Document Information

Document Title:	Application Specification
Chapter:	In-Vehicle Signage (IVS)
Version:	1.0
Release Date:	11/12/2020

Disclaimer

5.2 In-Vehicle Signage (IVS)

5.2.1 General description[1,2,3,4]

The In-Vehicle Signage (IVS) application shows important road signs on the vehicle's information display.

The IVS application uses Infrastructure-to-Vehicle (I2V) communication information. This information is processed by rider assistance systems in the vehicles and relevant data is presented to the rider. The rider can thus be informed about current traffic regulations and advices at all times and not only during brief moments when passing by fixed traffic sign or gantries.

It is expected to improve the rider's awareness of important road signs.

---

[1] C-ROADS GERMANY "C-ITS SERVICES: IN-VEHICLE SIGNAGE". (https://www.c-roads-germany.de/english/c-its-services/ivs/, accessed 17.11.2020)

[2] CAR 2 CAR Communication Consortium; C2C-CC Basic System Profile; Release 1.5.0 https://www.car-2-car.org/documents/basic-system-profile/ accessed 17.11.2020)

[3] U.S. Department of Transportation (US DOT) Connected Vehicle Reference Implementation Architecture: "Use case: In-Vehicle Signage". (https://local.iteris.com/arc-it/html/servicepackages/sp115.html , accessed 17.11.2020)

[4] Common C-ITS Service Definitions Version 1.5 from C-Roads (https://www.c-roads.eu/platform/about/news/News/entry/show/release-15-of-c-roads-harmonised-c-its-specifications.html, "accessed on 17.11.2020)

