal operators plan the (un)loading of trucks based on their ETA.
Expected benefits	The expected impact is a reduction in loss of time (less waiting time) for truck drivers at logistic hubs and better management of resource utilization.
Use case description	
Situation	A vehicle driver must transport a container from a storage location to a port (or to a logistic hub in general) to load it on a ship (or on another mode of transport). Truck drivers heading for logistic hubs provide to terminal operators their estimated time of arrival based on real-time traffic information. A vehicle driver must transport a container from a storage location to a port (or to a logistic hub in general) to load it on a ship (or on another mode of transport).
Logic of transmission	Provided at technical description phase.

Actors and relations	• **Truck transporter** (driver and/or service provider): provides the ETA to the terminal operator.
	• **End user**: Terminal operators at logistic hubs: receive information about Truck ETA and plan (un)loading trucks.
	• **Other**:
	  ○ **Traffic system operators**: Provide real-time traffic information.
	  ○ **Data provider**: Collects information from traffic systems and aggregates them into a single data source, which can be accessed at a data access point.
	
	The different sources of information are:
	1. The driver or the service provider: who entered information on the HMI like :
	  1. Gives information about the destination (port, terminal) of the truck,
	  2. Gives information about the container number, the booking reference, whether it is a loading or an unloading operation,
	  3. Sends the GPS position of the truck at regular intervals.
	  4. Displays information on ETA inside the truck ;
	2. The TMC (Traffic Management Centre) or Traffic system which broadcasts traffic conditions and travel time measurement ;
	3. The Terminal operator who sends information about the entrance to the port.

Scenario	<u>Main scenario</u> 1. Traffic systems provide real-time traffic information to a data access point.

	2. In the data access point real-time traffic information is available. 3. Truck drivers provide their location and destination via an HMI to the service provider. 4. This service calculates the ETA and provides the ETA to terminal operators. 5. Terminal operators use this service to plan (un)loading trucks at logistic hubs. <u>Alternative scenario</u> 1. The vehicle driver of the truck indicates his destination via his HMI. 2. The vehicle driver starts his trip. 3. The service provider receives this information, calculates an initial ETA and makes it available to the end user (terminal operator, road operator…). 4. The vehicle passes through geofenced areas. 5. The service provider receives new positions and detects the crossing of geofence zones. 6. It updates the ETA. 7. It centralizes the information to make it available to the end user. 8. Terminal operators use this service to plan (un)loading trucks at logistic hubs.
Display / alert principle	The terminal operator or port operator visualises trucks ETA and other information (container number, booking reference, etc.) on their HMI.
Possible standards	
Constraints / dependencies	The final destination (port or terminal) of the truck must be available / declared. The service relies both on the commitment of the operator and the individual use by the drivers. Privacy : • Vehicle driver must accept to be tracked if he wants to use this service because the position of the vehicle is crucial for the deployment of this service. Standardization : • Information about waiting time at entrance of a terminal or a port should be published using a standardized format.

J2 – Dock reservation

J2 – Dock reservation	
Type of road network	**All**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Optimization of cargo transport to logistic hubs by improving predictability of dock availability in time.
Background	Often truck drivers have to wait for some time when they arrive on a logistic hub. This service is meant to optimize the planning for (un)loading trucks at logistic hubs.
Objective	Decreasing waiting times at logistics hubs.
Desired behaviour	Terminal operators make a planning for (un)loading trucks based on the estimated time of arrival (ETA) of trucks. The other way around is that terminal operators release timeslots for (un)loading trucks. Transport planners make a reservation for a specific timeslot and plan a truck arriving in that timeslot.
Expected benefits	The expected impact is a reduction in loss of time (less waiting time) for truck drivers at logistic hubs. Other benefits could for terminal operators to manage the docks more efficiently.
Use case description	
Situation	Terminal operators at logistic hubs provide timeslots for (un)loading trucks at docks. Transport planners make a reservation for a specific timeslot and plan a truck arriving in that timeslot. Transport planners provide this information to truck drivers.
Logic of transmission	Will be provided at technical description phase
Actors and relations	• **Truck driver**: Receives a reservation for a timeslot at the logistic hub. Has the possibility to make dock reservations on-trip. • **End user**: vehicle driver. • **Other**: ◦ **Transport planners**: Receive available timeslots for (un)loading docks, plan cargo transport and make timeslot reservations. ◦ **Terminal operators** (at logistic hubs): Receive timeslot-reservations of transport planners and provide to a data access point available timeslots for (un)loading trucks at docks. ◦ **Traffic system operators**: Provide real-time traffic information. ◦ **Data provider**: Collects information from terminal operators and aggregates them into a single data source, which can be accessed at a data access point. Source of information: An occupancy measurement system for docks at logistic hubs.
Scenario	1. Terminal operators at logistic hubs provide available timeslots for (un)loading trucks at docks to a data access point. 2. In the data access point information about available timeslots is available and the service provides it to transporters. 3. Transport planners use this service to assign docks to trucks. 4. Transport planners reserve docks for (un)loading trucks. 5. Truck drivers receive the reserved docks on their HMI.
Display / alert principle	The end user (truck driver) receives dock reservations at logistic hubs on his HMI.
Possible standards	
Constraints / dependencies	• Available docks should be counted in a correct manner. • Reserved docks should be available at the reserved timeslot.

	• Development of an occupancy measurement system.

