



French C-ITS Deployment Coordination committee

Vro-Global-System 2422_M – VroES IVI services

2.4.2.2_M_IVI_Event

Activity 2: Studies

Sub Activity 2.4 > Specifications

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Quality rules

Reference to the version administration

Version number to be composed of 3 digits > vR.XY

- **R** corresponds to the release number: it is upgraded each time SC Studies validates the diffusion of a new release,

- **X** is the major version number: it is upgraded each time SC Studies validates the deliverable,

- **Y** is the minor version number: it is upgraded each time a contributor changes anything.

Once the deliverable is approved, its version number is upgraded from vR.XY to vR.(X+1)0

Once the deliverable is release, its version number is upgraded from vR.XY to v(R+1).00

As illustration:

0.03 > Work in progress version

0.10 > Del. Approved by SC Studies but not released

2.00 > Del. approved & released (in release 2)

2.05 > Del. Updated - in progress version

Requirements identification & traceability

In this document, the following verbal forms are used to indicate requirements: **Shall / Shall not**

Recommendations shall be indicated by the verbal forms: **Should / Should not**

Permissions shall be indicated by the verbal forms: **May / May not**

Possibility and capability shall be indicated by the verbal forms: **Can / Cannot**

Inevitability used to describe behaviour of systems beyond of the scope of this del. shall be indicated by:

Will / Will not

Facts shall be indicated by the verbal forms: **Is / Is not**

In the table here below:

2.4.X.XX > is the number given to the deliverable (e.g. 2.4.4.8)

YYYY > for digit are given to identifying which component/entity the requirement is addressing (e.g. LTCA for long term certificate authority)

ZZZ > is the numeration of the requirement

W > is the number of the version of the requirement

ID	2.4.X.XX-YYYY-ZZZ (W)
Component(s)	(e.g.) Vru-ITS-S, Vro-ITS-S, R-ITS-S, PKI
Requirement	(e.g.) An ITS station SHALL be able to request and get a Long-Term Certificate (LTC) from the SCOOP Public Key Infrastructure (PKI).
Acceptance	(e.g.) CA1: Vru-ITS-S sends a LTC request to the LTCA CA2: R-ITS-S relays the LTC request CA3: The LTCA verifies the request and sends a response CA4: The R-ITS-S relays the response CA5: The response is received by the Vru-ITS-S and is valid
Additional information	

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1 Introduction

1.1 Purpose of the document

The present document is an annex of “Vro-Global-System 2422_M - Main Document”. It completes the main document by specifying the handling of IVI messages and the events supported by this type of messages.

/!\ Warning: The requirements of the present document absolutely cannot be extracted without taking into account the master’s ones.

e.g., some general phrasing in the present document might indicate that the requirement is applicable in all case, while the master limits the usage via a filtering process.

1.2 Context

This document is added to the 2.4.2.2x bundle during a restructuration of the bundle. It is created to split the handling of project use cases depending on the type of message that carries the information.

This document is added in order to specify in the context of C-Roads and InDiD projects the use-cases supported by IVI messages in Vro-ITS-S. Those use cases (named “Event” in this document) are:

- ❑ C2 Dynamic Speed Limit
- ❑ C3 Embedded eVMS
- ❑ H2 Dynamic traffic ban
- ❑ H4 Dynamic lane management – reserved lane
- ❑ H6 Overtaking ban
- ❑ E8 Traffic information on the closure of a mountain pass.
- ❑ E1 Traffic information about snow on the road.

In the context of InDiD, it represents the step 4 of the project.

At the date of writing, the Vro-ITS-S does not trigger IVI events. It receives IVI message, and emits IVI messages after translating them from Datex. In future versions, the triggering of IVI events might be added.

1.3 Document organisation

In order both to specify the current supported events, and to easily add new events based on IVI, the document contains:

- ❑ A brief presentation of the events to develop in a user point of view in order to better understand the resulting requirements on the system (see § 3)
- ❑ A description (§ 4) of the functional requirement using UML notation by VroES services (summarized in Figure 14). Each sub-chapter is composed of:
 - A nominal case,

- Potential alternative cases,
- A user interface description.

This excludes the graphical elements to be displayed, which requirements are described in [DA2].

- A description (§ 5) of the requirements applicable to IVI in general (and not use-case-specific). This includes amongst other:
 - The IVI services identifications. (see § 5.3)
 - The IVI filling rules (see § 5.7)
 - The IVI dissemination rules (see § 5.8)
- A presentation of the [VroES services] impacted by the [IVI services] and the distribution of the responsibilities between the different sub-systems composing the Vro-global-system to implement them.



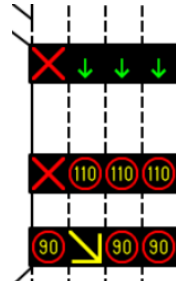
1.4 Definitions and Abbreviations

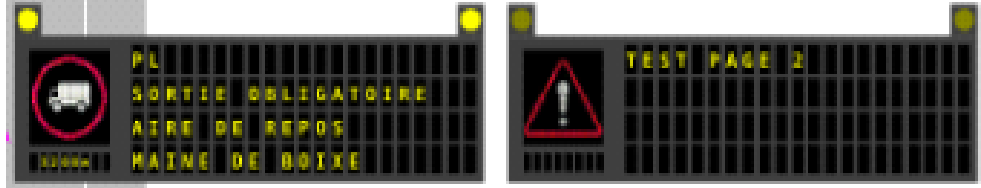
1.4.1 Abbreviations

Term	Definition
CAM	Cooperative Awareness Message
CAN	Car Access Network – standard access bus to the vehicle electronics
C-ITS	Cooperative – Intelligent Transport Systems
[DAX]	Document Applicable n°x
DENM	Decentralized Environmental Notification Message
DLM-RL	Dynamic Lane Management – Reserved Lane
[DRx]	Document de Référence n°x
DSL	Dynamic Speed Limit
DTB	Dynamic Traffic Ban
eVMS	Embedded Variable Message Signal
ICPU	Information and Communication Processing Unit
HGV	Heavy Goods Vehicle
HMI	Human-Machine Interface
MRI	Multi-lane road-information
Nfr-ITS-S	National French ITS Station
PKI	Public Key Infrastructure
POI	Point Of Interest
PFro	Platform road operator
R-ITS-S	Roadside ITS station
SCOOP@F	French C-ITS pre-deployment project – European Project
SRI	Single-lane road-information
TMS	Traffic Management System
TSL	Temporary Speed Limit
V-ITS-S	Vehicle ITS station
VroES	Vro Embedded System

1.4.2 Definitions

Term	Definition
DE	As defined in [DA1], data type that contain one single data.
DF	As defined in [DA1], data type that contain more than one data element in a predefined order (it may imply presence of others DF)
Event	As defined in [DA1], corresponds to the “use cases” in the project context. e.g. D2a Animal on the Road, C3 eVMS, D7 Wrong Way Driving, D10 emergency breaking
IVI service	Services defined in the present document (Figure 14). e.g., Display multilane road information
IVI	<p>ITS service that provides static, as well as dynamic road sign and message sign information to drivers based on IVIM. The following figure represents the concepts and terms related to this service. The main terms are described below.</p> <pre> graph TD MR[Multilanes road information] -- "2..*" --> L[Lane] L -- "1" --> RI[Road Information] RI -- "1" --> EVMS[eVMS] RI -- "1" --> P[Page] RI -- "1" --> RS[Road Sign] RI -- "0..1" --> ST[SubText] P -- "1..4" --> TL[TextLine] D[Dynamic Speed Limit] -- > RI </pre> <p><i>Figure 1 : IVI Service - Domain model</i></p>

Road Information	<p>A road information is composed of a road sign and optionally a sub text. ISO/TS 14823 classifies the road sign into 3 main categories subdivided into subcategories.</p> <table><tr><th>Type of service</th><th>Subdivision</th><th>Nature</th></tr><tr><td rowspan="3">Traffic sign information</td><td>Danger warning</td><td>Warning/priority sign information</td></tr><tr><td>Regulatory</td><td>Priority, prohibitor or restrictive, mandatory/end sign information</td></tr><tr><td>Informative</td><td>Direction, road/place, pedestrian crossing, lane affectation, ... sign information</td></tr><tr><td>Public facilities information</td><td>Public facilities</td><td>Information giving notice of public facilities which may be useful to road users.</td></tr><tr><td rowspan="2">Ambient/Road condition information</td><td>Ambient conditions</td><td>Information indicating ambient conditions which may be useful to the drivers of vehicles.</td></tr><tr><td>Road conditions</td><td>Sign information indicating road conditions which may be useful information for drivers of vehicles</td></tr></table> <div></div> <p>Figure 2 : Road information example</p>	Type of service	Subdivision	Nature	Traffic sign information	Danger warning	Warning/priority sign information	Regulatory	Priority, prohibitor or restrictive, mandatory/end sign information	Informative	Direction, road/place, pedestrian crossing, lane affectation, ... sign information	Public facilities information	Public facilities	Information giving notice of public facilities which may be useful to road users.	Ambient/Road condition information	Ambient conditions	Information indicating ambient conditions which may be useful to the drivers of vehicles.	Road conditions	Sign information indicating road conditions which may be useful information for drivers of vehicles
Type of service	Subdivision	Nature																	
Traffic sign information	Danger warning	Warning/priority sign information																	
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Public facilities information	Public facilities	Information giving notice of public facilities which may be useful to road users.																	
Ambient/Road condition information	Ambient conditions	Information indicating ambient conditions which may be useful to the drivers of vehicles.																	
	Road conditions	Sign information indicating road conditions which may be useful information for drivers of vehicles																	
Dynamic Speed Limit (DSL)	<p>The DSL is a specialized road information. The road sign used is a speed limit sign.</p> <div></div> <p>Figure 3 : Dynamic Speed Limit example</p> <p>This dynamic signage always has priority over static signage. When dynamic speed limit is applicable to all lanes then it is considered as temporary speed limit.</p>																		
Multi-lane road-information (MRI)	<p>Road information (lane status, restriction, ...) applicable on each lane of a carriageway. The multiple lanes (or multilane) is only used if the road information is not applicable to the whole carriageway.</p> <div></div>																		
eVMS	<p>Service on which information about particular events can be presented for road users in the form of free text, accompanied by at least one pictogram. The information can reproduce what displays a physical Variable Message Sign (VMS) or can be a complete virtual VMS (not present on the road). An eVMS is composed of maximum 2 pages. Each page contains a road information and a textual zone of maximum 4 lines.</p>																		

	 <p>Figure 4 : eVMS example</p>
VroES service	Service as defined in the master document [DA1]. e.g., Display events on the HMI.