5.2.2 Use case description

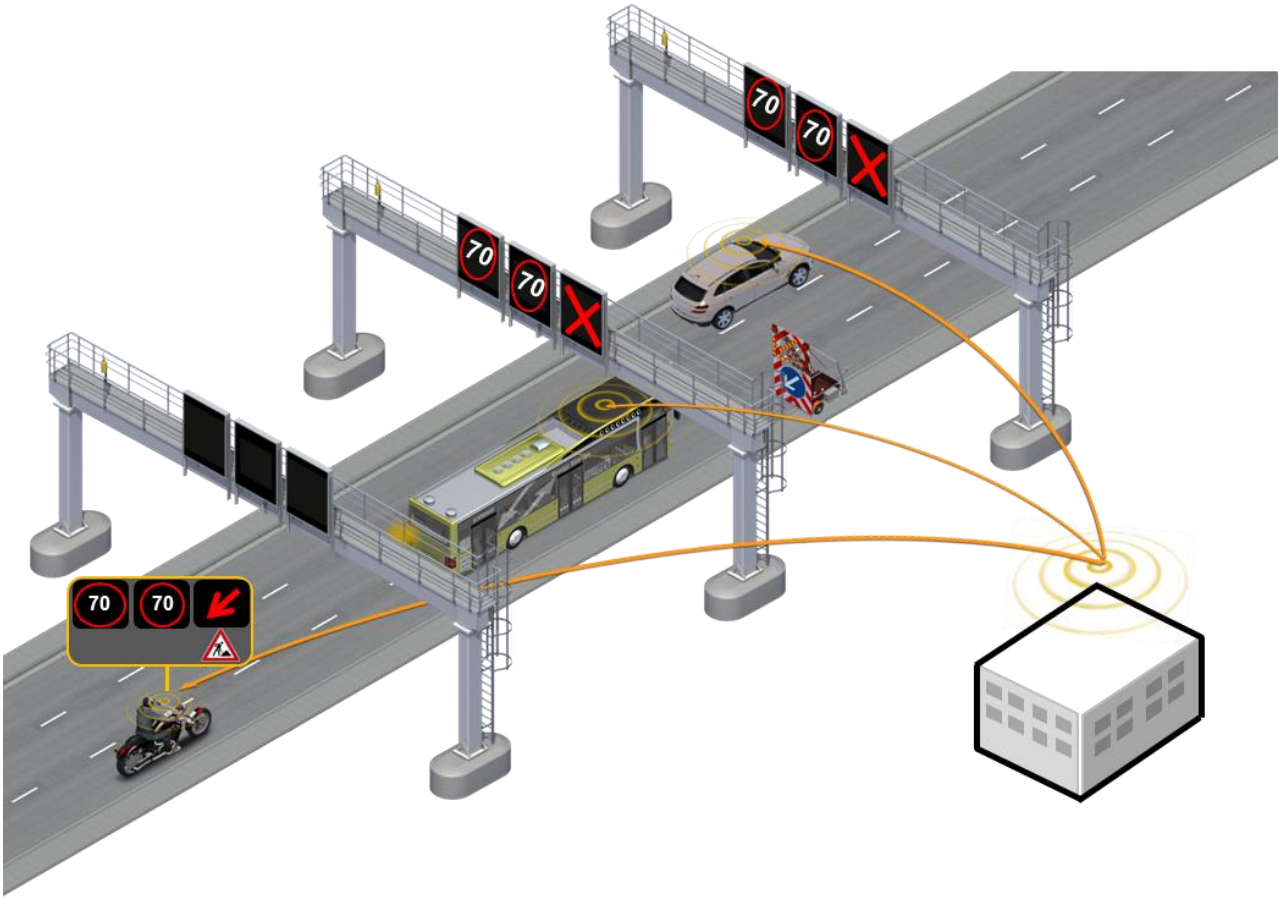

Figure 1: General overview

IVS application inform road users via in-car information systems about static and dynamic road signs as indicated on physical road signs along the road and on additional virtual information (virtual Variable Message Signs (VMS) or free text).
IVS might use the option to target information to PTW or to individual vehicles.
IVS is a subset of the broader scope of In-Vehicle Information (IVI) service. The IVS information is sent out by means of I2V communication. VMS systems are used today by road operators to send operational, tactical or strategic information to road users. Different types of dynamic traffic sign systems are used, with both static pictograms and text and variable pictograms and text on.

IVS consists of several use cases.

- Dynamic speed limit information, (IVS - DSLI)
- Dynamic Lane Management, (IVS - DLM)
- Embedded VMS “Free Text”, (IVS - EVFT)
- Other Signage Information, (IVS - OSI)

5.2.2.1 Dynamic speed limit information (IVS - DSLI)

The rider receives speed limit notifications as they ride. The message subject is the dynamic speed limit given by the road operator.

This Use Case transmits information on the currently valid speed limit continuously, as set by the road operator because of e.g. roadworks, incidents and traffic jams.

5.2.2.2 Dynamic Lane Management (IVS - DLM)

The rider receives the status of the lanes (open/closed, normal, high occupancy vehicle (HOV) lane, bus lane or rush hour) of a road.

The rider is notified if PTW is allowed to use specific lanes or not. The rider might be notified if PTW is allowed to filter.

5.2.2.3 Embedded VMS “Free Text” (IVS - EVFT)

This use case treats ‘free text’ as set and distributed by the road operator. The information shall be consistent with the currently valid dynamic traffic signs. This use case contains the following information e.g.:

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

etc.

5.2.2.4 Other Signage Information (IVS - OSI)

This use case is to display signage information to road users other than the speed limit and free text information presented in previous use cases, e.g. bans on overtaking. The information will either reproduce what is displayed at a physical VMS (e.g. Variable Text Panel) or display a completely new message (virtual VMS).

This use case contains currently valid and continuous information on e.g.:

- Speed advice: information on the current speed advice, based on a specific traffic situation along the route
- Detected hazardous situation (e.g. weather (rain, fog, wind), road status (slippery road, hole, object on road) or approaching emergency vehicle

- Overtaking prohibition: information on actual overtaking prohibition
- Information about potentially dangerous situations and road construction / road works

5.2.3 Technical description

5.2.3.1 Dynamic speed limit information (IVS - DSLI)

5.2.3.1.1 State Flow

The function state flow from Service-In to Service-Out is indicated in the following figure.