J3 – Assigning a slot to a given vehicle for cross-channel traffic

J3 – Assigning a slot to a given vehicle for cross-channel traffic	
Type of road network	**Logistics infrastructure**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Optimization of cargo transport to logistic hubs by dynamic status slot verification or slot reservation.
Background	During a transport by truck, the container must be programmed on another transport mode. This is done with a slot at a logistic hub, the loading date and time. Reservation before departure is optimal but must be done at the latest before arrival at the logistic hub. If this is not done, then the container arrives without any preparation which perturbs the port activities.
Objective	• Decreasing waiting time at logistics hubs and simplifying access to the port/terminal.
Desired behaviour	• A slot reservation must be made for crossing the channel. • The driver requests a slot. The infrastructure provides the available slots and the vehicle driver selects the most appropriate slot. The infrastructure receives confirmation of booking.
Expected benefits	• The expected impact is the transparency for terminal operators about the "compliance" status of approaching trucks, a reduction in loss of time (less waiting time) for truck drivers at logistic hubs and better management of resource utilization.
Use case description	
Situation	A truck has for destination a logistic hub and the container has no slot registration.
Logic of transmission	Will be provided at technical description phase.
Actors and relations	• **Vehicle driver** (sender and receiver): The truck driver interacts with an HMI to: ○ Indicate his destination ○ Ask for a slot for cross-channel traffic and visualize result • **End users:** ○ **Road operator** (receiver) ○ **Terminal operators at logistic hubs** (sender and receiver): provide available timeslots for (un)loading trucks at docks and receive information about reserved slots by truck ○ **Port authorities** (receiver): receives information about reserved slots by truck ○ **Truck companies** (receiver): receives information about reserved slots by truck ○ And **possibly service providers** that are the end-receivers of the data. • **Other:** ○ **Terminal operated carrier** (sender) provide a slot or a slot validity status.
Scenario	**Initial**: An ETA has been calculated for a truck to reach a slot managed terminal 1. The truck driver enters a slot reference, 2. The service asks for validity of the slot reference with the terminal, or the terminal operated carrier, 3. Terminal or terminal operated carrier provides slot reference validity status, 4. The service displays validity status to terminal operator or terminal operated carriers, 5. The service displays validity status to truck drivers, 6. If validity status is not correct, the truck driver can submit another reference and restart the process at stage 1.

	Secondary: 1. The truck driver doesn't have a slot reference, 2. The service asks for a slot reference with the terminal, or with the terminal operated carrier, 3. The service displays the list of slots to truck driver on his HMI, 4. Truck driver chooses and reserves a slot, 5. The service sends reserved slot to the terminal, 6. The service displays slot reference and validity status to truck driver, 7. The service displays slot reference and validity status to terminal operator or terminal operated carriers, 8. The slot reference presence is checked at each crossing of a geofence zone.
Display / alert principle	• The truck driver visualizes the reserved slot and its status.
Possible standards	

Constraints / dependencies	• Available docks should be counted in a correct manner.
	• Reserved docks should be available at the reserved timeslot.
	• The final destination (port or terminal) of the truck must be available / declared.
	• Privacy: Vehicle driver must accept to be tracked if he wants to use InterCor services because, for example, the position of the vehicle is important information for the operation of the services.
	• The GPS positioning must be active.
	• All information systems used in the different scenarios shall ensure and provide API for connection with the service Cargo Optimization to send or publish data.
	• Interfaces should be intuitive for the end user and should be available in the local language.
	• The OBU must be active:
	  ○ To provide positions in real time.
	  ○ To receive information and notifications in real time.

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J4 – Information on the site's access conditions

Prerequisites: the truck driver is declared in use case J1 and he has arrived in front of the port. Distance to be defined.

J4 – Information on the site's access conditions	
Type of road network	**All**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Give information to the driver on the site's access conditions upstream from the port like road events, parking slot information and waiting time at port entrance.
Background	When a truck is in approach of a port it needs to know the access conditions (security procedure, average waiting time…)
Objective	• Allowing the driver to better manage its arrival at the port. • Optimizing the flow of trucks around the port (thus reducing congestions or traffic jams) • Improving safety around the port (decreasing risk of accidents) • Allowing terminal operator to broadcast information on port entrance
Desired behaviour	When the driver is close to the port (distance to be defined), by request or automaticaly, the platform provides all interesting information permitting an optimized arrival.

Expected benefits	• Information on the site's access conditions permits:
	  ○ For the driver: Simplification of logistic hub access, gain of time, less stress, problem anticipation
	  ○ For the Terminal operator: Optimized truck flow management around the port
	  ○ For port authorities, reduction of the traffic volume of trucks at the entrance of the port and reduction of risks of accidents and congestion.

Use case description	
Situation	Information collection and displaying about destination terminal access state (Traffic jam, Busy access lane, Gate congestion, Accident) and real time updating according to truck progression via Geofence zone crossing.
Logic of transmission	Will be provided at technical description phase.

Actors and relations	• **Vehicle driver** (sender and receiver): The truck driver interacts with an HMI to:
	  ○ Indicate his destination
	  ○ Visualize information about terminal access
	• **End users:**
	  ○ **Traffic system operators:** provide real-time traffic information.
	  ○ **Road operator** (receiver)
	  ○ T**erminal operators at logistic hubs** (sender and receiver): send information about entrance to the port to service provider
	  ○ Possibly **service providers** that are the end-receivers of the data.
	• **Other**:
	  ○ **TMC** (Traffic Management Centre - sender) broadcasts traffic conditions
	  ○ **Parking operator** (sender) provides information on the parking lot
	
	The different sources of information are:
	• The driver who entered information on the HMI (his destination (port, terminal))
	• The OBU sends the GPS position of the truck to the service at regular intervals.
	• The TMC (Traffic Management Centre) broadcasts traffic conditions and travel time measurement.
	• The parking operator provides information on the parking lot.
	• The Terminal operator sends information about the entrance to the port.

Scenario	1. The service detects the crossing of a geofence zone by a truck driver for which the terminal of destination is identified 2. The service requests information from different providers about terminal access 3. The service sends the information to the driver 4. This process is done at each geofence zone crossing
Display / alert principle	The HMI presents a map with information about access conditions: traffic and road events, location of parking lots, waiting time at entrance of port
Possible standards	

Constraints / dependencies	• The final destination (port or terminal) of the truck must be available / declared.
	• Privacy: Vehicle driver must accept to be tracked if he wants to use InterCor services because, for example, the position of the vehicle is important information for the operation of the services.
	• Standardization:
	  ○ For the publication of static and dynamic parking information, it would be interesting to standardize the data format / exchange and use for example the Datex 2 standard. Also, information about waiting time at entrance of port should be published using a common format.
	• The OBU must be active :
	  ○ To provide positions in real time.
	  ○ To receive information and notifications in real time.
	• The GPS positioning must be active.
	• Static and dynamic parking information must be available.
	• Information about waiting time at entrance of port must be available.
	• All information systems used in the different scenarios shall ensure and provide API for connection with the service Cargo Optimization to send or publish data.
	• Interfaces shall be intuitive for the end user and shall be available in the local language.