1.5 Parameter naming and usage

There are 3 different levels of parameters used to implement the setting of the Vro-Global-System. All those parameters are configurable via the Scoop Server. The following table sums up their usage and meaning:

Type	Description
General (_GEN_)	<p>Those parameters allow to set up the general behavior of the application (setting of the DENMs, settings of the logs, exchange with PFro, Road Operator Specific Software...) They are relevant for the all Vro-ITS-S connected to the Scoop Server.</p> <p>Those parameters are used by the Scoop Tablet Software and Scoop ICPU Software</p>
Vehicle (_VEH_)	<p>Those parameters allow the customization of each Vro-ITS-S vehicle characteristics (vehicle dimensions, position of the antennas, Mobile-R-ITS-S identification, CAN dictionary...)</p> <p>Those parameters are used by the Scoop ICPU Software and the Basic ICPU Software.</p>
ICPU (_ICPU_)	<p>Those parameters only impact the behavior of the Basic ICPU Software. They are all set in the Scoop Server which provides a service to download this setting.</p> <p>However, contrary to the General and Vehicle setting, those parameters can also be generated and managed by the Vro-ITS-S server. The choice to either use one setting or the other is up to the road operator organizations and their ICPU sub-contractor.</p> <p>Those parameters can be either specific to each ICPU or global to all the road operator's ICPU.</p>

Each time a parameter is used, its type is indicated: *GEN – VEH – ICPU*.
In addition, if the parameter applies only to one ICPU, it is stated.

2 Documents

2.1 Reference documents

Id.	Reference	Version	Title / Content
[DR1]	2.4.1.2_M_C2(DynSpeedLimit)	V4.50	Common technical specifications for use cases - C2 - dynamic speed limit (I2V)
[DR2]	2.4.1.2_M_C3(eVMS)	V4.60	Common technical specifications for use cases - embedded VMS
[DR3]	2.4.1.2_M_H2(DTB)	V4.50	Common technical specifications for usecases : H2 - dynamic traffic ban to specificvehicle (I2V)
[DR4]	2.4.1.2_M_H4(DLM-RL)	V4.40	Common technical specifications for use cases: H4 - dynamic lane management - reserved lane (I2V)
[DR5]	2.4.1.2_M_H6(OvertakingBan)	V4.30	Common technical specifications for usecases – H6 - HGV overtaking ban (I2V)
[DR6]	2.4.2.2_M_DENM_Event	See Master	Vro-Global-System 2422_M - Main Document Annex - DENM handling
[DR7]	2.4.1.2_M_E8	V0.10	Common technical specifications for use cases: E8_Traffic information on the closure of a mountain pass route (I2V)
[DR8]	2.4.1.2_M_E1(TISR)	V0.10	Common technical specifications for use cases: Traffic information about snow on the road (TISR)

Note: The listed version of [DR8] is not the latest approved version.

2.2 Applicable documents

Id.	Reference	Version	Title / Content
[DA1]	2.4.2.2_M_Vro_System	0.40	Specifications of the Vro-Global-System 2422_M - Main Document
[DA2]	2.4.2.2_M_Vro_HMI	See Master	Management of displays on the MMIs of road operator OBUs
[DA3]	2.4.1.2_M	See Master	Master technical specifications for I2V use cases
[DA4]	ISO 14823	2017	Intelligent transport systems — Graphic data dictionary
[DA5]	ISO TS 19321	2020	Intelligent transport systems — Cooperative ITS — Dictionary of in-vehicle information (IVI) data structures
[DA6]	2.4.1.4_M ANNEXE 3	V4.110	Datex II adapted for C3-IVI between PF and R-ITS-S
[DA7]	2.4.1.4_M ANNEXE 8	V4.70(*)	Datex II adapted for H-IVI between PF and R-ITS-S
[DA8]	ETSI 103 301	V2.1.1	Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services

(*) This version does not correctly take into account C-Roads PF 2.0. The requirements contained in this document should be reconsidered in the event of any discrepancies.

3 Project use case description

3.1eVMS – C3

A VMS is an electronic panel (see Figure 5) giving information about special events (traffic conditions, accidents, roadworks ...). They are mainly situated on highways. SCOOP 2 aims to display virtual VMS on the HMI.



Figure 5 : VMS with two pages

A VMS can contain several pages composed of a pictogram, a sub-text and lines of text. Real and virtual VMS are both transmitted in IVI messages.

3.2 Traffic information on the closure of a mountain pass – E8

A traffic information on the closure of a mountain pass is a C-ROADS use case. It consists of alerting the driver about a closed mountain pass route approaching. The driver is already engaged in the road to the mountain pass. This use case concerns all vehicle. The objective is to alert the driver already engaged that the road is blocked in order to allow him to take another road by turning around safely and rerouting himself on the bypass itinerary.



Figure 6 : Example of traffic information on the closure of a mountain pass.

As we can see in Figure 6, this present use case is an eVMS.

3.3 TISR – E1

TISR (Traffic Information about Snow on the Road) is a C-ROADS use case. It describes the conditions on the road about the snow and allows the driver to adapt his route and/or to drive according to the traffic conditions related to snow. This use case concerns all vehicles.



Figure 7: Example of traffic information about snow on the road.

As we can see in Figure 7, this use case is an eVMS.

3.4 DSL – C2

DSL is a C-ROADS use case. For DSL, road is cut into sections. For each section, there are loops or similar systems to detect traffic flow and speed of vehicles. Road operators have an algorithm that analyses the data from the field (high pollution levels for example) and modulates **temporarily** the speed of each section to delay or avoid congestion. Speed limits can concern all vehicles or some category of vehicles. The DSL is displayed on dynamic speed road sign panel dedicated for speed mainly situated on highways.

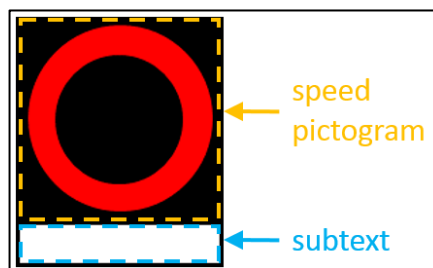


Figure 8: Speed road sign panel used for DSL use case.

As we can see in Figure 8, a speed road sign panel is divided in two parts, the first one is dedicated to speed limit (pictogram) and the second one is dedicated for vehicle category (subtext: “VL” Véhicule léger or “PL” Poids Lourd).

This use case is divided in two types:

- DSL applicable on all lanes
- DSL specific on different lanes of the road

See Figure 14 and Table 1 for DSL repartition between IVI services.

3.4.1 DSL applicable on all lanes

DSL all lanes corresponds to the situation with single speed road sign panel situated on the side of the road. In this case the speed road sign is dedicated for all lanes. Figure 9 below provides an example.

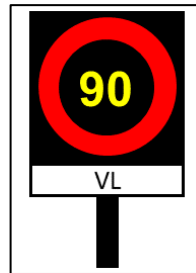


Figure 9: Example of speed road sign panel used for DSL applicable on all lanes.

3.4.2 DSL applicable by lanes

DSL by lane corresponds to the situation with multi-speed road sign panel. In this case each speed road sign panel is dedicated to the lane below it. The Figure 10 below provides 2 examples.

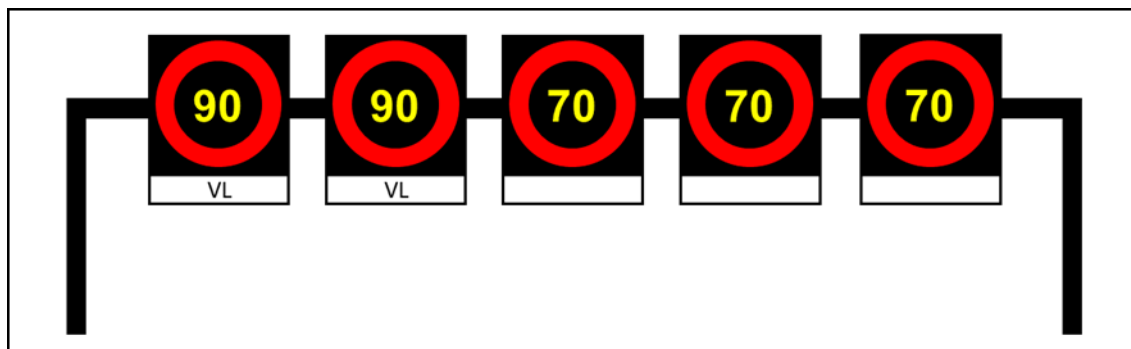


Figure 10: Example of speed road sign panels used for DSL by lane. 2 different road information.

3.5 DTB – H2

The DTB is a C-ROADS UC. The DTB (dynamic traffic ban to specific vehicle) consists of prohibiting the usage of the road for specific vehicle or even all vehicles on certain sections of the road.

Figure 11 below provides some examples.



DTB specific to vehicle over 7,5t	DTB for all vehicle
 7,5t	

Figure 11: Example of DTB.

3.6 DLM-RL – H4

The DLM-RL is a C-ROADS UC. The dynamic lane management – reserved lane consists of managing the lane status, i.e. reserved lanes (e.g. for public transport or carpooling) and open/closed lanes. Figure 12 below provides some examples.


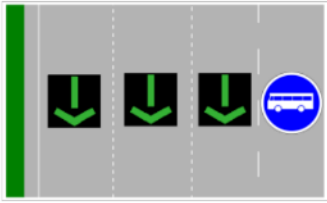
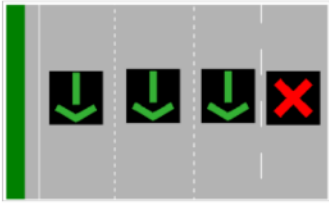

	High occupancy vehicle	Bus lane
Activated		
Disabled		

Figure 12: Example of DLM-RL.

