



C-ITS SERVICE AND USE CASE DEFINITIONS

**IN-VEHICLE SIGNAGE (IVS)
[C-ROADS SUD02]**

VERSION 3.1.0

C-Roads Platform

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Version	Date	Description, updates and changes	Status
3.0.0	01.09.2025	Extracting the service categories into separate documents	Final
3.1.0	01.11.2025	Two very minor amendments regarding the new ESVN service category	Final

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Introduction

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

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

2. In-Vehicle Signage (IVS)

2.1 IVS: Service introduction

Service introduction	
Summary	In-Vehicle Signage (IVS) is an information service to inform drivers on actual static or dynamic traffic signs (or additional information mimicking virtual traffic signs) via in-vehicle systems. The traffic signs can be regulatory (mandatory) or informational (advisory).
Background	<p>The IVS service is meant to inform drivers via in-vehicle information systems about static and dynamic traffic signs mirroring physical traffic signs along the road. Additionally, further information (virtual traffic signs or additional free text) can be provided. IVS may target information to specific vehicle types. The IVS information is sent out by means of Infrastructure-to-Vehicle (I2V) communication. Today, in addition to static traffic signs, VMS systems are used by road operators to provide operational, tactical, or strategic information to drivers. Different types of variable or dynamic traffic sign systems are used, with both static pictograms and text and variable pictograms and text on:</p> <ul style="list-style-type: none"> • Variable Message Signs (VMS), including variable speed signs • Variable Text Panels (VTP) • Variable Direction Signs (VDS)
Objective	<ul style="list-style-type: none"> • More attentive driving. • Increased awareness on the content of traffic signs by providing sign information directly in the vehicle where it can potentially be presented throughout the period of its entire validity. This will severely reduce observation problems attributed to physical traffic signs, such as limited line of sight, obstructions obscuring sight of a sign or limited attention by drivers passing signs.
Expected benefits	<ul style="list-style-type: none"> • IVS allows earlier and more comprehensive information to drivers by providing continuous signage information directly in the vehicle. This should result in better adaptation to current regulations and traffic conditions, reducing the risk and severity of accidents and congestion. Overall, this should improve traffic safety. • Another benefit is the possibility to present information in the language chosen by the drivers or information only valid for the respective vehicle type (e.g., trucks), which increases the relevance of the information provided and can lead to less distraction.
Use cases	<ul style="list-style-type: none"> • Traffic Signs (IVS-TS) • Free Text (IVS-FT)

2.2 IVS: Use Cases

2.2.1 IVS – Traffic Signs (IVS-TS)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	The Vienna Convention on Road Signs makes a distinction between danger warning signs, regulatory signs and informative signs. The purpose of this use case is to inform drivers via in-vehicle information systems and Advanced Driver Assistance Systems (ADAS)-vehicles / Automated Driving Systems (ADS)-vehicles about all static and dynamic signs that are part of the Vienna Convention on Road Signs ¹ and are represented in the ISO 14823 graphic data dictionary ² for road traffic signs. And which can be indicated either on physical traffic signs along the road or in terms of virtual VMS i.e. where a physical VMS is not present.
Background	This use case enables the road operator to optimise the management of warnings, information and regulations knowing the real-time traffic characteristics. Currently, dynamic signs need to be clearly indicated on the road by signalisation, for instance via lane control signs located on (mobile) gantries. This use case makes it possible to easier apply/implement the use of dynamic regulations on the road network. The current use case description describes the situation where physical signs are present and represented in a digital way.
Objective	<ul style="list-style-type: none"> The aim is to inform drivers about current valid and applicable (dynamic) traffic signs, to improve traffic safety by using additional means and communication channels to inform drivers about traffic regulations and traffic advice otherwise provided via conventional signage on the road.
Desired behaviour	<p>Drivers can:</p> <ul style="list-style-type: none"> adapt their driving behaviour to be compliant with the applicable traffic regulations. adapt their driving behaviour/position on the road according to the information given. drive more attentive based on the warnings given. <p>In the future, the information may be used by ADAS or ADS vehicles.</p>

¹ <https://unece.org/road-traffic-and-road-signs-and-signals-agreements-and-conventions>