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J5 – Optimal route advice for trucks

J5 – Optimal route advice for trucks	
Type of road network	**All**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Optimization of cargo transport from logistic hubs by providing optimal routes.
Background	During traffic jams, road operators want to reduce the inflow and logistic companies do not want any delays. Providing information on traffic jams, both goals can be achieved.
Objective	Reduction in loss of time for trucks caused by traffic jams and a reduction of traffic jams (in time and distance).
Desired behaviour	Truck drivers on-trip change their original, delayed routes.
Expected benefits	The primary expected impact is a smoother route for the truck driver and therefore less loss of time (and money) for the transporter. The secondary expected impact is a shorter duration of traffic jams.
Use case description	
Situation	Truck drivers receive real-time traffic information and choose, in case of traffic jams on their route, another available route.
Logic of transmission	Will be provided at technical description phase

Actors and relations	• **Vehicle driver**: The truck driver receives his route, based on real-time traffic information.
	• **End user**: see vehicle driver.
	• **Other**:
	  ○ **Traffic system operators**: Provide real-time traffic information.
	  ○ **Data provider**: Collects information from traffic system operators and aggregates them into a single data source, which can be accessed at a data access point.
	
	Source of informatio : Travel time measurement systems.

Scenario	1. Traffic systems provide real-time traffic information to a data access point. 2. In the data access point information on real-time traffic information is available. This service provides real-time traffic information. 3. Truck drivers adapt their routes based on real-time traffic information.
Display / alert principle	The end user (truck driver) receives his optimal route on his HMI.
Possible standards	
Constraints / dependencies	• Truck drivers receive real-time traffic information and choose, in case of traffic jams on their route, another available route. • The traffic system gains information in real-time.

J6 – Guide the truck in the port (terminal or truck parking)

Pre-requisite: the truck is declared in use case J1 and has recovered a slot in use case J2

J6 – Guide the truck in the port (terminal or truck parking)	
Type of road network	**Logistics infrastructure**
Type of vehicle	**Logistics**
Use case introduction	
Summary	Guide the trucks in the port to access a terminal or truck parking using a predefined path. If the terminal is ready the truck will be guided directly otherwise it will first be guided to a parking and then to the terminal when possible.
Background	To manage and secure truck traffic inside terminals.
Objective	• Simplifying access to the port terminal for the driver. • Reducing the time of the truck's presence in the port. • Optimizing the flow of trucks in the port (thus reducing slowdown or traffic jams) • Improving safety in the port (decreasing risk of accidents)
Desired behaviour	When the truck driver arrives to the port, on his HMI, he receives and visualizes the route he must follow to the parking or the terminal. The truck driver follows the instructions until arrival.
Expected benefits	The guidance in the port permits: • For the driver: Simplification to access terminal, gain of time, reduce early arrivals (with additional waiting time), reduce stress • For the Terminal operator: Truck flow and management on the terminal / in the port, knowing truck's position in the port • For the port: Better manage traffic flows by having the possibility to guide the truck via several paths and to several destinations (terminal, parking).
Use case description	
Situation	In the terminal, drivers are routing for better reliability and security of traffic inside terminals.
Logic of transmission	Will be provided at technical description phase

Actors and relations	• **Vehicle driver** (sender and receiver): The truck driver interacts with an HMI to:
	  ○ Indicate his destination
	  ○ Follow an itinerary to access a terminal or truck parking in a port
	• **Service provider** (sender): Map Repository Platform provides circuits to access different terminals
	• **Other**:
	  ○ **Port** (sender) sends terminal or parking destination
	
	The different sources of information are:
	• The driver who entered, on the HMI, his destination (port, terminal)
	• The OBU which :
	  ○ Sends the GPS position of the truck at regular intervals.
	  ○ Displays information on guidance in the port, etc.
	• The port who indicates the terminal or the parking where the driver must go when he enters the port.
	• The map repository platform on which the different paths for each terminal in the port are described.

Scenario	1. A driver enters a port 2. The service detects the entry of the truck in the port via a geofence 3. The service requests from the port manager the terminal or the parking where the driver must go 4. The service requests the itinerary from the Map repository platform

	5. The service detects the movement of the truck via a geofence 6. The driver HMI displays instructions in real time at each critical point of the drivers itinerary 7. The service closes action at arrival
Display / alert principle	• On the HMI, a map is displayed with graphical directions (left, right, straight, etc.) on the way to take.
Possible standards	Cellular, G5, GPS positioning, Security standards.

Constraints / dependencies	• A mapping of the port must exist.
	• Privacy: Vehicle driver must accept to be tracked if he wants to use InterCor services because, for example, the position of the vehicle is important information for the operation of the services.
	• The OBU must be active:
	  ○ To provide positions in real time.
	  ○ To receive information and notifications in real time.
	• The GPS positioning must be active.
	• Interfaces shall be intuitive for the end user and shall be available in the local language.