3.7 HGV overtaking ban – H6

The “HGV overtaking ban” is a C-ROADS UC. It consists in prohibiting the heavy goods vehicles (HGV) from overtaking by managing the lane status.

Figure 13 below provides an example:



Figure 13: Example of HGV overtaking ban.

4 VroES IVI services

In order to facilitate the addition of future events supported by IVI messages, this document introduces the concept of **IVI services**. The current distribution of [Event] in the IVI services is described in Table 1:

Project events	IVI service
H2 – dynamic traffic ban to specific vehicle	Single-lane road-information
H4 – dynamic lane management - reserved lane	Multi-lane road-information
H6 – HGV overtaking ban	Multi-lane road-information
C3 – embedded VMS	eVMS
C2 – dynamic speed limit	All lane - Temporary speed limit By lane - Multi-lane road-information
E8 – Traffic information on the closure of a mountain pass	eVMS
E1 – Traffic information about snow on the road	eVMS

Table 1: Project events distribution in IVI services

Figure 14 represents the services supported by the Vro-ITS-S in the scope of the usage of IVI messages.

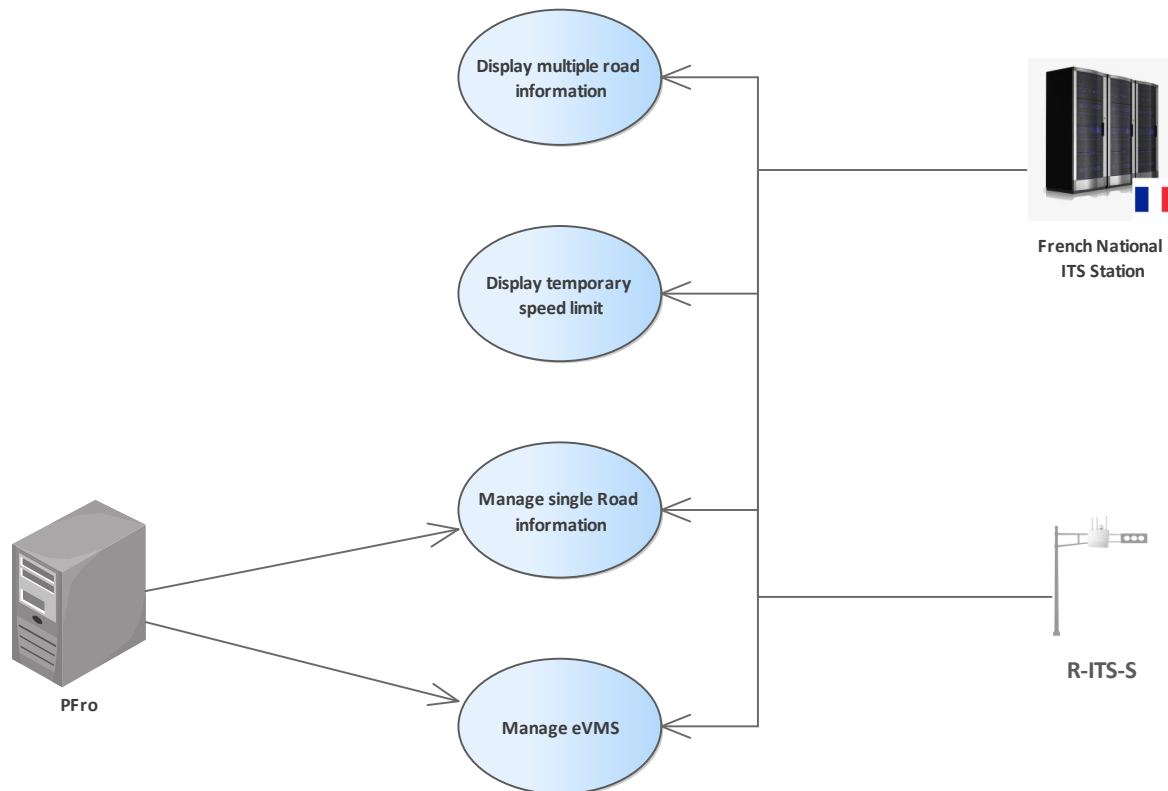


Figure 14: IVI services

The term "Manage" covers the requirements related to the DATEX translation function (Mobile R-ITS-S function is defined in [DA1]) as well as those related to the display.

The above [IVI services] are therefore a specialization of the more generic [VroES services] of the Master document [DA1] "Display events on the HMI" and "Relay information from PFro".

The link between those [IVI services] and [VroES services] is described in § 6.

4.1 Manage eVMS

As a reminder, this service covers C3, E1 and E8 events (see Table 1).

The expected content of a received IVI message describing a C3, E1 or E8 event is detailed respectively in [DR2], [DR8] and [DR7].

4.1.1 Nominal case

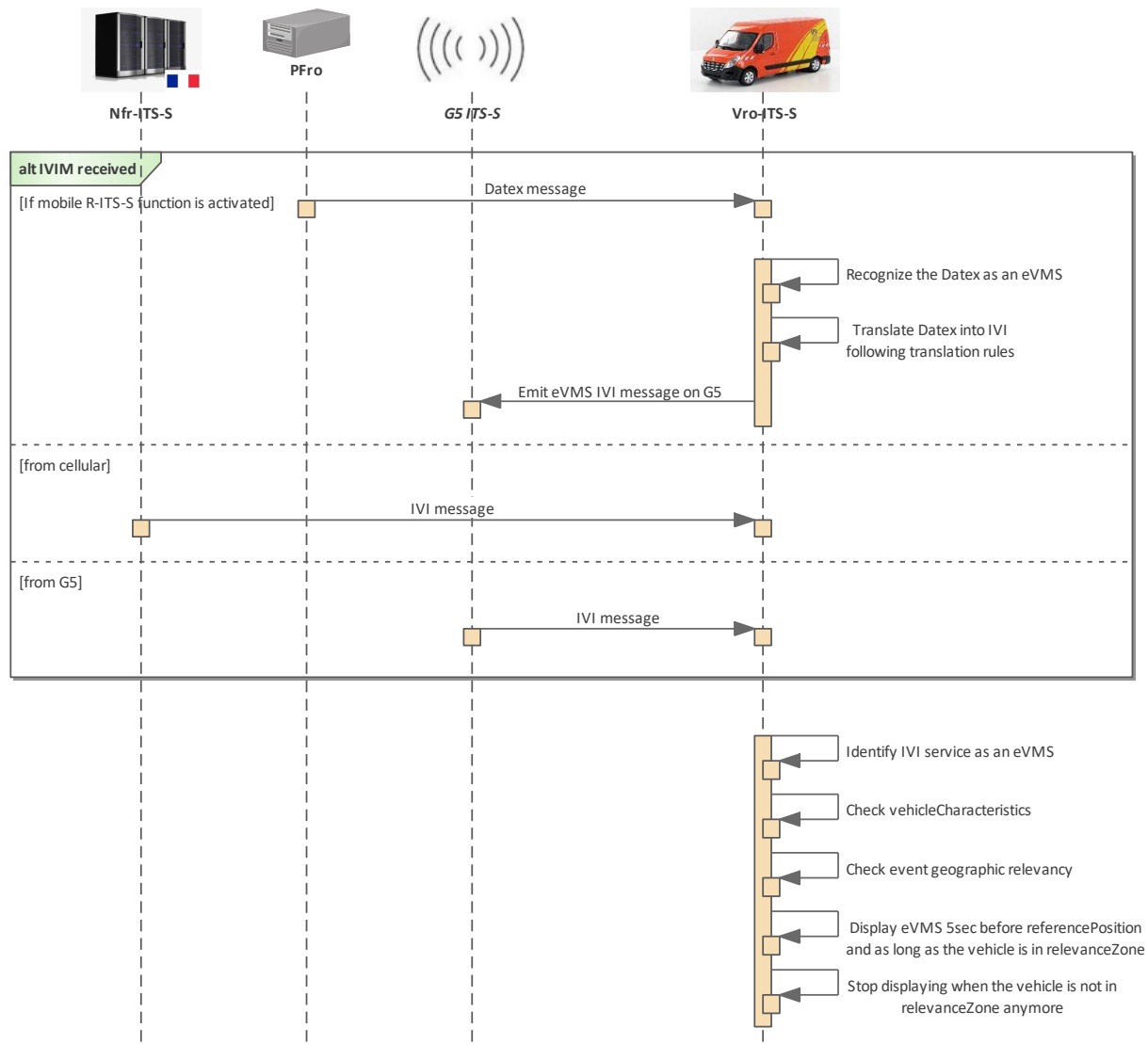


Figure 15 : Display eVMS- nominal case

ID	2.4.2.2_Ivim-VMS-001(1)
Component(s)	VroES
Requirement	<p>If the Mobile R-ITS-S function is activated:</p> <p>When a Datex is received, the Vro-ITS-S shall identify the Datex as an eVMS by checking the presence of:</p> <ul style="list-style-type: none"> • VMSPublication
Additional information	N/A

ID	2.4.2.2_Ivim-VMS-002(3)
Component(s)	VroES
Requirement	<p>When a received Datex describes an eVMS service, the Vro-ITS-S shall create the corresponding IVI message following [DA6] and [DR2] and shall respect the dissemination rules as described in [DA1] service [Relay information from PFro]</p>
Additional information	- N/A

ID	2.4.2.2_Ivim-VMS-003(2)
Component(s)	VroES
Requirement	<p>When an IVI message is received, the Vro-ITS-S shall identify the IVI service as an eVMS by checking the following point:</p> <ul style="list-style-type: none"> • Presence of textContainer.
Additional information	See IVI services identifications in § 5.3

ID	2.4.2.2_Ivim-VMS-004(1)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall display a VMS of at most 2 pages composed of:</p> <ul style="list-style-type: none"> • 4 lines of 21 characters maximum each, • 1 road information: <ul style="list-style-type: none"> ○ 1 subtext of 9 characters max, ○ 1 road sign (or pictogram).
Additional information	See requirements § 5.4 for road information display.