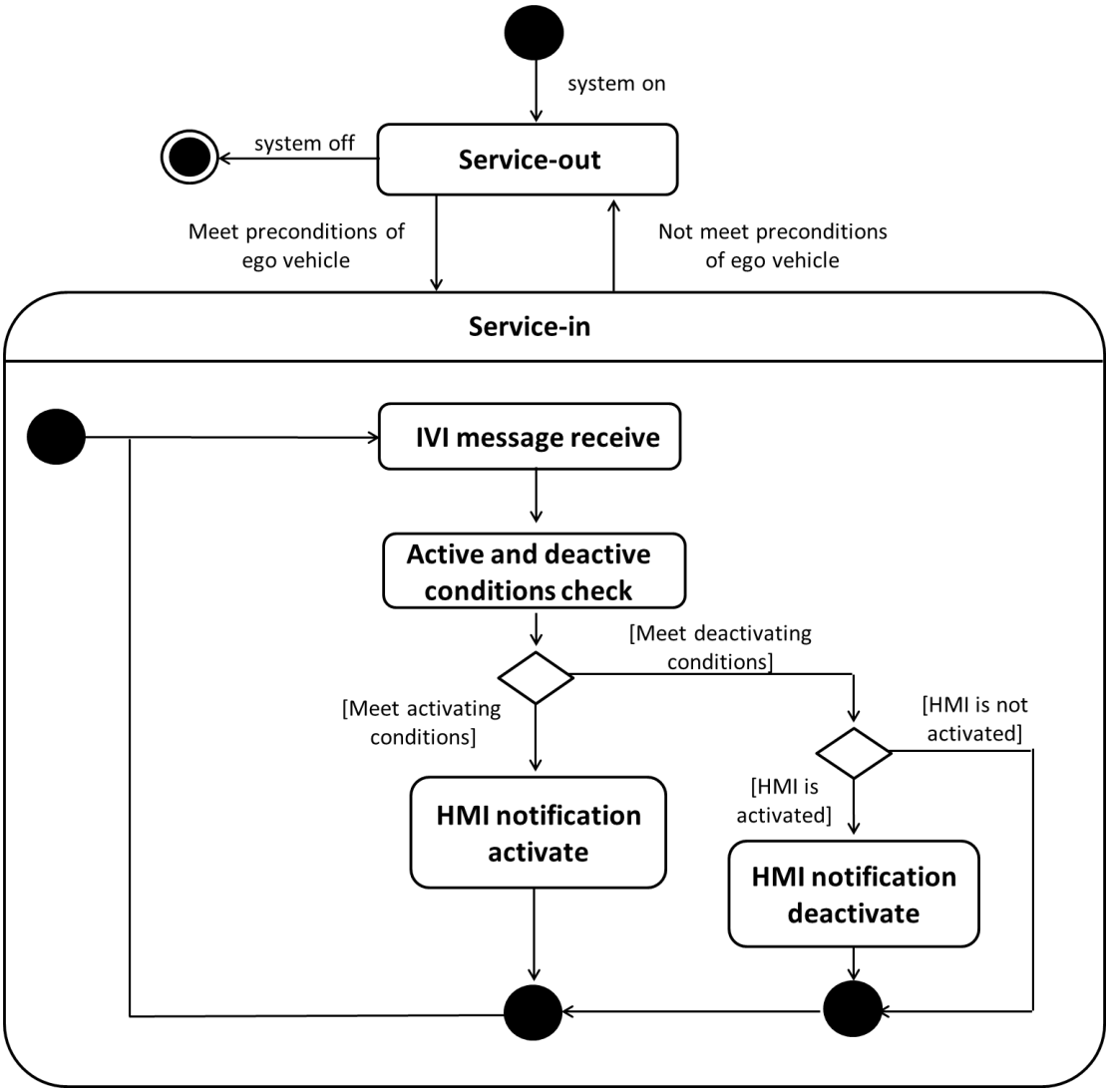

Figure 2: State Flow of IVS (IVS - DSLI)

5.2.3.1.2 Preconditions

The preconditions of IVS-DSLI are stated below.

All of the following preconditions shall be satisfied every time before this use case is activated:

Table 1: Preconditions of ego vehicle (IVS - DSLI)

#	**Item**	**Condition**
PC_1	Ego vehicle	PTW
PC_2	Speed range	-
PC_3	Location	-
PC_4	Road type	-
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

5.2.3.1.3 Activation and deactivation requirements

The activating and deactivating requirements of IVS - DSLI are stated below.

Activate the notification scheme when the conditions below (AC_1 to AC_4) is satisfied.

The information needs to be displayed to the rider early enough and in the right location.

If the IVS application can use map data, it helps to make accurate assessment of the location, false alarms may be decreased as a result.

However, the exact details of the presentation (how and when) is based on the individual application designer's decision.