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K – Level Crossing

K1 – Level Crossing status

K1 - Level Crossing status	
Type of road network	**All except highway. It concerns every crossing on national railway network line according to the French ministerial decree of 18th March 1991**
Type of vehicle	**All, adapted for automated driving systems**
Use case introduction	
Summary	The human driver or the automated driving system must be able to detect the level crossing (LC) and adapt the speed and the behaviour depending the level crossing status and cross it safely or wait in front of it if necessary.
Background / added values	• Today, this information is provided only with devices of level crossing (lights, barriers, ring and panel of type A7 for automatic level crossing). • If the human driver or the automated driving system is not aware of the level crossing and its state, it can lead to accidents.
Objective	The objective is to inform road users of the LC status.
Desired behaviour	Depending of status of LC - LC out of order • For vehicles stopped at LC: Wait at the LC; • For vehicles coming: Use another way. - LC closed for train • When the road user or the automated system receives the alert, the desired behaviour is that he respects the light and stops the vehicle without engaging the railway zone; - LC in nominal mode • The road user is more attentive to the LC; the driver or the automated system can adapt the vehicle speed and behaviour if needed. • To be noted : the priority is always given to the train.
Expected benefits	Reduce the risk of collision between trains and road vehicles.
Use case description	
Situation	• A vehicle is approaching a LC. The signs (flashing red light and/or barrier) may forbid it to cross or not.
Logic of transmission	**I2V Logic, Broadcast**
Actors and relations	• **The Railway infrastructure manager** is the sender of the information[7]. • **The road user** is the end-user of the service. The road operator is also interested to be noticed about this information. • **The information** is automaticaly detected by the level crossing through specific equipment.
Scenario	1. The railway infrastructure manager informs of the localization and the status of the railway crossing, by broadcasting it to all vehicles. 2. The vehicle receives the message. 3. If the vehicle has an automated driving system, it reacts accordingly to the information received and to its embedded functions. 4. The vehicle may display the information on its HMI.
Display principle / Alert logic	• The display to the human driver needs to be early enough to adapt his speed (or even his itinerary, accordingly to the functionality of the system). However, since he should not forget about the alert, it could be repeated closer to the location. • If the vehicle has an automated driving system, the service may be invisible for the fallback driver.

[7]It does not preempt the choice for a future massive deployment.

Possible standards	• DENM • MAPEM
Functional constraints / Dependencies	**Constraints :** • End users have always the same kind of message in every vehicle whatever the brands and country origin. • The precision information to stop before the line of lights or the location where the vehicle is queuing could be poor. • Depending on the capacities of the automated driving system, additional functions may be required to ensure safe crossing as sensors (lidar, radar, cameras) or HD Maps.

K4 – Detection of a vehicle in distress on a level crossing

K4 - Detection of a vehicle in distress on a level crossing	
Type of road network	All except highway. Level crossings on national railway network line according to the ministerial decree of 18th March 1991
Type of vehicle	All
Use case introduction	
Summary	This use case permits an automatic detection of the presence of a vehicle in distress in a critical area. The critical area, previously determined by the infrastructure operator, can be a level crossing, a bridge, a tunnel...
Background / added values	For example, if the critical area is a level crossing: • Today, the railway manager has the information of the presence of an obstacle on level crossing by the train driver, and most of time the collision is unavoidable. • The benefit of this use case is to provide information in advance so that the train can stop before the obstacle.
Objective	• The objective is to alert the infrastructure manager that an obstacle is present in a critical area (the platform of the level crossing, a bridge, a tunnel...).
Desired behaviour	• No specific behaviour is expected from road users for whom the operation of the service is totally invisible.
Expected benefits	• For the infrastructure manager, the service enables the detection of a vehicle in distress in a critical area. • The collected data proves as a basis for other I2V applications which are improved or possibly otherwise impossible.
Use case description	
Situation	• Stationary vehicle on a railway platform (level crossing) • Stationary vehicle on a critical area of a tunnel • Stationary vehicle on a critical area of a bridge • An accident occurred on a critical area
Logic of transmission	V2I Logic, broadcast
Actors and relations	• **The vehicle** is the source of the information • **The infrastructure operator (roads, railways...):** ○ Determines precisely the critical areas of its networks ○ Is the end user of the service, and collects the data from vehicles. It can use the information derived from the data to provide information, warnings and advice.
Scenario	1. The infrastructure operators define precisely the critical areas of their networks (e.g. Level crossing for Railway operator) 2. A vehicle is stuck on a critical area (for example, a level crossing). 3. The vehicle sends a D4 event (Alert stationary vehicle / breakdown) 4. This information, coupled with the presence of the vehicle in a critical area, triggered a specific message to the infrastructure operator on the presence of a distress vehicle in a critical area
Display principle / Alert logic	• This use case is totally invisible for the road user
Possible standards	• CAM • DENM
Functional constraints / Dependencies	Functional constraint: • The precision information of vehicle to avoid sending false alarms Dependencies: • D4 – Alert stationary vehicle / breakdown • D5 – Alert accident area (if an accident occurred in the LC)

	• Use cases “Prove vehicle data” (category A)

K5 – Unguarded level crossing ahead

K5 – Unguarded level crossing ahead	
Type of road network	**All except highways**
Type of vehicle	**All**
Use case introduction	
Summary	The presence of an unguarded level crossing is reported to the vehicles in a close vicinity.
Background	• Today the information is only provided by vertical signalization (panel of type A8). • If the driver is not aware of the approaching unguarded level crossing, it can lead to accidents. • This use case concerns every crossings on national railway network line according to the ministerial decree of March the 18th, 1991. • The panels are different according to the distance to the level crossing: a St Andrew cross in front of the level crossing and A8 panels before.
Objective	The objective of this use case is to inform road users of the presence of an unguarded level crossing, in order for them to anticipate and increase their vigilance.
Desired behaviour	• Increase vigilance • Adaptation of the speed • Stop at the level crossing and check to the right and left whether a train is arriving before crossing
Expected benefits	• To avoid collisions between trains and road vehicles.
Use case description	
Situation	A road vehicle is approaching an unguarded level crossing.
Logic of transmission	I2V broadcast
Actors and relations	• **Information provider**: the railway infrastructure manager provides the information to the sender. • **Sender of the information**: The sender of the information may be different from the information provider. • **End user:** The road user is the end user of the service.
Scenario	1. The sender broadcasts the information to all vehicles around the railway crossing. 2. The vehicles in a close vicinity receive the message and display it on their HMI.
Display / alert principle	• The information is transmitted early enough in order to allow to the driver to adapt his behaviour. • The message is displayed on the HMI of the vehicle. Vehicles choose the way to display on the HMI, based on commonly specified communication profiles.
Possible standards	• DENM • IVI • MAP
Constraints / Dependencies	Constraints: • The sender of the information needs to be aware of the location of the unguarded railway crossing.