ID	2.4.2.2_Ivim-VMS-005(2)
Component(s)	VroES
Requirement	<p>When there is no GicPart, the Vro-ITS-S shall consider the first TcPart as the 1st VMS page and, if present, the second TcPart as the 2nd page.</p> <p>Otherwise, when there is 1 GicPart, the Vro-ITS-S shall consider the GicPart and the first TcPart as the 1st VMS page and, if present, the second TcPart as the 2nd page.</p> <p>If there are 2 GicPart, the Vro-ITS-S shall consider the first GicPart and the first TcPart as the 1st VMS page and, the second GicPart and the second TcPart as the 2nd page.</p>
Additional information	

ID	2.4.2.2_Ivim-VMS-010(1)
Component(s)	VroES
Requirement	<p>When there are several languages in the DF text, the VroES shall choose the textContent in French language by default.</p> <p>If there is no textContent in French language, the VroES shall choose the textContent in English language.</p> <p>If there is neither a textContent in French nor a textContent in English, the VroES choose the first textContent available.</p>
Additional information	One textContent is chosen to describe one page.

ID	2.4.2.2_Ivim-VMS-006(1)
Component(s)	VroES
Requirement	To know when and how long an eVMS should be displayed, the Vro-ITS-S shall respect requirements defined in § 5.5.
Additional information	N/A

4.1.2 Alternative case

ID	2.4.2.2_Ivim-VMS-007(3)
Component(s)	VroES
Requirement	<p>If the vehicle is in the relevance zones of several eVMS that shall be displayed on the same area of the tablet, the Vro-ITS-S shall respect the following priority rules:</p> <ul style="list-style-type: none"> it shall display the IVI message with the highest priority considering that the priority of an eVMS message is the highest priority of its two first TcPart.

	<ul style="list-style-type: none"> if several IVI messages have the same level of priority, it shall display the message corresponding to the last received IVI message.
Additional information	<p>IVI priority is given by the DE <i>iviType</i> providing by the GIC's field and/or the TextContainer's field. In the case of VMS, only the <i>iviType</i> providing by TextContainer's field is used. In [DA5], there are 5 values of <i>iviType</i>: immediateDangerWarningMessages (0), regulatoryMessages (1), trafficRelatedInformationMessages (2), pollutionMessages (3), notTrafficRelatedInformationMessages (4)</p> <p>Two priority groups are considered: high priority (0 and 1) and low priority (2, 3 and 4).</p>

4.1.3 User interface

The aim of this part is to link the IVI content to a realistic representation of a VMS. The figure below is just a graphical representation of the information contained in the IVI for eVMS service.

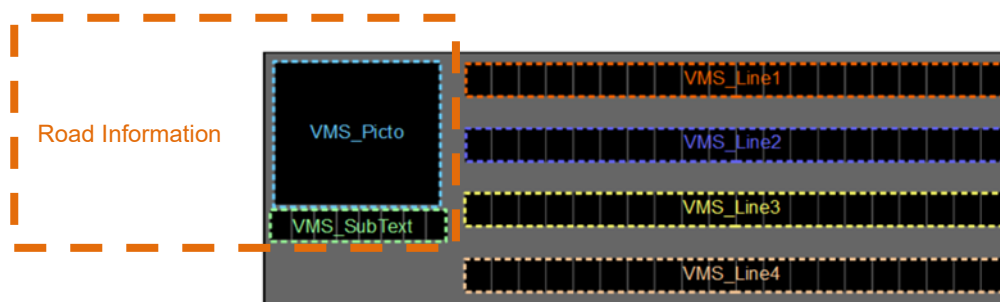


Figure 16 : VMS layouts

ID	2.4.2.2 _Ivim-VMS-008(3)
Component(s)	VroES
Requirement	For each page (i.e., GicPart and/or TcPart), the Vro-ITS-S shall fill VMS layouts (see Figure 16) according to Table 2.
Additional information	<p>In Table 2, “#X” means the Xth line feed in the textContent. extraText corresponds to the extraText contained in the GicPart representing the page.</p> <p>The 4 lines of the VMS are found in the same DE textContent. Each line is separated by a line feed. The line feed is an UTF8String coded like this in hexadecimal: 0x0A.</p>

	IVI message parameter
VMS_Picto	See § 5.4 Road Information management
VMS_SubText	ExtraText
VMS_Line1	text before line feed #1 in the DE textContent
VMS_Line2	text before line feed #2 in the DE textContent
VMS_Line3	text before line feed #3 in the DE textContent
VMS_Line4	text before line feed #4 in the DE textContent

Table 2 : VMS display

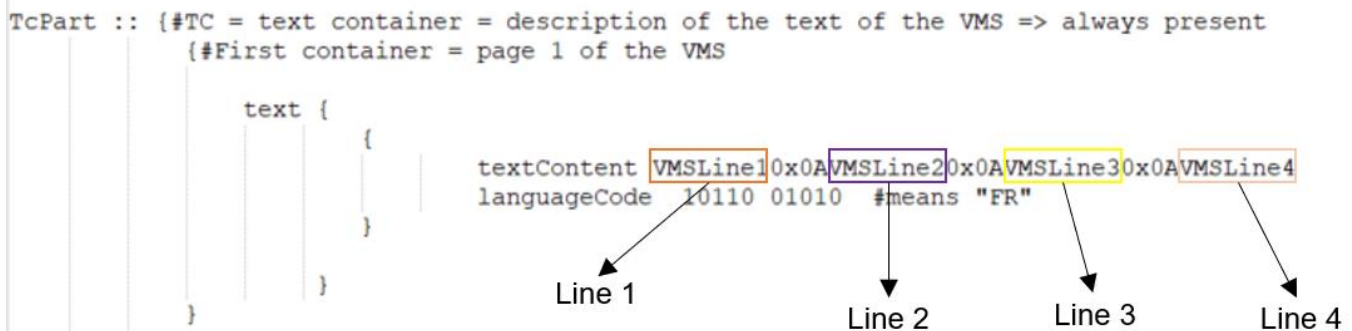


Figure 17: Example of How to fill text in VMS

In the example above, the "0x0A" is written only to illustrate line feed and line separation.

ID	2.4.2.2_Ivim-VMS-009(3)
Component(s)	VroES
Requirement	The Vro-ITS-S shall limit the number of characters in a line to 21 characters by taking only the first 21 characters of each line.
Additional information	N/A

4.2 Display multilane road information (MRI)

As a reminder, this service covers H4, H6 and “C2 by lane” events (see Table 1).

The expected content of a received IVI message describing those events is detailed in [DR1], [DR4] & [DR5].

4.2.1 Nominal case

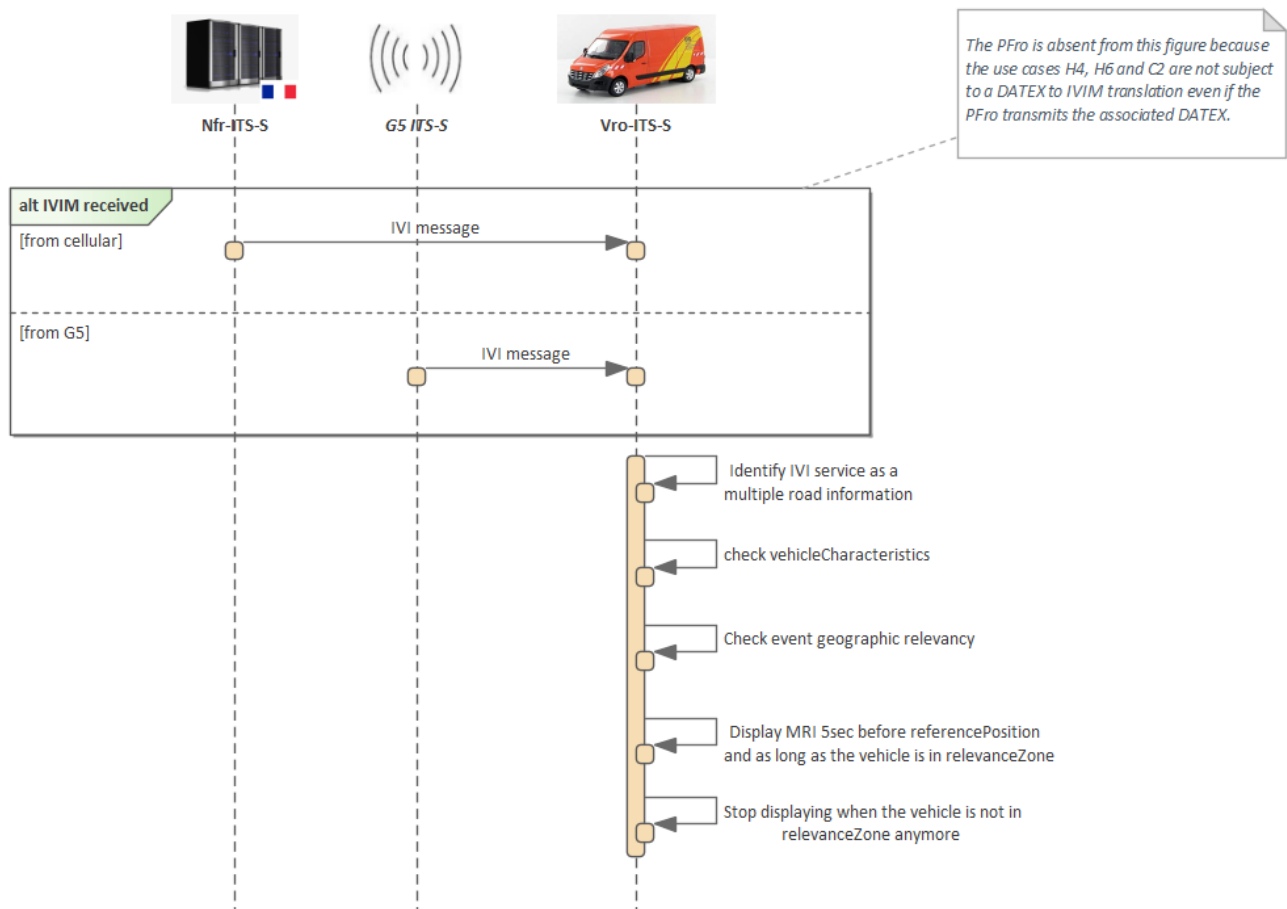


Figure 18 : Display multilane road information – nominal case

ID	2.4.2.2_Ivim-MRI-001(3)
Component(s)	VroES
Requirement	<p>When an IVI message is received, the Vro-ITS-S shall identify the IVI service as a multilane road information by checking the following points:</p> <ul style="list-style-type: none"> Absence of textContainer in the message, Presence of the DE applicableLanes in each GicPart of the message. <p>2.4.2.2_Ivim-GNRL-018(2) shall still be fulfilled.</p>

Additional information	See IVI services identifications in § 5.3
------------------------	---

ID	2.4.2.2_Ivim-MRI-002(2)
Component(s)	Vro-ITS-S
Requirement	<p>To construct the multilanes road information panel, association of a road information to each lane number of the road (see Figure 1), the Vro-ITS-S shall use the following information in each GicPart of the IVIM:</p> <ul style="list-style-type: none"> • first RScore of roadSignCodes with code of type iso14823, • extraText, • applicableLanes, lane numbers on which the road information is applicable. <p>Road information is defined by the two first elements (see § 5.4). applicableLanes is a list of LanePosition which is defined as:</p> <p>LanePosition::= INTEGER{offTheRoad(-1), innerhardShoulder(0), innermostDrivingLane(1), secondLaneFromInside(2), outerHardShoulder(14)} (-1..14).</p>
Additional information	All lanes are described one time through the whole IVI message.