Table 2: Activating conditions (IVS - DSLI)

#	**Item**	**Condition**	
AC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	regulatory
		nature	5
		serial number	57
		attributes/spe/spm	the value of the speed limit in km/h and unit = 0 (i.e kmperh) or the equivalent for other countries (e.g. 1 for milesperh)
		vehicleCharacteristics	use only if the IVS-DSLI is applicable to specific vehicles

		applicableLanes	use only if the IVS-DSLI is applicable to specific lanes
AC_2	Position	Target lane is within the estimated route of ego vehicle	Estimated route of ego vehicle (latitude, longitude, pathHistory, etc)
AC_3	Detect applicability	If ego vehicle is applied to this IVI message, it should be determined that notification is required.	
AC_4	Inform information	Display dynamic speed limit information. HMI is left to OEM-specific implementation.	

Deactivate the notification when at least one of the conditions below (DC_1 OR DC_2) is satisfied. When deactivating condition is satisfied, i.e. PTW leave the relevance zone that is defined in the received IVI message, information is erased. This deactivating (ending) message might be redundant to the end point of the relevance zone of the activating (initial) IVI message.

Furthermore, information is erased when the message valid time of the activating (initial) IVI message is exceeded.

Table 3: Deactivating conditions (IVS - DSLI)

#	**Item**	**Condition**	
DC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	regulatory (12)
		nature	6
		serial number	14 (Notice of the end of speed limit)
DC_2	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	informative (13)
		nature	6
		serial number	63 (notice of the end of all restrictions by electronic signs)

5.2.3.2 Dynamic Lane Management (IVS - DLM)

5.2.3.2.1 State Flow

The function state flow from Service-In to Service-Out of IVS - DLM is as same as IVS - DSLI.

5.2.3.2.2 Preconditions

The preconditions of IVS-DLM are stated below.

All of the following preconditions shall be satisfied every time before this use case is activated:

Table 4: Preconditions of ego vehicle (IVS - DLM)

#	**Item**	**Condition**
PC_1	Ego vehicle	PTW-
PC_2	Speed range	-
PC_3	Location	-
PC_4	Road type	Highway
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

5.2.3.2.3 Activation and deactivation requirements

The activating and deactivating requirements of IVS - DLM are stated below.

Activate the notification scheme when the conditions below (AC_1 to AC_5) are satisfied.

The information needs to be displayed to the rider early enough and in the right location.

If the IVS application can use map data, it helps to make accurate assessment of the location, false alarms may be decreased as a result.

However, the exact details of the presentation (how and when) is based on the individual application designer’s decision.

Table 5: Activating conditions (IVS - DLM)

#	**Item**	**Condition**	
AC_1	Receive IVI message	Road Sign Codes: the road sign codes according to ISO14823:2017 are applicable	
AC_2	Receive IVI message	several pictogram codes for the traffic sign are used with	
		a) countryCode:	ISO 3166-1 code for countries, e.g. BE for Belgium
		b)serviceCategorycode	13 (1: Traffic Sign, 3: Informative)
		c)pictogramCategoryCode	i. 659 - Lane closed ii. 660 - Lane free iii. 661 - Clear lane to left iv. 662 - Clear lane to right
		d) No attributes	-
AC_3	Position	Target lane is within the estimated route of ego vehicle	Estimated route of ego vehicle (latitude, longitude, pathHistory, etc)
AC_4	Detect applicability	If ego vehicle is applied to this IVI message, it should be determined that notification is required.	
AC_5	Inform information	Display dynamic lane management information. HMI is left to OEM-specific implementation.	

Note: other electronic signs may be used in specific countries. The corresponding serviceCategorycode and pictogramcode of ISO 14823:2017 will be used, if available.

Deactivate the notification when the condition below (DC_1) is satisfied. When deactivating condition is satisfied, i.e. PTW leave the relevance zone that is defined in the received IVI message, information is erased. This deactivating (ending) message might be redundant to the end point of the relevance zone of the activating (initial) IVI message.
Furthermore, information is erased when the message valid time of the activating (initial) IVI message is exceeded.

Table 6: Deactivating conditions (IVS - DLM)

#	**Item**	**Condition**	
DC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	informative (13)
		nature	6
		serial number	63 (notice of the end of all restrictions by electronic signs)

5.2.3.3 Embedded VMS “Free Text” (IVS - EVFT)

5.2.3.3.1 State Flow

The function state flow from Service-In to Service-Out of IVS - EVFT is as same as IVS - DSLI.

5.2.3.3.2 Preconditions

The preconditions of IVS- EVFT are stated below.