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K6 – Traffic restriction at a level crossing

K6 – Traffic restriction at a level crossing	
Type of road network	**All except highways**
Type of vehicle	**All**
Use case introduction	
Summary	The presence of a traffic restriction at a level crossing is reported to the vehicles in a close vicinity. This restriction can concern width, height, weight, speed of the vehicle and the type of road. It is possible to have several traffic restrictions at the same level crossing.
Background	• Today the information is only provided by vertical signalization (panels of types B11, B12, B13, B14, A2a). The panel used is different according to the traffic restrictions of the level crossing. • If the driver is not aware of the traffic restriction, it can lead to accidents. • This use case concerns every crossings on national railway network line according to the ministerial decree of March the 18th, 1991.
Objective	The objective of this use case is to inform road users of the traffic restrictions that apply at the level crossing, in order for them to choose another path if their vehicle is not allowed or to respect the restrictions such as the speed limit before crossing it.
Desired behaviour	• The road user has to ensure that he respects all the traffic restrictions. • If he cannot match the restrictions, the road user changes his path.
Expected benefits	• To avoid collisions between trains and road vehicles.
Use case description	
Situation	A road vehicle is approaching a level crossing with specific restrictions.
Logic of transmission	I2V broadcast
Actors and relations	• **Information provider**: the railway infrastructure manager provides the information to the sender. • **Sender of the information**: The sender of the information may be different from the information provider. • **End user:** The road user is the end user of the service.
Scenario	1. The sender broadcasts the information to all vehicles around the railway crossing. 2. The vehicles in a close vicinity receive the message and display it on their HMI. 3. Depending on the restrictions and the type of vehicle receiving the information, the driver may need to choose another path.
Display / alert principle	For connected vehicles: • The information is transmitted early enough in order to allow to the driver to adapt his behaviour. • The message is displayed on the HMI of the vehicle. Vehicles choose the way to display on the HMI, based on commonly specified communication profiles. • If navigation is activated and if the vehicles' characteristics are known, the navigation system can propose another path, if needed. For connected automated vehicles: • The automated system either gives the control of the vehicle back to the human driver of change its path according to the characteristics of the vehicle, if needed. • Either way, the message is displayed on the HMI of the vehicle.
Possible standards	• DENM • IVI • MAP
Constraints / Dependencies	Constraints: • The sender of the information needs to be aware of the location of the railway

	crossing and its restrictions.

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L – Law Enforcement

L1 – Identification of vehicles reported by law enforcement agencies

L1 – Identification of vehicles reported by law enforcement agencies	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The aim is to enable the police to identify and locate vehicles reported in the national and Schengen police files.
Background	• Vehicles reported stolen in France and the Schengen area are registered in databases that can be consulted by the police. These databases are currently used either manually from an interface dedicated to law enforcement agencies or from an automatic number plate recognition (ANPR) system. • ANPR is based on cameras and an optical character recognition (OCR) system. The system sometimes fails (bad weather conditions, used plates) and is ineffective when the license plates of the stolen vehicle have been changed.
Objective	• Check the serial number (VIN) of a vehicle from a mobile or static device belonging to the police force
Desired behaviour	• The controlled vehicles shall provide their serial number at the request of the mobile or static device of the police force.
Expected benefits	• Fight against trafficking in stolen vehicles – return of stolen vehicles to victims
Use case description	
Situation	• A vehicle flow passes in the vicinity of a law enforcement control device (police vehicle or static police device installed on the infrastructure).
Logic of transmission	$V_{LEA}2V2V_{LEA}$, $I_{LEA}2V2I_{LEA}$, broadcast, unicast
Actors and relations	• The control device (embedded in a police vehicle or installed on the infrastructure) sends requests to any vehicle passing in the vicinity. • Any controlled vehicle responds to the control device.
Scenario	1. The control device (embedded in a police vehicle or installed on the infrastructure) permanently transmits a request for the serial numbers of vehicles in its coverage area 2. A vehicle entering the coverage area of the control device receives the request and responds with its serial number (VIN). 3. From the VIN received, the control system queries the national and Schengen vehicle databases. 4. In the event of a positive hit, the control device sends a request to the reported vehicle to transmit its position at all times so that the police command room can track it. 5. The reported vehicle transmits its position permanently to the police forces. 6. When the vehicle is found, the police send a message to the controlled vehicle to stop the transmission of its position.
Display / alert principle	• The occupants of the controlled vehicle shall not be informed of the control (no display on the HMI).
Possible standards	
Constraints / Dependencies	**Constraints:** • The exchange of messages between the law enforcement control system and the controlled vehicles must be secured: ○ Only requests from duly authenticated law enforcement control devices must

	be processed by the vehicles checked. ○ The message integrating the VIN and the position of the vehicle must only be readable by the police.

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L2 – Stationary law enforcement vehicle