ID	2.4.2.2_Ivim-MRI-003(1)
Component(s)	VroES; Scoop Server
Requirement	<p>The Vro-ITS-S shall be able to display at maximum <i>p_GEN_maxLanesToDisplay</i> lanes of a multilanes road information indicating for each lane the road information associated (road sign and subtext).</p> <p>The <i>p_GEN_maxLanesToDisplay</i> value used shall be configured in the Scoop Server.</p>
Additional information	N/A

ID	2.4.2.2_Ivim-MRI-004(1)
Component(s)	VroES
Requirement	To know when and how long a multilane road information should be displayed, the Vro-ITS-S shall respect requirements defined in § 5.5.
Additional information	N/A

ID	2.4.2.2_Ivim-MRI-005(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall display an alert until the event is no more on the trajectory of the Vro-ITS-S

Additional information	N/A
------------------------	-----

4.2.2 Alternative case

ID	2.4.2.2_Ivim-MRI-006(1)
Component(s)	VroES
Requirement	If a lane is described in more than one GicParts, the nominal case is followed using the first GicParts that matches the vehicleCharacteristics.
Additional information	N/A

ID	2.4.2.2_Ivim-MRI-007(1)
Component(s)	VroES
Requirement	If the index of applicableLanes is discontinuous, a blank pictogram shall be displayed for the missing lane(s) on the tablet.
Additional information	E.g. if applicableLanes = [1,2,4], the tablet will display 4 lanes, and the 3rd one starting from the left will be blank.

4.2.3 User interface

The aim of this part is to link the IVI content to a realistic representation of a multilane road information. The figures below are just graphical representations of the information contained in the IVI for multi-lane road service.



Figure 19 : Example of display for a H4 event



Figure 20 : Example of display for a H6 event



Figure 21 : Example of display for a "C2 by lane" event

As no filter is realised on the pictograms field, the multilane road information service allows the display of pictograms out of the scope of H4, H6 and "C2 by lane" events. This anticipates the implementation of future events using this service.

4.3 Manage a single road information (SRI)

As a reminder, this service covers H2 events (see Table 1).

The expected content of a received IVI message describing those events is detailed in [DR3].

4.3.1 Nominal case

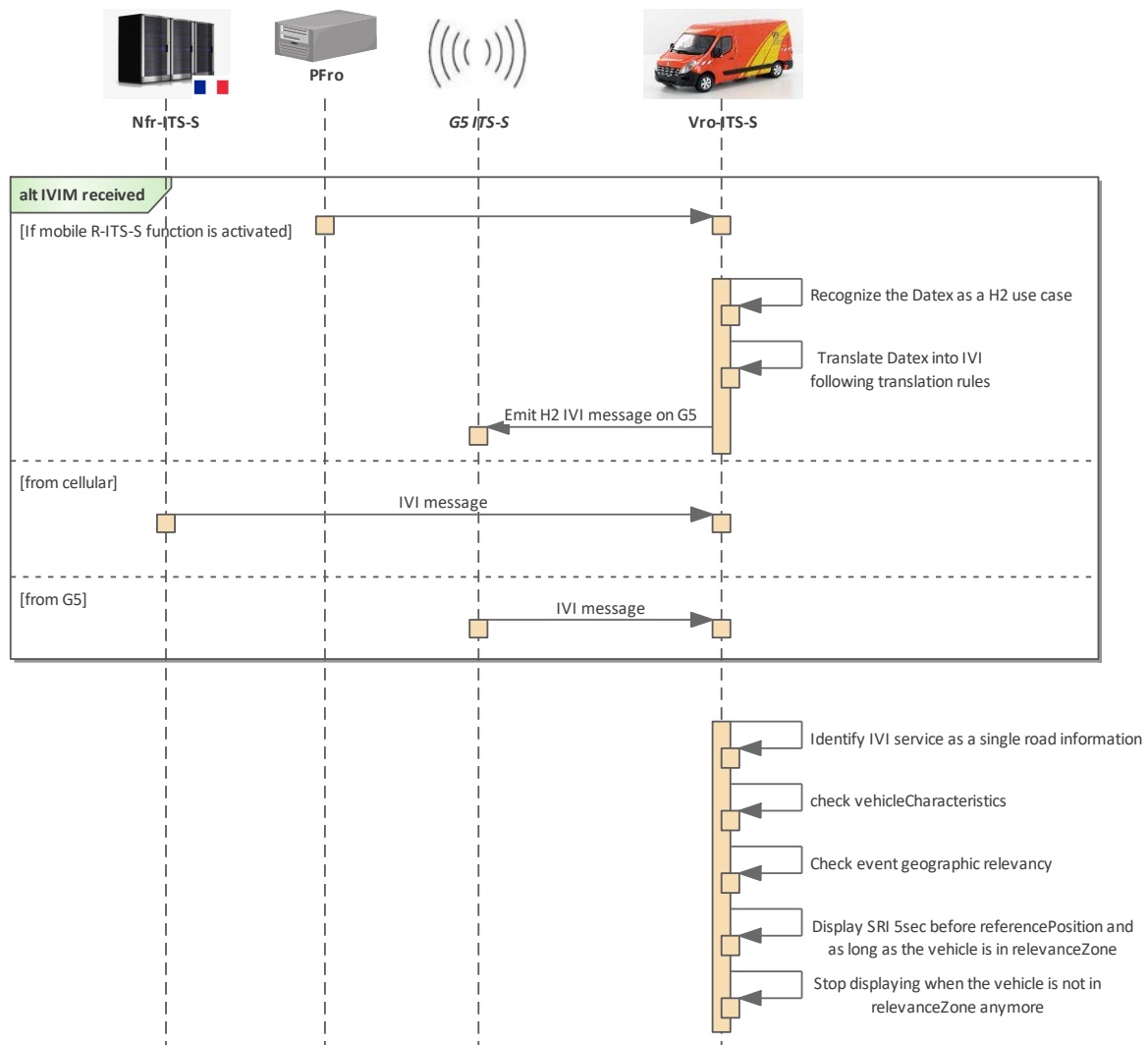


Figure 22 : Display single road information – nominal case

ID	2.4.2.2_Ivim-SRI-001(1)
Component(s)	VroES
Requirement	<p>If the Mobile R-ITS-S function is activated:</p> <p>When a Datex is received, the Vro-ITS shall identify the Datex as an SRI by checking that:</p> <ul style="list-style-type: none"> • The Datex is «SituationPublication » • The first situationrecord is a Networkmanagement of type RoadOrCarriagewayOrLaneManagement • RoadOrCarriagewayOrLaneManagementType is set to one of the following values: <ul style="list-style-type: none"> ○ vehicleStorageInOperation ○ turnAroundInOperation ○ carriagewayClosures (*) ○ roadClosed (*) • GrossWeightCharacteristic is present. <p>(*) For these values, the translation shall only apply if the situationRecord is the first in the situation.</p>
Additional information	N/A

ID	2.4.2.2_Ivim-SRI-002(1)
Component(s)	VroES
Requirement	<p>When a received Datex describes an SRI service, the Vro-ITS-S shall create the corresponding IVI message following [DR3] et [DA7] and shall respect the dissemination rules as described in [DA1] service [Relay information from PFro]</p>
Additional information	N/A

ID	2.4.2.2_Ivim-SRI-003(2)
Component(s)	Vro-ITS-S
Requirement	<p>When an IVI message is received, the Vro-ITS-S shall identify the IVI service as an SRI by checking the following points:</p> <ul style="list-style-type: none"> • Absence of textContainer , and • Absence of the DE applicableLanes in each GicPart of the message, and • Presence of trafficSignPictogram with which is “regulatory” and the couple (nature/serialNumber) which is 4/21, or 5/12, or 4/15 according to the use case. <p>2.4.2.2_Ivim-GNRL-018(2) shall still be fulfilled.</p>
Additional information	<p>4/21 corresponds to the use case “dynamic traffic ban to all trucks”,</p> <p>4/15 corresponds to the use case “dynamic traffic ban to all vehicles”, and</p> <p>5/12 corresponds to the use case “dynamic traffic ban to truck heavier than the indicated weight”. In this last case, attribute wei shall be given.</p>

ID	2.4.2.2_Ivim-SRI-004(1)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall be able to display an SRI based on the road sign.</p> <p>Road Information is described in § 5.4.</p>
Additional information	N/A

ID	2.4.2.2_Ivim-SRI-005(1)
Component(s)	VroES
Requirement	<p>To know when and how long an SRI should be displayed, the Vro-ITS-S shall respect requirements defined in § 5.5.</p>
Additional information	N/A

4.3.2 User interface

The aim of this part is to link the IVI content to a realistic representation of a SRI.

The ergonomics requirements are specified in [DA2]. The figure below is just a graphical representation of the information contained in the IVI for single road service.



Figure 23 : Example of display for a H2 event

As no filter is realised on the pictograms field (except speed information), the SRI service allows the display of pictograms out of the scope of H2 events. This anticipates the creation of future events using this service.

4.4 Display temporary speed limit (TSL)

As a reminder, this service covers C2 events (see Table 1).

The expected content of a received IVI message describing those events is detailed in [DR1].