All of the following preconditions shall be satisfied every time before this use case is activated:

Table 7: Preconditions of ego vehicle (IVS - EVFT)

#	**Item**	**Condition**
PC_1	Ego vehicle	PTW-
PC_2	Speed range	-
PC_3	Location	-
PC_4	Road type	-
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

5.2.3.3.3 Activation and deactivation requirements

The activating and deactivating requirements of IVS - EVFT are stated below.

Activate the notification scheme when the conditions below (AC_1 to AC_4) is satisfied.

The information needs to be displayed to the rider early enough and in the right location.

If the IVS application can use map data, it helps to make accurate assessment of the location, false alarms may be decreased as a result.

However, the exact details of the presentation (how and when) is based on the individual application designer’s decision.

Table 8: Activating conditions (IVS - EVFT)

#	**Item**	**Condition**	
AC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	appropriate
		nature	appropriate
		serial number	appropriate
		attributes (optional)	appropriate
		vehicleCharacteristics	use only if the IVS-EVFT is applicable to specific vehicles
AC_2	Position	Target zone is within the estimated route of ego vehicle	Estimated route of ego vehicle (latitude, longitude, pathHistory, etc)
AC_3	Detect applicability	If ego vehicle is applied to this IVI message, it should be determined that notification is required.	
AC_4	Inform information	Display embedded VMS “Free Text” information. HMI is left to OEM-specific implementation.	

Deactivate the notification when the condition below (DC_1) is satisfied. When deactivating condition is satisfied, i.e. PTW leave the relevance zone that is defined in the received IVI message, information is erased. This deactivating (ending) message might be redundant to the end point of the relevance zone of the activating (initial) IVI message.
Furthermore, information is erased when the message valid time of the activating (initial) IVI message is exceeded.

Table 9: Deactivating conditions (IVS - EVFT)

#	**Item**	**Condition**	
DC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	informative (13)
		nature	6
		serial number	63 (notice of the end of all restrictions by electronic signs)

5.2.3.4 Other Signage Information (IVS - OSI)

5.2.3.4.1 State Flow

The function state flow from Service-In to Service-Out of IVS - OSI is as same as IVS - DSLI.

5.2.3.4.2 Preconditions

The preconditions of IVS- OSI are stated below.

All of the following preconditions shall be satisfied every time before this use case is activated:

Table 10: Preconditions of ego vehicle (IVS - OSI)

#	**Item**	**Condition**
PC_1	Ego vehicle	PTW-
PC_2	Speed range	-
PC_3	Location	-
PC_4	Road type	-
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

5.2.3.4.3 Activation and deactivation requirements

The activating and deactivating requirements of IVS - OSI are stated below.

Activate the notification scheme when the conditions below (AC_1 to AC_4) are satisfied.

The information needs to be displayed to the rider early enough and in the right location.

If the IVS application can use map data, it helps to make accurate assessment of the location, false alarms may be decreased as a result.

However, the exact details of the presentation (how and when) is based on the individual application designer’s decision.

Table 11: Activating conditions (IVS - OSI)

#	**Item**	**Condition**	
AC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	informative
		nature	6
		serial number	59 (for lane closed), 60 (for lane free), 61 (for clear lane to left) or 62 (for clear lane to right).
		vehicleCharacteristics	use only if the IVS-OSI is applicable to specific vehicles
		applicableLanes	use only if the IVS-OSI is applicable to specific lanes
AC_2	Position	Target lane is within the estimated route of ego vehicle	Estimated route of ego vehicle (latitude, longitude, pathHistory, etc)
AC_3	Detect applicability	If ego vehicle is applied to this IVI message, it should be determined that notification is required.	
AC_4	Inform information	Display other signage information. HMI is left to OEM-specific implementation.	

Deactivate the notification when the condition below (DC_1) is satisfied. When deactivating condition is satisfied, i.e. PTW leave the relevance zone that is defined in the received IVI message, information is erased. This deactivating (ending) message might be redundant to the end point of the relevance zone of the activating (initial) IVI message.
Furthermore, information is erased when the message valid time of the activating (initial) IVI message is exceeded.

Table 12: Deactivating conditions (IVS - OSI)

#	**Item**	**Condition**	
DC_1	Receive IVI message	**ISO14823 Data Field**	**Value(Code)**
		serviceCategoryCode	informative (13)
		nature	6
		serial number	63 (notice of the end of all restrictions by electronic signs)

Abbreviations

Please refer to the abbreviations in Preamble document.