² <https://www.iso.org/standard/61546.html>

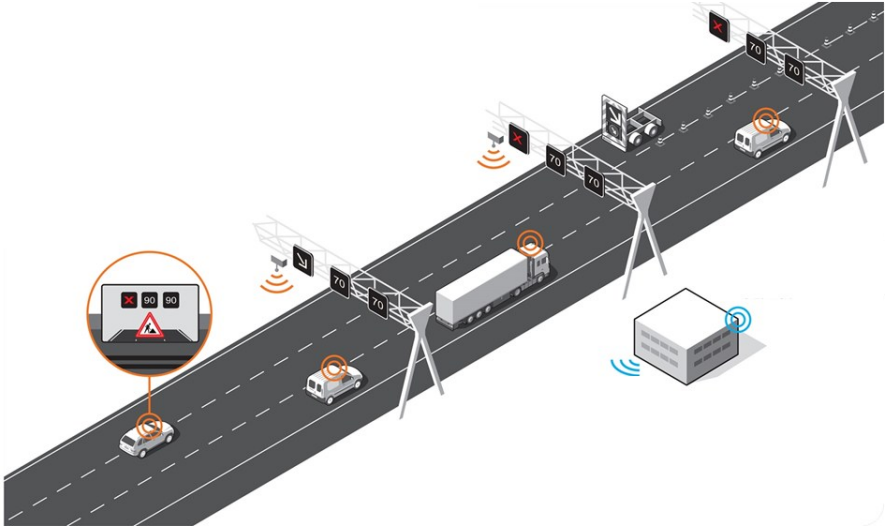
Expected benefits	<ul style="list-style-type: none"> • More convenience for drivers, resulting in better compliance to regulatory signs (e.g., speed limits), improved safety and potential environmental benefits. • The virtual VMS allows to present the representation of a traffic sign exactly in the area where it is applicable, enhancing for example the compliance with regulations.
Use case description	
Situation	<p>The aim of IVS is to relay the information presented on (electronic) traffic signs into the vehicle. To that end, VMS systems have been deployed on sensitive parts of the motorway network all over Europe. They are being used in conjunction with monitoring systems to enforce traffic regulations (such as speed control and lane management).</p>  <p>The diagram illustrates a motorway with several dynamic speed limit signs (VMS) mounted on overhead gantries. A car is shown on the left, with a circular inset showing a digital speed limit sign displaying '90' and a warning sign. A truck is shown in the middle, and a car is shown on the right. A small box on the right side of the road is connected to the VMS system by a blue line, representing the in-vehicle signage service. The signs display '70' and '90' speed limits.</p> <p><i>Figure 2:1 Example of status information on dynamic speed limit signs on a variable message system also sent as in-vehicle signage service</i></p>



Figure 2:2 Example of dynamic regulatory signs



Figure 2:3 Example of dynamic regulatory signs

Logic of transmission	I2V
Actors and relations	<ul style="list-style-type: none"> • Road operator: The source of many of the traffic signs is the road operator via the Traffic Control Centre (TCC). The road operator is expected to have validated the content of the message before sending this message into the system. • Drivers: The traffic sign information is continuously received by all C-ITS equipped vehicles and presented to the drivers. The exact details of the presentation (how and when) is based on the individual application designer's decision. The drivers can use the information to better comply with the current traffic regulations or drive more attentively. • Service provider: Disseminates the traffic sign information to the drivers.

Use case scenario

- The TCC sends a message with the applicable traffic signs. The traffic sign information can target all vehicles, or a specific vehicle type (e.g. heavy goods vehicles) and it can be applicable to all lanes, but also to specific lanes (see examples).
- The message is received in the vehicle and presented to the driver, if relevant.
- The drivers can act accordingly.

Special Scenario – Hard Shoulder Running (HSR)

- Hard Shoulder Running (HSR) enables the dynamic temporary use of hard shoulders at road sections, including junctions, with the aim to increase road capacity under certain conditions. Because HSR is based on traffic signs, it can be represented by the IVS-TS use case, with some specific requirements listed below.
- Any HSR scenario shall be based on the following signage and zones:
 - “Hard shoulder in operation” as sign indicating the start of the HSR section with a relevance zone up until “hard shoulder clearing sign”.
 - “Hard shoulder clearing” as sign noticing that the HS will be cleared, with a relevance zone until the “hard shoulder not in operation” sign.
 - “Hard shoulder not in operation” is not encoded as a separate sign as it is represented as the end of the relevance zone of the “hard shoulder clearing” sign.
- In case dynamic lane management systems are used along the HSR section, the messages representing signage for dynamic lane management should be linked to the HSR messages.