4.4.1 Nominal case

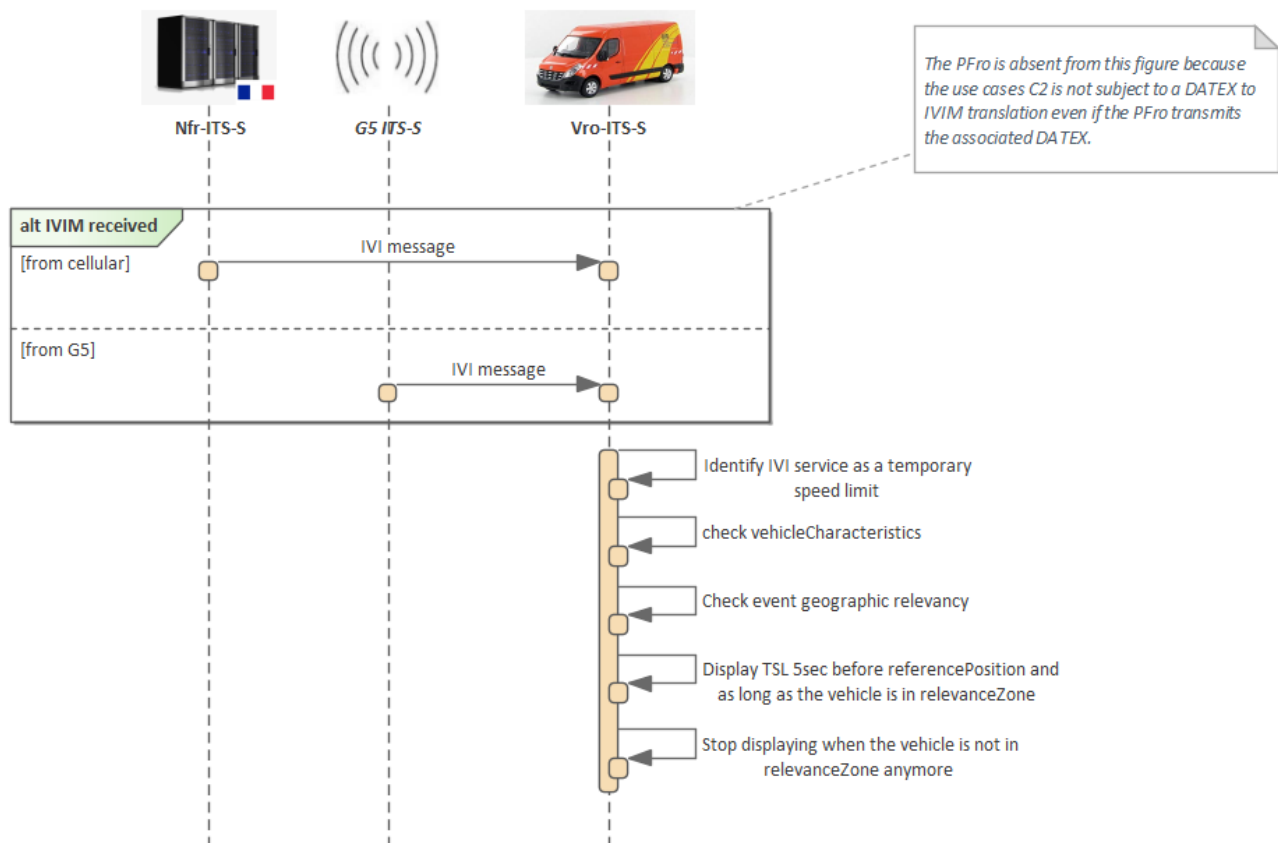


Figure 24 : Display temporary speed limit – nominal case

ID	2.4.2.2_Ivim-TSL-001(3)
Component(s)	VroES
Requirement	<p>When an IVI message is received, the Vro-ITS-S shall identify the IVI service as a temporary speed limit by checking the following points:</p> <ul style="list-style-type: none"> - Absence of textContainer , <p>And</p> <ul style="list-style-type: none"> - Absence of the DE applicableLanes in each GicPart of the message , <p>And</p> <ul style="list-style-type: none"> - Presence of the attribute SPE (speed) in all GicPart.
Additional information	

ID	2.4.2.2_Ivim-TSL-002(2)
Component(s)	Vro-ITS-S
Requirement	<p>The Vro-ITS-S shall be able to display the road sign code pictogram associated to a speed regulation (see pictogram nature/serialNumber: 5/57 in [DA4]).</p>
Additional information	N/A

ID	2.4.2.2_Ivim-TSL-003(1)
Component(s)	VroES
Requirement	<p>To know when and how long a temporary speed limit should be displayed, the Vro-ITS-S shall respect requirements defined in § 5.5.</p>
Additional information	N/A

4.4.2 Alternative case

!/\ This service interferes with DENM messages as the speed information might also be available in roadworks event (B1a/b/c).

ID	2.4.2.2_Ivim-TSL-004(1)
Component(s)	Vro-ITS-S
Requirement	<p>In the case where:</p> <ul style="list-style-type: none"> - A temporary speed provided via an IVI is relevant (time and zone) - A temporary speed provided via a DENM roadworks (defined in [DR6]) is relevant (zone and time) <p>then the system shall give priority to the speed provided by the DENM.</p>
Additional information	N/A

ID	2.4.2.2_Ivim-TSL-005(1)
Component(s)	VroES
Requirement	In the situation described in 2.4.2.2_Ivim-TSL-004(1), if the roadwork zone is shorter than the IVIM relevanceZone then at the end of the roadwork zone, the system shall resume the speed provided by the IVI message in the display.
Additional information	N/A

4.4.3 User interface

The aim of this part is to link the IVI content to a realistic representation of a temporary speed limit. The ergonomics requirements are specified in [DA2]. The figure below is just a graphical representation of the information contained in the IVI for temporary speed limit.



Figure 25 : Speed regulation road sign with its subtext

5 IVI general requirements

5.1 Format restriction

ID	2.4.2.2_Ivim-GNRL-001(1)
Component(s)	VroES
Requirement	The requirements described in the document [DA5] and [DA8] concerning the IVI standard shall be applicable unless a requirement in this chapter specifies a difference.
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-002(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall only treat IVI messages whose at least one RSCode.code parameter of each GicPart.roadSignCodes is equal to iso14823. Otherwise, IVI messages are rejected.
Additional information	N/A

5.2 IVI Storage

ID	2.4.2.2_Ivim-GNRL-003(3)
Component(s)	VroES
Requirement	The Vro-ITS-S shall retain an IVI message if: <ul style="list-style-type: none"> - none of project mandatory IVI parameters is missing (see [DA3] and annexes) - the current time of the Vro-ITS-S is equal or greater than the IVI message validity start time and less than or equal to the IVI message validity end time
Additional information	- N/A

ID	2.4.2.2_Ivim-GNRL-004(1)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall update a retained IVI message when it receives another IVI message with:</p> <ul style="list-style-type: none"> - the same identifier {serviceProviderId + iviIdentificationNumber} - the status "update" - a more recent timeStamp
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-005(1)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall remove an IVI message from storage when:</p> <ul style="list-style-type: none"> - an IVI message with same identifier {serviceProviderId + iviIdentificationNumber} and a iviStatus=2(cancellation) is received - an IVI message with same identifier {serviceProviderId + iviIdentificationNumber} and an iviStatus=1(update) is received with a more recent timestamp - the message has expired (validTo < currentTime)
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-006(1)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall reject a message if there is another IVI message already stored with:</p> <ul style="list-style-type: none"> - the same identifier {serviceProviderId + iviIdentificationNumber}, an iviStatus=1(update) and the same timeStamp
Additional information	This type of message is a duplicate of the original message. There is no need to store it.

5.3 IVI services identifications

IVI services are defined in § 1.4.2_Definitions – see Figure 1

The figure below illustrates how a receiver can identify the type of service provided via an IVI message from the following services:

- A Single-lane road information,
- A temporary speed limit,
- An eVMS,
- A multilanes road information.