L2 – Stationary law enforcement vehicle	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The aim is to warn users that law enforcement officers are stationed on their route.
Background	• Road users despite the use of warning lights and reflective equipment do not always properly perceive law enforcement officers stationed on a roadway. The stationing of a service vehicle and the intervention of an officer on foot on a roadway are highly accident-prone situations that must be prevented by all possible means. The risk is even more important with accidents that drivers usually stop to look at. • Levels 4 and 5 of driving automation will require reliable interactions between law enforcement and road users.
Objective	• The objective of this use-case is to alert a road user that a law enforcement vehicle is intervening on a site so that the driver can adapt his behaviour.
Desired behaviour	• Increased vigilance • Adaptation of the speed • Change of lanes or vehicle stop (if needed)
Expected benefits	• Reducing the risk of accidents (for users, road agents) • Informing the road user about a risk of discomfort on the road (slowing down, maneuvering)
Use case description	
Situation	• Intervention of law enforcement on a traffic route (context: accident, public safety, public order, judicial case). The law enforcement vehicles are generally parked upstream of the intervention area and the officers are required to intervene on foot.
Logic of transmission	$V_{LEA}2V$, $V_{LEA}2I$ – broadcast
Actors and relations	• The sender is an **operating law enforcement officer** in his vehicle, or the vehicle itself (if automatic detection). • The end-receivers are **drivers around the event**. • The **officer in his vehicle** is the source of information • Messages are also transmitted to **control centres** (TCC, emergency services and law enforcement) via the infrastructure.
Scenario	1. A law enforcement vehicle stops in an intervention zone located on or near a roadway. 2. The activation of the service is possible in three cases: • If the "Law enforcement vehicle approaching" service is active, when the vehicle is stopped, the system proposes to the on-board officers the activation of the "Stationary law enforcement vehicle" service. If the service is neither validated nor refused after X seconds, the "Stationary law enforcement vehicle" service is automaticaly activated. The activation of the "Stationary law enforcement vehicle" service automaticaly deactivates the "Law enforcement vehicle approaching" service. • The warning lights are activated by an officer on board or were already activated before the vehicle stopped. The system proposes the activation of the "Stationary law enforcement vehicle" service. If the service is neither validated nor refused after X seconds, the "Stationary law enforcement vehicle" service is automaticaly activated. • The on-board officers activate the "Stationary law enforcement vehicle" service on their own initiative. • In any case, the activation of the "Stationary law enforcement vehicle" service

	is not possible if the vehicle is in motion. 3. Vehicles approaching the intervention site receive the message, process it and display the information to the driver. 4. Deactivation of the service. Two cases are possible: • If the law enforcement vehicle moves more than X metres, the "Stationary law enforcement vehicle" service is automaticaly deactivated. • The service is manually deactivated by an onboard officer.
Display / alert principle	• When the message is first received by the road user, an alert is displayed on the user's HMI: "Law enforcement on your route. Stay alert. » • Then, display of the position of the law enforcement vehicle in the user's HMI as long as the service is not deactivated and as long as the user's vehicle is moving towards the intervention zone.
Possible standards	• DENM • CAM
Constraints / Dependencies	**Constraints** • Another message could be sent by the TCC providing information on the actual event (in the event of a road accident, for example). Two messages could be then sent. See if it is possible to link dynamically the events. • The notion of users approaching the area of the law enforcement intervention depends on the road configuration (separate or not carriageways, presence of crossroads, rerouting). • Some options in the scenario require the OBU to know the operating status of the warning lights. **Dependencies** • Links are to be done with the "Law enforcement vehicle approaching" (see the scenario above). • This use case is similar to "B2b – Vehicle operator alert in intervention".

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L3 – Automated driving system status

L3 – Automated driving system status	
Type of road network	**All**
Type of vehicle	**Automated vehicles (SAE levels 3 to 5)**
Use case introduction	
Summary	The aim is to allow law enforcement to know the status of the automated driving system.
Background	• The future regulations on automated vehicles could introduce derogations for certain offences (use of a hand-held telephone, use of a screen, safety distance, etc.). The offence would then not be constituted if the automated driving system is active at the time of the event. • When an automated vehicle commits a traffic offence, such as speeding or crossing a continuous line, it is necessary to know who was in charge of driving the vehicle at the time of the offence (human driver or automated driving system). • The behaviour of an automated vehicle may differ from the behaviour of a driver, particularly when interacting with law enforcement. Knowing the status of the automated driving system would then enable law enforcement to adapt their response to the vehicle.
Objective	• Define responsibilities in the event of an alleged offence. • Enable the police to adapt their behaviour according to the status of the automated driving system.
Desired behaviour	• Communication of the automated driving system status from vehicles to law enforcement vehicles. • No specific behaviour is expected from road users for whom the operation of the service is totally invisible.
Expected benefits	• Establishing the facts • Securing interactions between law enforcement and automated vehicles
Use case description	
Situation	• A law enforcement officer or an automated traffic enforcement device (e.g. speed enforcement cameras) notices an alleged offence committed by a road user. • A law enforcement officer must interact with a vehicle in circulation (control, interception, traffic).
Logic of transmission	$V2P_{LEA}$, $V2V_{LEA}$, $V2I_{LEA}$ – broadcast
Actors and relations	• **The vehicle** is the source of the information, through its internal data. • **The end-users** of these data are the law enforcement officer or the automated traffic enforcement device, and possibly all surrounding vehicles.
Scenario	1. The vehicle regularly generates messages indicating its automated driving system status. • Several status and/or modes will potentially exist: OFF (“disengaged”), STAND-BY, ACTIVE, FAILURE, LIMITED, TRANSITION... 2. Messages from the vehicle are received by the law enforcement officer or the automated traffic enforcement device. 3. The law enforcement officer or the automated traffic enforcement device adapt their response.
Display / alert principle	• This use case is totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI. • The law enforcement officer must be able to identify a particular vehicle on his/her HMI to determine the status of the automated driving system. A display solution could consist of a dynamic map to visualize all connected vehicles and their associated information (automated driving system status, vehicle type, direction).

Possible standards	• CAM • future European regulations on the DSS-AD (Data Storage Systems for Automated Driving)
Constraints / Dependencies	**Dependencies:** • refer to the B2b use case “Alert operator vehicle in intervention”

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L4 – Location of vehicle particularly sought after by law enforcement agencies