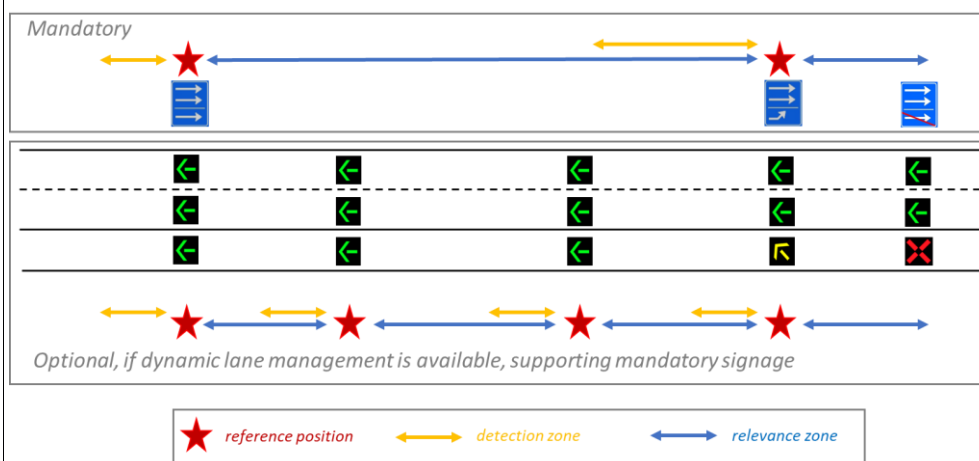







Figure 2:4 Example of active hard shoulder running

- For the mandatory HSR indication, the following signs shall be used:
 - “Hard shoulder open”:
 - ISO 14823 option “hard shoulder running in operation”.
 - serviceCategoryCode: informative
 - pictogramCategoryCode:
 - nature: 6

	<ul style="list-style-type: none"> ○ serialNumber: 45 ○ “Hard shoulder clearing”:  <ul style="list-style-type: none"> ▪ ISO 14823 option „hard shoulder running being closed“ ▪ serviceCategoryCode: informative ▪ pictogramCategoryCode: <ul style="list-style-type: none"> ○ nature: 6 ○ serialNumber: 48 ○ “Hard shoulder not in operation”  (only if a corresponding dynamic lane management is continuing after the closing, otherwise the end of the relevance zone of “hard shoulder clearing” represents the end of HSR): <ul style="list-style-type: none"> ▪ ISO 14823 option „hard shoulder not in operation“ ▪ serviceCategoryCode: informative ▪ pictogramCategoryCode: <ul style="list-style-type: none"> ○ nature: 6 ○ serialNumber: 46 • If dynamic lane management systems are available along the HSR section, the following signs shall be used for the hard shoulder: <ul style="list-style-type: none"> ○ “Hard shoulder open”:  <ul style="list-style-type: none"> ▪ ISO 14823 option “lane free” ▪ serviceCategoryCode: informative ▪ pictogramCategoryCode: <ul style="list-style-type: none"> ○ nature: 6 ○ serialNumber: 60 ○ “Hard shoulder clearing” (based on right-hand-traffic):  <ul style="list-style-type: none"> ▪ ISO 14823 option „Clear lane to left or lane is merging to the left“ ▪ serviceCategoryCode: informative ▪ pictogramCategoryCode: <ul style="list-style-type: none"> ○ nature: 6 ○ serialNumber: 61 ○ “Hard shoulder not in operation”:  <ul style="list-style-type: none"> ▪ ISO 14823 option „lane closed“ ▪ serviceCategoryCode: informative ▪ pictogramCategoryCode: <ul style="list-style-type: none"> ○ nature: 6 ○ serialNumber: 59
Intended Presentation/Alert principle	<ul style="list-style-type: none"> • IVS information shall be presented to the drivers and shall be consistent with the current valid (dynamic) traffic signs. • The information shall be presented to the driver early enough and in the appropriate location on the road. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.