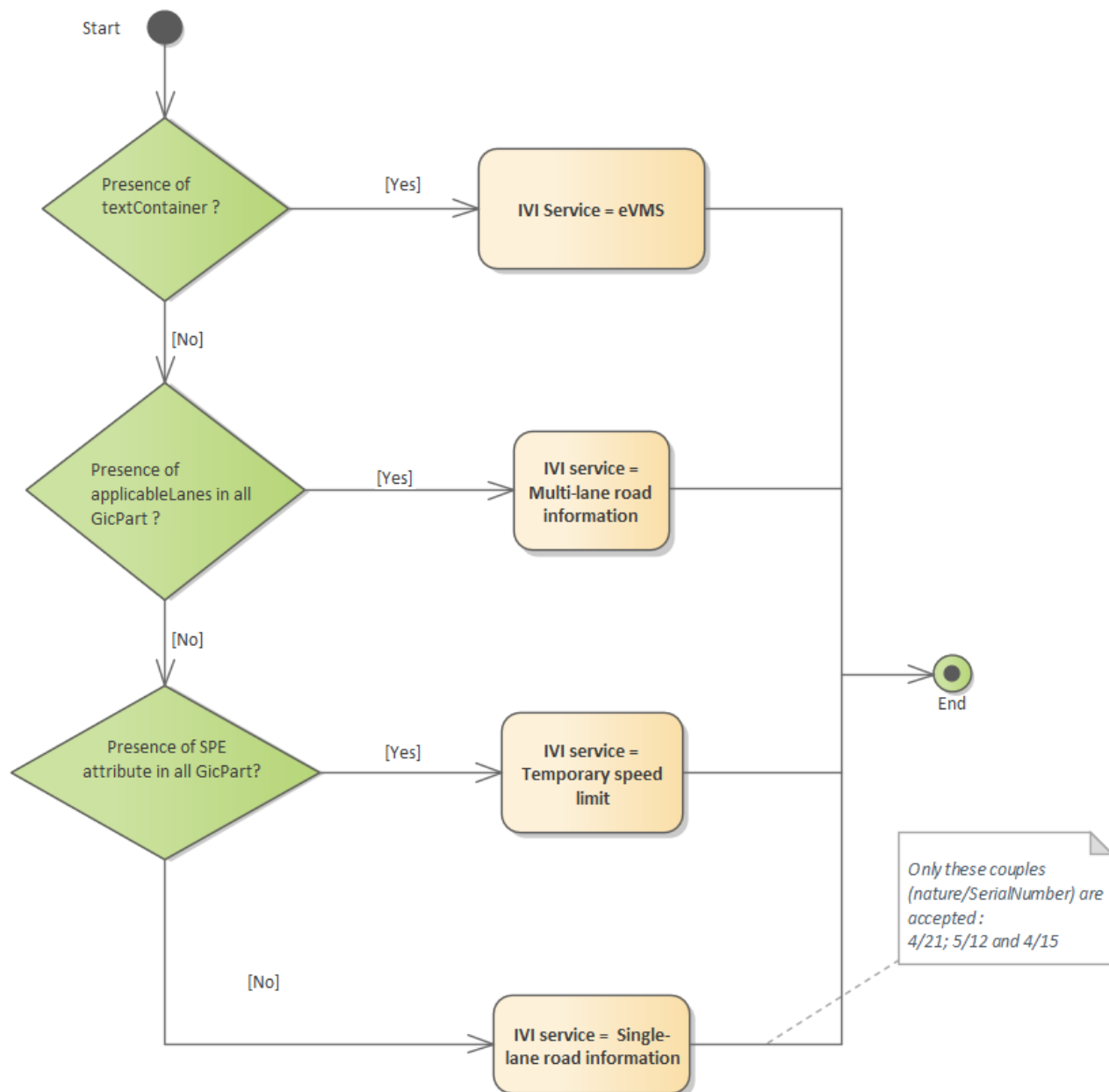


Figure 26 : IVI services identification - flow chart

5.4 Road Information management

Road information is a major component in all IVI services (see Figure 1). This section brings together all the requirements associated with it. When it is used as a simple service see the service [\[Display a road information\]](#)

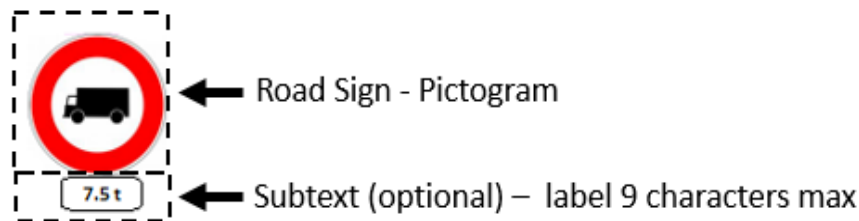
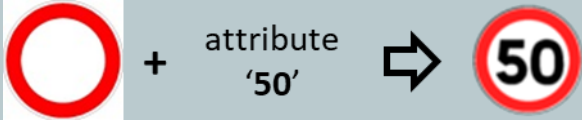


Figure 27 : Illustration of a road information

ID	2.4.2.2_Ivim-GNRL-007(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall use the first DF RSCoDe with code iso14823 of each GiCPart.roadSignCodes from the IVIM to determine the pictogramCode associated to the road sign of the road information.
Additional information	The pictogramCode is composed of the countryCode, serviceCategoryCode and pictogramCategoryCode (see [DA4]). countryCode is not taken into account.

ID	2.4.2.2_Ivim-GNRL-008(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall be able to display all pictograms defined in [DA4].
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-009(1)
Component(s)	VroES
Requirement	If the pictogram encoded in an IVI message is unknown (i.e., not present in [DA4]), Vro-ITS-S shall use a “blank” pictogram.
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-010(1)
Component(s)	VroES
Requirement	<p>Vro-ITS-S shall take into account the field attributes of the message received to integrate into the pictogram's content for the following pictogramCode in [DA4] (nature/serialNumber):</p> <ul style="list-style-type: none"> <input type="checkbox"/> 3/47 (attribute: ROI) <input type="checkbox"/> 4/99 (attribute: VED (WID)) <input type="checkbox"/> 5/11 (attribute: VED (HEI)) <input type="checkbox"/> 5/12 (attribute: VED (WEI)) <input type="checkbox"/> 5/57 (attribute: SPE) <input type="checkbox"/> 5/15 (attribute: DBV) <input type="checkbox"/> 6/14 (attribute: SPE)
Additional information	<p>Example with 5/57:</p>  <p><i>Figure 28 : updating pictogram with attribute</i></p>

ID	2.4.2.2_Ivim-GNRL-011(2)
Component(s)	VroES
Requirement	The Vro-ITS-S shall use extraText from the IVIM to determine the label associated to the subtext of the road information.
Additional information	N/A

ID	2.4.2.2_Ivim-GNRL-012(2)
Component(s)	VroES
Requirement	The Vro shall limit the number of characters in a subText to 9 characters by taking only the first 9 characters of the associated label.
Additional information	According to [DA5], each component textContent of extraText can contain at most 32 characters but the HMI (dedicated to French layout) shall only display 9 characters in subtext.

ID	2.4.2.2_Ivim-GNRL-013(2)
Component(s)	VroES
Requirement	<p>If the RoadSign has an attribute SPE and ISO14823Attributes.SPE.RSCUnit is set to 1 (milesperh), the Vro-ITS-S shall convert the speed value into km.h-1.</p> <p>If needed, the value will be rounded to have an accuracy of 1km.h-1 (49.9 -> 50 and 50.1 -> 50)</p>
Additional information	If RSCUnit is set to 0 (kmperh) the speed value is unchanged.

5.5 Display IVI services management

5.5.1 Display an icon

ID	2.4.2.2_Ivim-GNRL-014(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall not display an icon on the map for services based on IVI messages.
Additional information	For validation purpose, the Vro-ITS-S might add an icon on the map on the map-matched referencePosition of the IVI. This might be configurable.

5.5.2 Display an alert

In some situations, a vehicle ITS-S must be able to detect whether or not it is approaching a Relevance Zone at a certain minimum time before it enters the Relevance Zone. Therefore, a Detection Zone occurs in approach to a Relevance Zone. If a receiving ITS-S moves through the Detection Zone, then the received IVIM will be enabled for further usage in the receiving ITS-S.



Key





	minimum dissemination area (not transmitted)
	detection zone
	driver awareness zone
	relevance zone

Figure 29 : Illustration of Detection and Relevance Zone

ID	2.4.2.2_Ivim-GNRL-015(1)
Component(s)	VroES; Scoop Server
Requirement	The Vro-ITS-S shall display a service associated to an IVI message when the Vro-ITS-S is situated in one of its map-matched detection Zone (trace relevant) and p_GEN_displayTTE seconds before reaching its referencePosition. p_GEN_displayTTE shall be configurable per service.
Additional information	Parameters linked to pre-awareness zone (driverAwarenessZone and minimumAwarenessTime) are not used to display IVI service.

ID	2.4.2.2_Ivim-GNRL-016(1)
Component(s)	VroES
Requirement	The Vro-ITS-S shall display the IVI service associated to an IVIM all its map-matched relevance zone(s) long.
Additional information	The component relevanceZonelds contains all the zonelds of relevance zone(s).

ID	2.4.2.2_Ivim-GNRL-017(1)
Component(s)	VroES; Scoop Server
Requirement	<p>If an IVI message is received within its relevanceZone, it shall be displayed by the Vro-ITS-S respecting the relevance zone long during at least <i>p_GEN_MinDisplayingDuration</i> seconds.</p> <p>The default value of the <i>p_GEN_MinDisplayingDuration</i> is 3 s.</p>
Additional information	The tempo avoids a too-short information display if ego vehicle received the IVI message at the end of its relevanceZone. It gives enough time to the driver to read the whole message so that he is sure it is a real message. 3 seconds seems enough but may change.

5.6 Vehicle Characteristics checking

ID	2.4.2.2_Ivim-GNRL-018(2)
Component(s)	VroES
Requirement	<p>The Vro-ITS-S shall check the vehicleCharacteristics of each GicPart(s) and TcPart(s) to retain only the GicParts and TcParts whose selection criteria match the Vro-ITS-S characteristics.</p> <p>If none of the GicPart and Tcpart is applicable to the Vro-ITS-S, the IVIM shall be dropped.</p>
Additional information	Absence of vehicleCharacteristics into the GicPart or TcPart indicates that there is no restriction on it (i.e. GicPart concerns all type of vehicles).

ID	2.4.2.2_Ivim-GNRL-019(1)
Component(s)	VroES; Scoop Server
Requirement	<p>The parameters used to characterize the ego vehicle shall be the following:</p> <ul style="list-style-type: none"> station type, vehicle role, vehicle length, vehicle width, vehicle height, vehicle weight.

	The values of all these parameters shall be configured.
Additional information	At the date of writing, the TMS only handles the weight as a vehicle characteristic.

ID	2.4.2.2_Ivim-GNRL-020(2)
Component(s)	VroES
Requirement	<p>To check if vehicleCharacteristics criteria transmitted in the IVIM are compliant with ego vehicle characteristics (cf. 2.4.2.2_Ivim-GNRL-019(1)) only DF of type completeVehicleCharacteristics.tractor or .train shall be taken into account and the DE which shall be checked are:</p> <p>VehicleCharacteristicsFixValues/</p> <ul style="list-style-type: none"> ▪ simpleVehicleType ▪ iso3833VehicleType ▪ usage <p>VehicleCharacteristicsRanges/</p> <ul style="list-style-type: none"> ▪ vehicleDimensions: <ul style="list-style-type: none"> ○ vehicleLengthOverall ○ vehicleHeightOverall ○ vehicleWidthOverall ▪ vehicleWeightLimits: <ul style="list-style-type: none"> ○ vehicleWeightUnladen ▪ passengerCapacity
Additional information	<p>//\ Regarding the structure, all DE are not always given in completeVehicleCharacteristics. For instance, a GicPart or TcPart of an IVI message containing the following vehicleCharacteristics meets the ego characteristics even if all comparison DE are not present:</p> <pre> vehicleCharacteristics { tractor { equalTo { vehicleCharacteristicsFixValues { simpleVehicleType 5 } } } } </pre> <p>Whereas, a GicPart or TcPart of an IVI message containing the following vehicleCharacteristics:</p> <pre> vehicleCharacteristics{ tractor { equalTo { vehicleCharacteristicsFixValues { simpleVehicleType 5 } } ranges { comparisonOperator 0 //greaterThan limits { vehicleWightLimits { vehicleWeightUnladen 350 } } } } } </pre>

Doesn't meet ego characteristics, as the criteria about vehicleWeightUnladen does not meet the characteristics of our car, even if simpleVehicleType does.