L4 – Location of vehicle particularly sought after by law enforcement agencies	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The aim is to locate in real time a vehicle sought after by law enforcement authorities in the context of investigations of serious crimes and offences (terrorist attacks, kidnappings of minors, etc.), missing persons and fugitives.
Background	• The French Code of Criminal Procedure (article 230-32) enables the use of any technical means allowing the real-time location, throughout the national territory, of a person, without the person's knowledge, of a vehicle or any other object. • The technical means of locating vehicles available to the police are currently limited and do not systematically make it possible to find a wanted person.
Objective	• Perform a general search on the national territory or on a defined area based on a serial number (VIN) to collect the geographical coordinates of the vehicle being sought after.
Desired behaviour	• The request is sent to all vehicles in the defined area (national, regional, departmental) for a limited time. The vehicle corresponding to the serial number communicates its geographical coordinates until the service is deactivated. • No specific behaviour is expected from road users for whom the operation of the service is totally invisible.
Expected benefits	• The service enables the police to find a person wanted by the justice and/or the law enforcement agencies (person implicated in a serious crime, kidnapped person, missing person and fugitive). Given the sensitive context of the research, the time required to obtain this information has a direct impact on the safety of human lives.
Use case description	
Situation	• A judicial procedure is opened to find a person in one of the cases provided for in Article 230-32 of the French Code of Criminal Procedure: ○ an investigation into a crime punishable by at least three years' imprisonment; ○ a procedure for investigating the causes of death or disappearance provided for in articles 74, 74-1 and 80-4; ○ a search procedure for a fugitive provided for in Article 74-2. • Investigators have information on the serial number of a vehicle involved in the case. The serial number may be partial.
Logic of transmission	$I_{LEA}2V2I_{LEA}$, $I_{LEA}2V2V_{LEA}$ – broadcast
Actors and relations	• The **law enforcement operational centre** is the service initiator by sending a request message to vehicles located in a given area. • The **vehicles located in the defined area** receive the request message. • The **vehicle(s) corresponding to the total or partial VIN** sends a response message to the law enforcement operational centre and if the request message specifies it, to law enforcement vehicles located in their surroundings.
Scenario	1. The law enforcement operational centre sends a request message containing a complete or partial serial number (VIN) targeting a specific area and a flag specifying whether the response messages of the vehicle(s) concerned should be transmitted to law enforcement vehicles located in their surroundings. 2. Vehicles located in the specified area receive the message. 3. The vehicle(s) whose VIN corresponds to the request regularly send a message

	specifying their VIN, type, geographical coordinates, speed and direction every... second to the law enforcement operational centre and if the request message specifies it, to law enforcement vehicles located in their surroundings. 4. The vehicle stops sending messages when the service is deactivated by law enforcement or when the vehicle crosses a national border (unless there are cross-border agreements).
Display / alert principle	• This use case **must** be totally invisible for the road user. There are no alerts / information displayed on the vehicle's HMI. • In the event that the response message is also sent to nearby law enforcement vehicles, the location of the vehicle sought is displayed in the law enforcement HMI with the following message: “Vehicle particularly sought after in the area: contact your operational centre”.
Possible standards	• CAM, DENM
Constraints / Dependencies	• The content of the request message must not be readable by actors other than vehicles for reasons of confidentiality, especially so that the wanted person does not know that he or she is the subject of a search procedure. • For the same reasons, the response message (existence and content) must be hidden from other users outside the law enforcement agencies.

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L5a – Police instructions to a single designated vehicle

L5a – Police instructions to a single designated vehicle	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The purpose is to allow a police officer to transmit unambiguously his instructions to a designated vehicle.
Background	• Despite the processes and protection equipment implemented, traffic police instructions may not be properly perceived by road users. There are many causes: weather conditions, site configuration, driver vigilance, lack of knowledge of national procedures. • The non-respect of injunctions can then lead to accidents, hit-and-run offences, or even cases of weapon used by police officers in self-defence. • High and full driving automation will need to ensure the reliability of interactions between police patrol and automated vehicles.
Objective	• Improve the perception of traffic police instructions by the road users and automated vehicles.
Desired behaviour	• Road user and self-driving vehicle respect the instructions given by the police and act in consequence.
Expected benefits	• Safety • Operational efficiency of the police forces
Use case description	

Situation	• Several situations lead a police officer to transmit instructions to a designated vehicle, such as:
	  ○ Road control from a static station by the police;
	  ○ Interception of a vehicle by the police;
	  ○ Traffic regulation (in the case of an accident or a public order event / to facilitate the circulation of a priority vehicle / to stop an offence without issuing a ticket)

Logic of transmission	$P_{LEA}2V$, $V_{LEA}2V$
Actors and relations	• **A police officer** is the sender of the message and the initiator of the service. He can be in a vehicle or on foot. • **A single vehicle** is the end user of the service.
Scenario	1. A vehicle is driving close to a police officer. 2. The police officer transmits a particular instruction to this vehicle. 3. The message is displayed on the HMI of the concerned vehicle as long as the service is activated. 4. The designated vehicle reacts accordingly to the instruction received. List of possible instructions: • "Police: mandatory stop" • "Police: move forward" • "Police: slow down" • "Police: keep left / keep right" • "Police: turn left / turn right" • "Police: police instructions have priority over traffic lights"

	• "Police control: follow us" • "Police control: stop at the indicated control area" ○ In that case, the location where the vehicle must stop is either indicated by the agent or materialized by special equipment. • "Police: speed too low → accelerate" • "Police: speed too high → slow down" • "Police: lane straddling → stay on your lane" • "Police: vigilance → keep your attention on the road"
Display / alert principle	• The road user receives the instruction translated into his language on his HMI.
Possible standards	• CAM • DENM • IVI

Constraints / Dependencies	**Constraints:**
	• Police officers are already equipped with communication devices (smartphones, tablets), which can potentially be integrated into their vehicles. These materials can constitute the police HMI, allowing the transmission of instructions to users.
	• The service is designated to one vehicle in an area where there can be other vehicles that are not concerned. At this point, three possibilities seem possible:
	  ○ The police officer is able to identify the vehicle and to send the information only to the designated vehicle.
	  ○ The police officer broadcasts a message and the vehicle automaticaly detects whether it is concerned.
	  ○ The police officer broadcasts a message, which is displayed on the HMI of all vehicles. Each driver takes the decision on how to act in consequence.
	• The selection of the instruction as well as the choice of the vehicle concerned by the police instruction must take into account the operational constraints of the police (reactivity, concomitant use of other equipment, etc.).