Functional constraints / dependencies	<ul style="list-style-type: none"> • This use case only covers the digital representation of traffic signs. If there is textual information available that is not directly applicable to a sign, the "Free Text" use case shall be used. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the In-Vehicle Information system with HMI how information is presented. Information may be translated to the preferred language of the driver. • The information presented by means of I2V is not legally binding: Information should be handled as 'convenience information' and presented accordingly to the driver, as currently done within navigation systems.
Link to other use cases	All HLN, ESVN and RWW use cases: since traffic signs are part of many different use cases, the IVIM can be accompanying other messages.
Interoperability Requirements	
Message profile requirements	<ul style="list-style-type: none"> • The IVI message for IVS-TS is profiled in chapter 4.2.2.2 of [C-Roads MP]. • IVI messages for IVS-TS shall use message management based on update and cancellation of messages. • iviStatus shall be set to "new" for new information in the IVIM, to "update" when the IVIM changes and to "cancellation" when the information in the IVIM is no longer valid. • A cancellation IVIM shall be repeated at least for 5min after its first transmission NOTE: The exact effort to ensure that all vehicles receive the cancellation will be resolved in future releases. • validTo may be used to encode an end time for the overall IVI message, at least 1 hour ahead of the time indicated by the DE timestamp. Providing this end time can serve the purpose of avoiding an issue of perpetually valid IVIM in case cancellation is missed repeatedly. • The definition of all geographical zones should be included in as few GicParts as possible. • IVIM can contain more than one Geographical Location Container (GLC). An additional GLC should only be included in an IVIM if required zones cannot be defined within the value range constraints of DF DeltaPositions towards the referencePosition. • IVIM shall be self-contained: definition of all zones referred to within the IVIM shall be included in the same IVIM. • One GicPart in the GeneralIviContainer shall be used to encode one traffic sign (main sign) and up to three additional signs (subsigns) that may be associated to the main sign using DF RSCode. • extraText shall be used to present additional text associated to a traffic sign (subpanel text) only if there is no subpanel code available in ISO 14823. extraText is ordered, so the first line of extraText corresponds to the first RSCode and so on. If a traffic sign does not have extra text, a string with a single NULL character (ASCII 0x00) shall be added. extraText may be ignored by receiving vehicles (i.e. neither

evaluated nor shown to the driver) and should only be used for informative and not regulatory data.

- Temporal restrictions of individual signs (when a sign is either valid or invalid only for a certain time period) shall be encoded with suitable ISO14823Attributes (DTM, EDT) in the DF roadSignCodes and not by using either validFrom or validTo of the overall IVIM.
- The IVIM shall always correspond to the legal statement as displayed by the static or electronic sign it represents.
- Signs which indicate the end of a specific or all regulations / restrictions should not be transmitted explicitly as individual signs in an IVIM.
- Road operators should try to reduce the number of individual IVI messages transmitted in parallel as far as possible, by combining consecutive signage information into one message using the mechanisms provided in the IVIM to reuse zones. If separate IVIMs are used for any reason, they should aim to combine either 1) information applying to the same lane, or 2.) information applying to the same direction of travel or 3.) information applying to the same local area in a single message (in descending order of priority from 1) to 3)).
- Within one or multiple IVIMs issued by the same road operator, the same traffic sign should not be assigned more than once to the same relevance zone.
- If the aim is to inform vehicles on all stretches of road diverging from or converging into a relevance zone, suitable zones for these stretches shall be present in the GLC and referenced in the GIC as necessary.
- Information corresponding to physical signs (either static or electronic) shall as far as possible be encoded using machine-readable message components, via adhering as much as possible to the following rules:
 - Shifting of relevance zone(s) according to subpanel information
 - Extension of relevance zone(s) in case of sign repetition
 - Restriction of signs to certain vehicle types and/or dimensions
 - Encoding of ISO14823Attributes where applicable
 - Validity in time (DMT, EDT)
 - Lane Flow (DFL)
 - Vehicle dimensions (VED)
 - Speed (SPE)
 - Rate of Incline (ROI)
 - Distance between vehicles (DBT)
 - Destination (DDD)
 - Encoding of subpanels using roadSignCodes available in ISO 14823 for subpanels instead of extraText
- The RoadConfigurationContainer (RCC) shall be provided, except if the road operator does not have the information, then both RCC and applicable lanes in the GeneralIviContainer (GIC) should be omitted and only signs valid for all legally drivable lanes on the entire carriageway shall be transmitted