5.7 IVI filling rules

The filling rules following the translation of a C-ITS Datex are described in each IVI service concerned by this functionality.

Future service implementation implying IVI triggered from the Vro-ITS-S (e.g. event B7) might complete this part in future releases.

5.8 IVI dissemination

The dissemination rules defined in this part are applicable to the G5 interface. For other interfaces, the dissemination rules are defined in [DA1].

ID	2.4.2.2_Ivim-GNRL-021(1)
Component(s)	VroES
Requirement	<p>If an event is translated from a Datex, then the Vro-ITS-S shall respect the dissemination parameters defined in [DA3] "IVIM transmission elements"</p> <p>This includes:</p> <ul style="list-style-type: none"> - repetitionDuration - repetitionInterval - Destination Area - Maximum hop limit
Additional information	N/A

6 VroES service realisation

As mentioned in § 4, the [IVI services], services are specific realisations of the more general services described in the master document [DA1].

The concerned [VroES services] are represented on Figure 30.

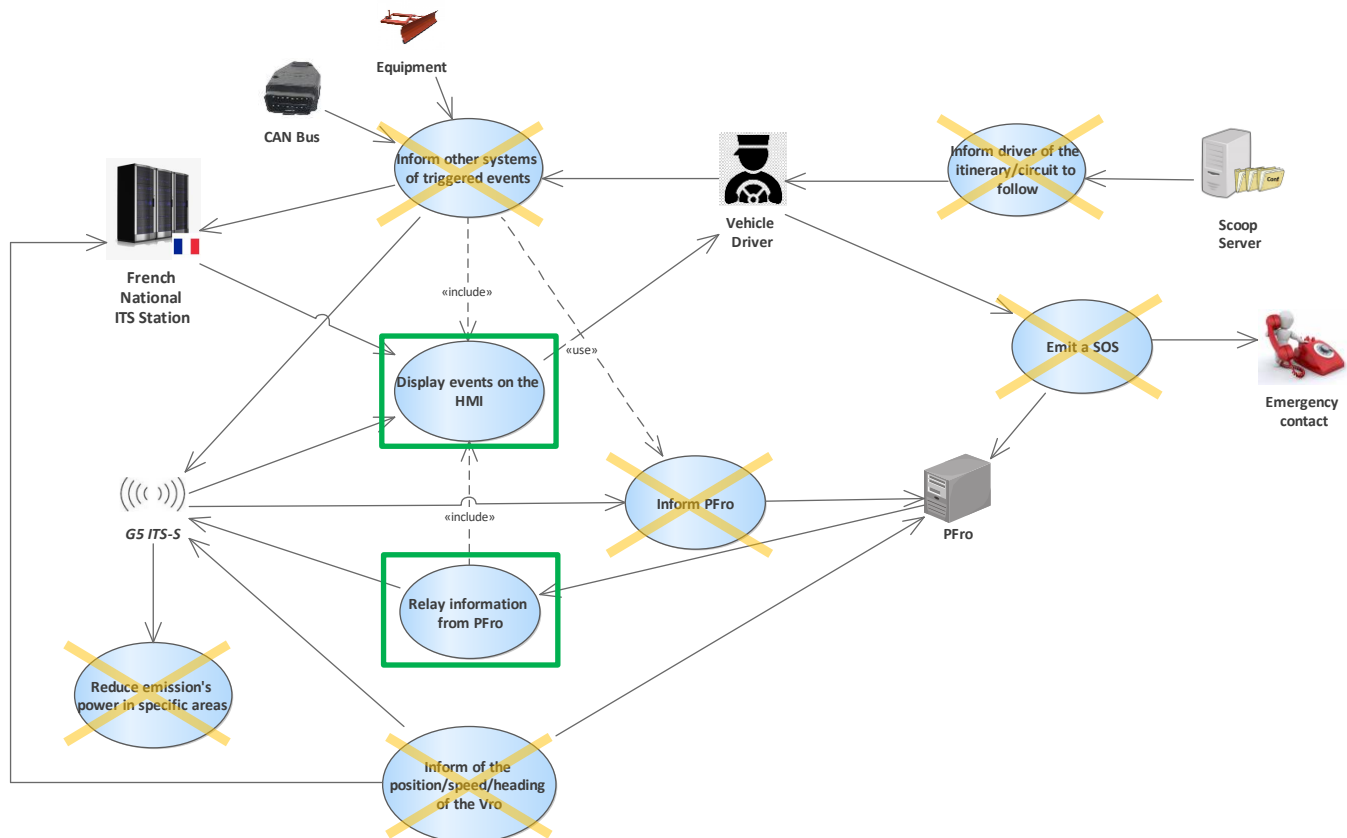


Figure 30: VroES services concerned by the IVI services – use case diagram

The following sub-chapters contain activity diagram(s) that define for each [VroES services]: the responsibility distribution between the different sub-systems composing the Vro Global System, and the data flow between those sub-systems.



Figure 31 : Display events on the HMI - activity diagram

6.2 Relay information from PFro

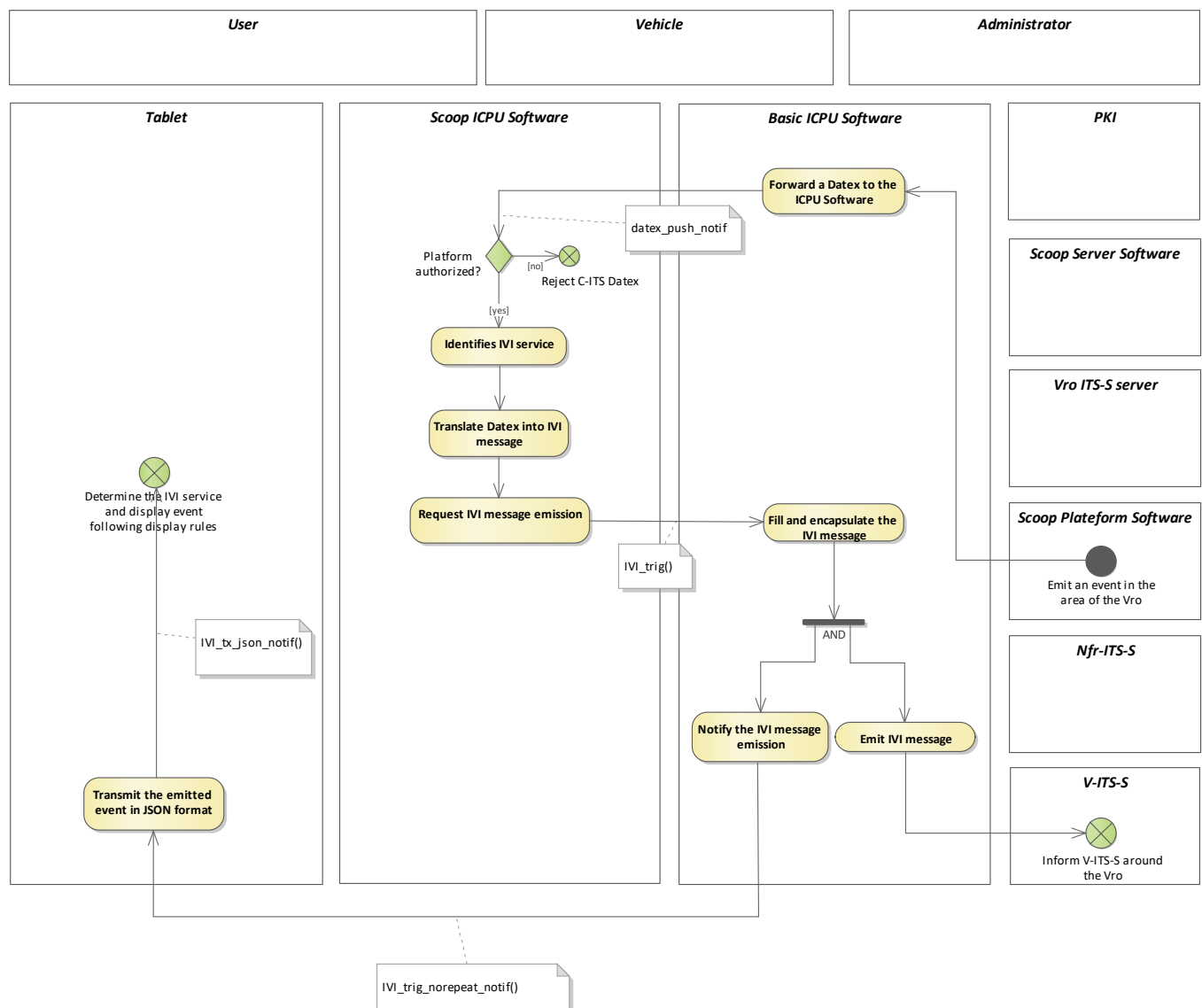


Figure 32: Communicate with PFro – activity diagram

The table below specifies certain behaviours of those methods in the activity diagram context. The list of parameters mentioned is not exhaustive compared to the definition of the method.

Method	Specificities and parameters
[datex_push_notif]	N/A
[ivi_trig]	N/A
[ivi_trig_notif]	<code>eventGenerator</code> set to 0 as it is a received event <code>issuerIdentifier</code> is filled.
[ivi_trig_norepeat_notif]	<code>eventGenerator</code> set to 0 as it is a received event
[ivi_tx_json_notif]	Tablet internal method

7 Communication Bus specificities

In extension to [DA1] § “Interfaces inside the VroES”, this part defines the additional methods on the bus used to implement the DENM services depending on the concerned interface.

7.1 IF_1 - Interface Scoop ICPU ↔ Basic ICPU

ivi_rx_notif
lvi_trig
lvi_trig_notif
datex_push_req
set_internal_data
internal_data_notif

7.2 IF_2 - Interface Scoop ICPU ↔ Scoop Tablet

event_trig
current_activity_notif

7.3 IF_7 - Interface Basic ICPU ↔ Scoop Tablet

ivi_rx_norepeat_notif
ivi_trig_norepeat_notif