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L5b – Police instructions to a group of vehicles located in a designated area

L5b – Police instructions to a group of vehicles located in a designated area	
Type of road network	**All**
Type of vehicle	**All**
Use case introduction	
Summary	The purpose is to allow a police officer to transmit unambiguously his instructions to a group of vehicles located in a designated area
Background	• Despite the processes and protection equipment implemented, traffic police instructions may not be properly perceived by road users. There are many causes: weather conditions, site configuration, driver vigilance, lack of knowledge of national procedures. • The non-respect of injunctions can then lead to accidents, hit-and-run offences, or even cases of weapon use by police officers in self-defence. • High and full driving automation will need to ensure the reliability of interactions between police patrol and autonomous car.
Objective	• Improve the perception of traffic police instructions by the road users and self-driving vehicles.
Desired behaviour	• Road users and self-driving vehicles respect the instructions given by the police and act in consequence.
Expected benefits	• Safety • Operational efficiency of the traffic police
Use case description	
Situation	• In the case of an accident or a public order event, a police officer has to direct traffic by transmitting the same instruction to a group of vehicles.
Logic of transmission	$P_{LEA}2V$, $V_{LEA}2V$
Actors and relations	• **A police officer** is the sender of the message and the initiator of the service. He can be in a vehicle or on foot. • The message containing the officer's instruction is addressed to **several vehicles in a given area** (example: any vehicle approaching an accident site, located less than X metres from the site, receives the instruction).
Scenario	1. A police patrol directs traffic in an intervention area (road accident, public order event, cultural or sporting event). 2. The policer officer sends an instruction from the following list to a group of vehicles. 3. The message is displayed on the HMI of the concerned vehicles as long as the service is activated. 4. The designated vehicles react accordingly to the instruction received. 5. The officer selects another message or disables the service: the previous message is no longer displayed. <u>List of possible instructions:</u> • “Police: mandatory stop” • “Police: move forward” • “Police: slow down” • “Police: keep left / keep right” • “Police: turn left / turn right” • “Police: police instructions have priority over traffic lights”

Display / alert principle	• The road user receives the instruction translated into his language on his HMI.
Possible standards	• CAM • DENM • IVI
Constraints / Dependencies	**Constraints:** • Police officers are already equipped with communication devices (smartphones, tablets), which can potentially be integrated into their vehicles. These materials can constitute the police HMI, allowing the transmission of instructions to users. • The service is designated to several vehicles in an area where there can be other vehicles that are not concerned. At this point, three possibilities seem possible: ○ The police officer is able to identify the vehicles and to send the information only to the designated vehicles. ○ The police officer broadcasts a message and the vehicles automaticaly detect whether it is concerned. ○ The police officer broadcasts a message, which is displayed on the HMI of all vehicles. Each driver takes the decision on how to act in consequence. • The selection of the instruction as well as the choice of the vehicles concerned by the police instruction must take into account the operational constraints of the police (reactivity, concomitant use of other equipment, etc.).

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M – Payment services

M1 – Payment service at a toll station

M1 – Payment service at a toll station	
Type of road network	**Motorways**
Type of vehicle	**All**
Use case introduction	
Summary	The service is to perform the tolling transaction automaticaly from the vehicle to the road operator.
Background	The toll payment on motorways could be performed by means of C-ITS equipment, instead of using the current DSRC tag (Dedicated Short Range Communication). This would increase the customer's experience by combining many applications in the same equipment. The same back office system as the usual tolling payment could be reused.
Objective	• Perform a secure transaction between the infrastructure and the connected vehicles.
Desired behaviour	Approaching the toll area, the driver should be notified about the availability of the tolling service using the C-ITS equipment and, about the occurrence of the transaction. The driver should approach one of the toll lanes or just cross the gantry (in case of free flow configuration).
Expected benefits	Fluidity of traffic flow, time saving, security.
Use case description	
Situation	The vehicle is approaching, crossing the toll station on motorways.
Logic of transmission	V2I2V unicast
Actors and relations	The vehicle driver or/and the automated vehicle are the end user of the use case. The road operator is in communication with the back-office system in charge of the authentication of subscribers, the toll management center, and the connected vehicles in order to: • Perceive the subscriber's mean of payment from the vehicle • Announce the availability of the tolling service to the connected vehicle.
Scenario	1. Approaching the toll area, the vehicle should be notified the service availability, and sends some information about its status to the infrastructure. 2. Closed to the toll area, the infrastructure sends a request to the concerned vehicle to send the subscriber's mean of payment. 3. The vehicle through the application sends the subscriber's mean of payment to the infrastructure (e.g. the merchant). 4. The subscriber's mean of payment has to be authenticated by the infrastructure. 5. After the authentication process, if the subscriber is authenticated, the infrastructure sends a message to the vehicle about the validity of the mean of payment. If the subscriber is not authenticated, the infrastructure notifies the vehicle as well. 6. When the transaction is terminated, the infrastructure opens the concerned barrier when the vehicle is in front of it. Then, the infrastructure notifies the vehicle to go ahead.
Display / alert principle	There is one main notification if the subscriber is well or not registered to the back office of the tolling application: • Close to the toll area, the RSU requests for payment information: ○ If the subscriber through the payment information is not authenticated, the HMI displays that the mean of payment is not correct and advises to use another mean of payment. • If the subscriber is well authenticated, in front of the barrier, the HMI displays the

	go-ahead.
Possible standards	• SAEM, CAM • IEEE Standard for Wireless Access in Vehicular Environments (WAVE) – Over-the-Air Electronic Payment Data Exchange Protocol for Intelligent Transportation Systems (ITS) • ISO 17573: Electronic fee collection — Systems architecture for vehicle-related tolling • CEN/TR 16690: Electronic fee collection – Guidelines for EFC applications based on in-vehicle ITS stations
Constraints / Dependencies	**Constraints:** • The infrastructure (eg: through RSU) has to ensure precise geolocation of the concerned vehicle (lower than one meter) to ensure the good reliability of the passage of the real concerned vehicle in the toll lane at the right place and at the right time. • The tolling transaction has to be performed in a secure way by ensuring authentication of the involved entities, integrity, confidentiality, and non-repudiation of the exchanges. **Dependencies:** • The tolling application is installed in the connected vehicle, and the subscriber's account is logged on it. • The vehicle knows that it is approaching the toll station.

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