Security and data protection requirements	<p>Security requirements and specifications of certificates are described in [C-ITS Security Requirements and Specifications].</p> <p>An overall introduction to the common European trust model is described in [C-ITS Security and Governance] which is referring to the relevant ETSI standards for certificates and PKI management as the underlying technical basis.</p> <p>This use case is based on the “General IVI Container” including lane status and all types of ISO/TS 14823 signs, as well as the “Road configuration container”. The IVIM permissions (SSP) shall be encoded as defined in [ETSI TS 103 301]. These SSPs are encoded in Octets 4-5 within the respective field of the certificate to be used (AT), in addition to the serviceProviderId encoded in Octets 1-3.</p> <table border="1" data-bbox="501 674 1329 1462"> <thead> <tr> <th colspan="2">SSP position</th></tr> <tr> <th>CauseCodeType / Container</th><th>Octet position Bit position</th></tr> </thead> <tbody> <tr> <td>General IVI Container / ISO 14823 / Danger Warning</td><td>4 1</td></tr> <tr> <td>General IVI Container / ISO 14823 / Regulatory</td><td>4 2</td></tr> <tr> <td>General IVI Container / ISO 14823 / Informative</td><td>4 3</td></tr> <tr> <td>General IVI Container / ISO 14823 / Public Facilities</td><td>4 4</td></tr> <tr> <td>General IVI Container / ISO 14823 / Ambient Condition</td><td>4 5</td></tr> <tr> <td>General IVI Container / ISO 14823 / Road Condition</td><td>4 6</td></tr> <tr> <td>General IVI Container / Lane Status</td><td>5 0</td></tr> <tr> <td>Road Configuration Container</td><td>5 1</td></tr> </tbody> </table> <p>The here listed SSP shall be granted only for C-ITS stations used by road operators or any contractor on their behalf.</p> <p>NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the party responsible for the use case (can be the same) which uses the C-ITS stations for it and therefore needs the respective SSPs.</p>	SSP position		CauseCodeType / Container	Octet position Bit position	General IVI Container / ISO 14823 / Danger Warning	4 1	General IVI Container / ISO 14823 / Regulatory	4 2	General IVI Container / ISO 14823 / Informative	4 3	General IVI Container / ISO 14823 / Public Facilities	4 4	General IVI Container / ISO 14823 / Ambient Condition	4 5	General IVI Container / ISO 14823 / Road Condition	4 6	General IVI Container / Lane Status	5 0	Road Configuration Container	5 1
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General IVI Container / ISO 14823 / Informative	4 3																				
General IVI Container / ISO 14823 / Public Facilities	4 4																				
General IVI Container / ISO 14823 / Ambient Condition	4 5																				
General IVI Container / ISO 14823 / Road Condition	4 6																				
General IVI Container / Lane Status	5 0																				
Road Configuration Container	5 1																				
Communication technology requirements: ITS-G5	<p>For ITS-G5 based implementations of use cases where roadside stations are used, the requirements of [C-Roads RSP] shall apply.</p>																				

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

2.2.2 IVS – Free Text (IVS-FT)

Type of road network	All
Type of vehicle (receiver)	All
Use case introduction	
Summary	The aim of this use case is to present in-vehicle information of type “Free Text” to the drivers. The information addresses the driver in human-readable form will either reproduce what is presented on a physical VMS (e.g., variable text panel) in textual form or present a completely new message that does not mirror a physical VMS (a virtual VMS).
Background	<p>This use case is not about providing machine-readable information about events or traffic signs but about providing free text information to human drivers and improving its visibility to the drivers by enabling a continuous presentation in the vehicle. This means that the drivers do not need to perceive and comprehend rather complex information in the few seconds that the VMS panel is visible during transit. Note, presenting more information should not lead to more distraction of the drivers.</p> <p>Compared to traffic signs, it is possible to present textual content to the drivers. Compared to physical VMS, there is a greater possibility to send more contextualised information than what can be presented on a physical VMS.</p>
Objective	<ul style="list-style-type: none"> • Transmission of textual information to drivers in human-readable “Free Text” that is not provided by the other IVS use case “Traffic Signs” (which is only conveying signs). • Adding details (in preferred language) to existing messages to give drivers more precise and comprehensible information to achieve the desired behaviour.
Desired behaviour	The drivers adapt their driving behaviour to the applicable textual warnings, information, advice, or guidance provided.
Expected benefits	<ul style="list-style-type: none"> • The use case allows for better traffic management (e.g., regulation, smart routing, etc.), because information can potentially be transmitted on the scale of an extended network, beyond the limited coverage of physical VMS. • The use case allows extended presentation of information in the vehicle compared to the short-term awareness provided by the physical VMS, thus limiting stress for the drivers to comprehend the content of the information and react accordingly. • In case of textual regulatory information, IVS-FT allows information to be presented to the driver at the most appropriate location, enhancing the compliance with regulations.

- Another added benefit is the ability to present the information in additional languages to the ones shown physically or used in the area of dissemination, if available.

Use case description

Situation

In managing and operating the roadways, there are several occasions and situations in which case a road operator wants to provide additional (textual) information to the drivers to get their extra attention and influence traffic flow and traffic safety in a positive way, e.g.:

- Accident details
- Traffic management plan
- Pollution
- Amber alert
- Special events (sports, demonstration, ...)
- Travel time
- Available parking spaces on highway rest areas
- Information on services available on highway parking areas



Figure 2:5 Example of a warning sign and free text



Figure 2:6: Example of a regulatory sign and free text

Logic of transmission	12V
Actors and relations	<ul style="list-style-type: none"> • Road operator: The source of this information is the road operator via the TCC. The road operator is expected to have validated the content of the message before sending this message into the system. • Drivers: The "Free Text" information is continuously received by all C-ITS equipped vehicles and presented to the driver. The exact details of the visualisation (how and when) is based on the individual application designer's decision. The drivers will benefit from the information contained in the "Free Text" information and could act accordingly. • Service provider: Disseminates the "Free Text" information to the drivers.
Use case scenario	<ul style="list-style-type: none"> • The road operator wants to send information to drivers via virtual VMS, physical VMS, radio, the internet, etc. • The road operator sends information via all or selected information channels
Presentation/Alert principle	<ul style="list-style-type: none"> • If information is provided via more than one channel, the information presented to the drivers via "Free Text" shall be consistent with the information provided via other channels. • The information needs to be presented to the driver early enough and at the appropriate location. • The HMI presentation sequence is at the vehicle manufacturer's and/or service provider's own responsibility.
Functional constraints / dependencies	<ul style="list-style-type: none"> • "Free Text" is used whenever the road operator wants to display textual information to the drivers that cannot be encoded via traffic signs. • How the information is presented to the drivers is not part of the service description. It is left to the provider of the in-vehicle information system with HMI how information is presented. • IVS-FT information should be presented in multiple languages, if possible, e.g. in the national languages used in a specific country as well as English to be commonly understandable within Europe • The geographic extend (or relevance zone) for IVS-FT messages is supposed to be only one point, where the information is relevant for the human driver. For backwards compatibility reasons, older implementations might use larger relevance zones covering specific road segments.

Link to other use cases	<ul style="list-style-type: none"> • If machine-readable warnings or signs are present on or can be derived from physical variable message or free text signs, they need to be encoded as separate, machine-readable information using the HLN or ESVN service or the IVS-TS use case - using appropriate detection and relevance zones depicting the extend of the event or sign, potentially also including other machine-readable elements (like e.g. vehicle characteristics, applicable lanes, ...) relevant to the event or sign • The in-vehicle information system cannot determine the content of the “Free Text” message, i.e. it is not machine readable. Therefore, it is the responsibility of the road operator to determine the appropriate location(s) for where this message should be available to be presented to the human driver. • The information presented by means of IVS-FT is not legally binding: Information should be handled as ‘convenience information’ and presented accordingly to the drivers, as currently done within navigation systems. • Difference between IVS-TS and IVS-FT: IVS-FT addresses human driver with human-readable information, while IVS-TS conveys traffic regulation in machine-readable format that can be expressed as traffic signs for humans. The geographic information in IVS-FT represents the points where information is relevant for the human driver while the geographic information in IVS-TS represents the area of relevance for any regulation. • All RWW use cases: IVS-FT can be used to present additional human readable information to drivers.
Interoperability Requirements	
Message profile requirements	<ul style="list-style-type: none"> • The IVI message for IVS-FT is profiled in chapter 4.2.2.3 of [C-Roads MP]. • IVI messages for IVS-FT shall use message management based on update and cancellation of messages. • iviStatus shall be set to “new” for new information in the IVIM, to “update” when the IVIM changes and to “cancellation” when the information in the IVIM is no longer valid. • A cancellation IVIM shall be repeated at least for 5min after its first transmission <i>NOTE: The exact effort to ensure that all vehicles receive the cancellation will be resolved in future releases.</i> • validTo may be used to encode an end time for the overall IVI message, at least 1 hour ahead of the time indicated by the DE timestamp. Providing this end time can serve the purpose of avoiding an issue of perpetually valid IVIM in case cancellation is missed repeatedly. • The definition of all geographical zones should be included in as few GlcParts as possible. • IVIM can contain more than one Geographical Location Container (GLC). An additional GLC should only be included in an IVIM if required zones cannot be defined within the value range constraints of DF DeltaPositions towards the referencePosition. • IVIM shall be self-contained: definition of all zones referred to within the IVIM shall be included in the same IVIM.

- "Free Text" Information without a sign shall be encoded in the TextContainer only. Free text information may be ignored by receiving vehicles (i.e. neither evaluated nor shown to the driver) and should only be used for informative and not regulatory data.
- If the "Free Text" Information includes at least one traffic sign, all signs shall be encoded in the optional GeneralIviContainer.
- Temporal restrictions of individual signs (when a sign is either valid or invalid only for a certain time period) shall be encoded with suitable ISO14823Attributes (DTM, EDT) in the DF roadSignCodes and not by using either validFrom or validTo of the overall IVIM.
- If traffic signs are present:
 - one GicPart in the GeneralIviContainer shall be used to encode one traffic sign (main sign) and up to three additional signs (subsigns) that may be associated to the main sign using DF RSCode.
 - extraText shall be used to present additional text associated to a sign (subpanel text.) only if there is no subpanel code available in ISO 14823. extraText is ordered, so the first line of extraText corresponds to the first RSCode and so on. If a traffic sign does not have extra text, a string with a single NULL character (ASCII 0x00) shall be added. extraText may be ignored by receiving vehicles (i.e. neither evaluated nor shown to the driver) and should only be used for informative and not regulatory data.
 - The IVIM shall always correspond to the legal statement as displayed by the static or electronic sign it represents.
 - Signs which indicate the end of a specific or all regulations / restrictions should not be transmitted explicitly as individual signs in an IVIM.
 - Within one or multiple IVIMs issued by the same road operator, the same traffic sign should not be assigned more than once to the same relevance zone. Information corresponding to physical signs (either static or electronic) shall as far as possible be encoded using machine-readable message components, via adhering as much as possible to the following rules:
 - Shifting of relevance zone(s) according to subpanel information
 - Extension of relevance zone(s) in case of sign repetition
 - Restriction of signs to certain vehicle types and/or dimensions
 - Encoding of ISO14823Attributes where applicable
 - Validity in time (DMT, EDT)
 - Lane Flow (DFL)
 - Vehicle dimensions (VED)
 - Speed (SPE)
 - Rate of Incline (ROI)
 - Distance between vehicles (DBT)
 - Destination (DDD)
 - Encoding of subpanels using roadSignCodes available in ISO 14823 for subpanels instead of extraText

Security and data protection requirements

- If the aim is to inform vehicles on all stretches of road diverging from or converging into a relevance zone, suitable zones for these stretches shall be present in the GLC and referenced in the TC as necessary.
- The RoadConfigurationContainer (RCC) shall be provided, except if the road operator does not have the information, then both RCC and (if signs are present) applicable lanes in the GeneralIviContainer (GIC) should be omitted and only signs valid for all legally drivable lanes on the entire carriageway shall be transmitted.

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

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

This use case is based on the “General IVI Container” including lane status and all types of ISO/TS 14823 signs, the “Road configuration container” as well as the “Text container”. The IVIM permissions (SSP) shall be encoded as defined in [ETSI TS 103 301]. These SSPs are encoded in Octets 4-5 within the respective field of the certificate to be used (AT), in addition to the serviceProviderId encoded in Octets 1-3.

CauseCodeType / Container	SSP position	
	Octet position	Bit position
General IVI Container / ISO 14823 / Danger Warning	4	1
General IVI Container / ISO 14823 / Regulatory	4	2
General IVI Container / ISO 14823 / Informative	4	3
General IVI Container / ISO 14823 / Public Facilities	4	4
General IVI Container / ISO 14823 / Ambient Condition	4	5
General IVI Container / ISO 14823 / Road Condition	4	6
General IVI Container / Lane Status	5	0
Road Configuration Container	5	1
Text Container	5	2

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

NOTE: The user in this sentence is not the station operator (as defined in the SP) who goes through the enrolment process and requests the necessary SSPs. The user is the

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